**CRASH DATA RESEARCH CENTER**
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# CALSPAN ON-SITE AMBULANCE CRASH INVESTIGATION
# SCI CASE NO.: CA09075

## VEHICLE: 2006 FORD F-450 CHASSIS
## W/ WHEELED COACH AMBULANCE TYPE I BODY

## LOCATION: NORTH CAROLINA

## CRASH DATE: OCTOBER 2009

Contract No. DTNH22-07-C-00043

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.

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*16. Abstract*

This on-site investigation focused of the severity of the crash, the location of the impacts, and the source of injury to the occupants of an ambulance that was en route to the site of an injury event. The ambulance was a Type 1 patient compartment that was mounted on a 2006 Ford F-450 chassis. The ambulance was occupied by a 46-year-old female driver and a 54-year-old male front right passenger. Both occupants were restrained by the manual 3-point lap and shoulder belt systems. En route to the call, the driver relinquished control of the ambulance. The ambulance traversed the left travel lane and departed the south road edge at a shallow angle in a tracking attitude. The ambulance continued in a westerly direction along the roadside for 127 m (416.7 ft) prior to impacting a small diameter tree. The ambulance continued forward for an additional 28 m (91.9 ft) and impacted five additional trees resulting in moderate frontal and right side damage. The vehicle's redesigned frontal air bags deployed during the crash. The driver sustained a closed head injury with loss of consciousness and a left elbow contusion. She was transported by ground ambulance to a local hospital where she was treated for her injuries and released. The front right passenger sustained an open occipital skull fracture, multiple right rib fractures, multiple thoracic spine fractures, unspecified facial fractures, and soft tissues injuries. He was extricated from the vehicle by the first responders and was transported by helicopter to a regional trauma center where he expired approximately 3-hours following the crash.

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## TABLE OF CONTENTS

**CALSPAN ON-SITE AMBULANCE CRASH INVESTIGATION**
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***BACKGROUND***

This on-site investigation focused of the severity of the crash, the location of the impacts, and the source of injury to the occupants of an ambulance that was en route to the site of an injury event. The ambulance was a Type 1 patient compartment that was mounted on a 2006 Ford F-450 chassis. The ambulance was occupied by a 46-year-old female driver and a 54-year-old male front right passenger. Both occupants were restrained by the manual 3-point lap and shoulder belt systems. En route to the call, the driver relinquished control of the ambulance. The ambulance traversed the left travel lane and departed the south road edge at a shallow angle in a tracking attitude. The ambulance continued in a westerly direction along the roadside for 127 m (416.7 ft) prior to impacting a small diameter tree. The ambulance continued forward for an additional 28 m (91.9 ft) and impacted five additional trees resulting in moderate frontal and right side damage. **Figure 1** is a right oblique view of the ambulance. The vehicle's redesigned frontal air bags deployed during the crash. The driver sustained a closed head injury with loss of consciousness and a left elbow contusion. She was transported by ground ambulance to a local hospital where she was treated for her injuries and released. The front right passenger sustained an open occipital skull fracture, multiple right rib fractures, multiple thoracic spine fractures, unspecified facial fractures, and soft tissues injuries. He was extricated from the vehicle by the first responders and was transported by helicopter to a regional trauma center where he expired approximately 3-hours following the crash.

**Figure 1. Right front oblique view of the ambulance.**

Notification of the crash was provided to the Calspan Special Crash Investigations (SCI) by NHTSA's Crash Investigation Division on October 23, 2009. The SCI team initiated telephone contact with the investigating police agency, the ambulance service, and the hospital Safety Director on the day of notification and obtained cooperation to conduct the on-site investigation on October 26, 2009. The investigation was conducted on October 28-29, 2009, and involved the inspection and documentation of the ambulance and crash site, and interviews with the Safety Director, the Chief of the ambulance service, the investigating police officers.

## *SUMMARY*

### *Crash Site*

**Figure 2. Overall westbound view of the crash site.**

The crash occurred on a rural two-lane road during nighttime hours. At the time of the crash, the conditions were clear and dark as the area was not illuminated. The asphalt road surface was dry and the temperature was reported by a local weather station at 8 degrees C (46 degrees F). In the vicinity of the crash site, the road was straight with a series of subtle elevation changes. The east and westbound travel lanes were 3.4 m (11.2 ft) in width and were bordered by 0.3 m (1 ft) wide asphalt shoulders. The center line of the road consisted of a broken yellow center line at the crash site preceded by a no passing zone in the easterly direction. The north roadside consisted of grass and hard-packed sandy soil that transitioned to a shallow grade, terminating at the centerline of a drainage ditch 4.1 m (13.4 ft) outboard of the north edge line. The south road edge was the location of the crash. This roadside consisted of grass and weeds within a hard-packed sandy surface. The roadside was level 0.4-1.6 m (1.3-5.2 ft) outboard of the south edge line and transitioned to a shallow grade to facilitate water runoff away from the road surface. A tree line consisting of various soft wood pines was located 11.7 m (38.4 ft) outboard of the edge line. Numerous trees were struck by the ambulance ranging in diameters from 3-46 cm (1-18 in). The posted speed limit was 89 km/h (55 mph). **Figure 2** is an overall approach view of the crash site. The schematics of the crash are attached as **Figures 18** and **19**.

### *Vehicle Data*

#### *Chassis*

**Figure 3. Front right view of the ambulance Ford chassis.**

The chassis of the involved ambulance was a 2006 Ford F-450 XLT Super Duty regular cab medium duty truck **(Figure 3)**. The chassis was manufactured in February 2006 and was identified by Vehicle Identification Number (VIN): 1FDXF47P36E (production number deleted). The vehicle's odometer reading at the time of the crash was 127,474 km (79,121 miles). The chassis was configured with a 419 cm (165 in) wheelbase and a 4x4 drive platform with a dual-wheel rear axle. The front axle was equipped with manual locking hubs and the transfer case was engaged by a driver compartment shift lever. The Ford was powered by a 6.0-liter, V-8 diesel engine linked to a 5-speed automatic transmission with overdrive and a column mounted shift lever. The service brakes were four-wheel power-assisted disc with anti-lock. The Ford chassis was rated with a 7,258 kg (16,000 lb) Gross Vehicle Weight rating (GVWR) with a

distribution of 3,175 kg (7,000 lb) at the front axle and 5,443 kg (12,000 lb) at the rear axle. The incomplete chassis produced by Ford was equipped with the ambulance prep package. The vehicle manufacturer recommended tire size was 225/75R19.5 front and rear with cold tire pressures of 655 kPa (95 PSI) and 620 kPa (90 PSI) respectively. All tires were mounted on OEM steel wheels. The tire data at the time of the SCI inspection was as follows:

| Position | Tire Size | Tire Make/Model | Measure Pressure | Measured Average Tread Depth |
|---|---|---|---|---|
| LF | 225/75R19.5 | Dunlop SP342 | Tire flat | 9 mm (11/32 in) |
| RF | 225/75R19.5 | Goodyear (Unk) | Tire flat | 6 mm (7/32 in) |
| LR Outer | 225/75R19.5 | OHTSU R128 | 607 kPa (88 PSI) | 2 mm (2/32 in) |
| LR Inner | 225/75R19.5 | OHTSU R128 | Unknown | 3 mm (4/32 in) |
| RR Outer | 225/75R19.5 | OHTSU R128 | 476 kPa (69 PSI) | 5 mm (6/32 in) |
| RR Inner | 225/75R19.5 | OHTSU R128 | Unknown | 5 mm (6/32 in) |

The interior of the Ford chassis was configured with two front bucket seats with integrated head restraints and manual adjustment for the seat track and recline features. The left seat track was adjusted 5 cm (2 in) forward of full-rear with a seatback angle of 16 degrees aft of vertical. The front right seat track was adjusted to the full-rear position. The seatback angle was deformed by the right side impact and the deflection of the floor. The safety systems consisted of redesigned frontal air bags for the front seat positions and manual 3-point lap and shoulder belts. The steering column was tilt adjustable. At the time of the SCI inspection, the tilt feature was set to the second highest of five positions. The Ford was also equipped with adjustable pedals. The pedals were adjusted to a mid position at the time of the inspection. An ultrasonic parking assist system was installed in the rear aluminum step bumper of the Ford chassis that provided an audible warning to the driver when backing. Manual cut-off switches for an external back-up alarm system were located on the exterior surface of the side rear corners of the patient compartment.

***Ambulance Body Exterior***

The ambulance body was manufactured by Wheeled Coach and was identified as a Type I body **(Figure 4)** with a data of manufacture of 07/06. The ambulance body had overall dimensions of 389 cm (153 in) in length, 220 cm (86.75 in) in height, and 241 cm (95 in) in width. The exterior of the Type I body was configured with a solid front wall with a 28-56 cm (11x22 in) window-type pass through to the cab of the vehicle. This was sealed from the weather by a corrugated rubber boot that surrounded the opening. The air conditioning condenser for the patient compartment was mounted on a platform at the front wall of the compartment over the cab of the chassis.


**Figure 4. Right rear view of the patient compartment of the ambulance.**

The left side of the patient compartment was configured with three doors that provided access to storage compartments. The forward door was 57 cm (22.5 in) in width and 193 cm (76 in) in length. An 89 x 72 cm (35 x 28.5 in) compartment door was located forward of the axle and a 79 x 89 cm (31 x 35 in) door was located aft of the axle at the rear corner. All doors remained closed and were operational post-crash. The fuel filler cap was located rearward of the drive axle and was intact post-crash. The diesel fuel tank was centered between the frame rails aft of the rear axle. The tank was intact with no damage or leakage noted to the fuel system.

The back of the patient compartment was configured with center closing doors that were offset to the right. The lateral distance between the hinge side of the right door and the right sidewall of the patient compartment was 21 cm (8.4 in). The corresponding measurement on the left side was 62 cm (24.25 in). The doors were symmetrical and were 79 cm (31 in) wide and 137 cm (54 in) in height. Both doors remained closed during the crash and were fully operational post-crash. Each door was equipped with a 41 x 41 cm (16 x 16 in) window at the upper aspect with a 41 x 23 cm (16 x 9 in) window at the lower aspect. All glazing remained intact.

The right exterior side of the ambulance body was configured with two compartment doors and the entrance door to the patient compartment. The forward compartment door was 48 x 141 cm (18.75 x 55.5 in) and was hinged at the forward edge. The lower aspect of this compartment contained two 12-volt batteries that provided electrical power to the chassis and the patient compartment. The batteries were mounted on a slide-out tray with a locking mechanism to secure the tray in the stowed position. The batteries retained a low-level charge at the time of the SCI inspection and were not physically disconnected by fire department personnel post-crash. The entry door to the patient compartment was 83 cm (32.5 in) in width and 194 cm (76.25 in) in height. The forward hinged door was equipped with a 41 x 41 cm (16 x 16 in) window at the upper third aspect of the door. All right side doors remained closed during the crash and were operational post-crash.

### *Crash Sequence*

#### *Pre-Crash*

The 46-year-old female driver of the ambulance was a 16-year employee of the ambulance service and held an Emergency Medical Technician (EMT) certification. She was categorized as an experienced driver and was considered an exceptional driver by her supervisor. The front right passenger was a 54-year-old male with a paramedic certification. Both occupants were off-duty for two days prior to the crash. They reported to duty on the day of the crash at their scheduled time, 3.5 hours prior to the reported time of the crash.

Prior to the call, the driver and the front right passenger were located at the ambulance station. They received the call for a medical transport of an injured person that was currently in the treatment of field medical personnel. The call did not require the use of the overhead emergency lights or siren and required a drive time of approximately 28-30 minutes to reach the destination of the injured party. This required westbound travel on two-lane roads in dark conditions with sparse traffic.

En route to the call and approximately 20 minutes into the drive, the driver relinquished directional control of the ambulance. The ambulance drifted left across the centerline of the two-lane road and departed the left road edge at a shallow angle of approximately 8 degrees in a tracking attitude. The ambulance continued along the roadside on a path that was nearly parallel to the roadway. The physical evidence at the crash scene consisted of rotating tire prints that clearly depicted the vehicle as tracking with no yaw or braking component evident in the marks. The dual-rear tires tracked over the front tire marks and created a raised ridge in the sandy soil surface between the rear tires. This ridge protruded above the compacted soil from the tires due to the weight of the ambulance. These tire marks continued uninterrupted over a longitudinal distance of 127 m (416 ft) from the point of road departure to the impact with the small diameter tree (**Figure 5)**. The tire marks supported the lack of avoidance actions by the driver, either by braking or steering.

**Figure 5. Rotating tire prints from the dual rear tires of the ambulance.**

**Figure 6. Struck trees along the trajectory of the ambulance.**

***Crash***

The front right area of the ambulance impacted two small diameter pine trees with diameters of 5 and 6 cm (2 and 2.5 in). The trees were fractured and overrode by the ambulance. These tree impacts were visible on the hood face of the Ford and did not alter the trajectory of the vehicle as the tracking, rotating tire marks continued in a westerly direction. The lateral offset of these tree impacts from the south edge of the westbound travel lane were 12 and 12.5 m (40 and 41 ft) respectively. The directions of force for these impacts were 12 o'clock.

The ambulance continued forward and struck a third tree that was approximately 30 cm (12 in) in diameter and located 139.1 m (456 ft) west of the point of departure. This tree was fractured and uprooted. A fourth tree that was approximately 20 cm (8 in) in diameter was subsequently struck by the front of the ambulance. This tree was also fractured and uprooted. This tree was located approximately 142.9 m (469 ft) west of the point of departure from the paved surface. **Figure 6** is a view of the struck trees along the trajectory of the ambulance.

The forward trajectory of the ambulance resulted in an undercarriage event as the front axle impacted and snagged the fractured trees. These impact fractured the axle mounts

from the suspension links and rotated the axle in a clockwise direction under the vehicle. The undercarriage engagement also deformed the left front steel wheel and aired out both front tires. As a result of the axle displacement, the ambulance rotated in a counterclockwise (CCW) direction as its center of gravity continued in a westerly direction.

A small diameter fifth tree was impacted and fractured by the frontal plane. This tree was located 140 m (459 ft) west of the referenced departure point. A sixth tree that was approximately 15 cm (6 in) in diameter and located 150 m (492 ft) west of the departure point was struck by the leading edge of the right front fender. This impact deformed the fender as the ambulance continued forward and rotated CCW. The damage pattern from this event extended rearward to the leading edge of the right front door of the ambulance. The lateral crush to the fender area allowed the tree to engage and snag the leading edge of the door, separating the door hinges at the A-pillar mount. The hinges were splayed open and the fastening bolts were fractured, indicating a longitudinal impact event. The door was displaced rearward into the right B-pillar, crushing the B-pillar rearward.

The frontal tree impacts crushed the front bumper and fractured the left aspect of the bumper inboard of the left frame rail. The upper radiator support was displaced rearward by the impacts. The yielding tree impacts resulted in combined crush profiles to the frontal structure at these locations. The singular events could not be separated; therefore these impacts were outside the scope of the WinSMASH reconstruction model.

**Figure 7. 46 cm (18 in) diameter tree struck by the right side of the ambulance.**

As the ambulance continued to rotate CCW to a near broadside trajectory, the right front door impacted a 46 cm (18 in) diameter tree **(Figure 7)** that was located 155.5 m (510 ft) west of the departure point and 17.2 m (56.5 ft) south of the road edge. The resultant direction of force from this impact event was within the 3 o'clock sector. The tree impact crushed the door to a maximum depth of 29 cm (11.5 in). The maximum crush was located 65 cm (25.75 in) forward of the aft edge of the door. Based on the damage to the door and the B-pillar, it appeared that the door hinges had separated prior to this event. The crush to the door was greater than the crush at the sill level due to this separation. There was no crush at the roof side rail area of the cab. The door latch remained engaged during this event. The separation of the door hinges prior to the lateral impact with the tree resulted in an altered crush profile that was not representative of the total energy associated with this event. The right frame rail of the chassis was displaced laterally by the combination of the frontal and side impacts, and the displacement of the front axle. This extensive induced damage could not be incorporated into the inputs for the side crush profile; therefore this event was classified as outside the scope of the WinSMASH reconstruction program.

The right outside rear view mirror was mounted on a large stalk with two horizontal mounting arms. The mirror engaged the tree at the on-set of the right side impact event. As the ambulance continued on its lateral trajectory, the mirror fractured and the mounting bracket intruded into the passenger compartment. The contact evidence to the struck tree consisted of debarking with paint fragments embedded into the surface of the tree. The debarking of the tree extended 155 cm (61 in) above the level of the ground. The ambulance rebounded from the tree and came to rest east of the tree, facing in a southerly direction.

***Post-Crash***

A passing motorist noted the lights from the ambulance in the tree line and used his cellular telephone to call the 9-1-1 emergency response system. Police, fire, and ambulance personnel were dispatched to the scene of the crash. The driver was observed by the first responders as unconscious and positioned in the front left seat position with her safety belt positioned across her torso and pelvic regions. She regained consciousness at the on-set of the rescue activities. The front right passenger was unconscious and positioned in the front right seat. The responders noted that the right side view mirror stalk had penetrated his occipital scalp. The first responders also noted an obvious deformity of his occipital scalp.

The first responders opened the left front door and cut the shoulder belt webbing of the driver's safety belt system. She was assisted from the vehicle and placed on a cot and transported by ground ambulance to a local hospital where she was treated for her injuries and released.

Fire department personnel used hydraulic rescue equipment to cut the sheet metal surrounding the front right door latch to release the latch from the B-pillar mounted striker. The door was removed from the vehicle and placed on the ground adjacent to the struck tree. The safety belt webbing was cut and the responders placed the passenger on a backboard as he was removed from the vehicle. Due to the severe nature of his injuries and his level of unconsciousness, helicopter transport was requested. The passenger was transported by helicopter from the scene of the crash to a regional trauma center where he expired approximately three hours following the crash. It was noted in the medical records that the passenger lost pulse during transport and active CPR was initiated prior to arrival at the trauma center.

The ambulance was winched from its final rest position to the roadside and towed from the crash site. The vehicle was secured at the tow facility for this SCI inspection.

***Vehicle Damage***

***Exterior – 2006 Ford Chassis***

The frontal area of the ambulance impacted five trees that were identified at the crash site. Six distinct impacts were noted to the hood face of the vehicle. One of these closely spaced areas of deformation was related to secondary contact from a fractured tree as the ambulance continued forward.

A large diameter tree impact was located on the hood face 12-41.6 cm (4.75-16.4 in) left of the vehicle's centerline. A small diameter tree impact was located 7-11 cm (2.75-4.5 in) right of center with a third impact located 15-24 cm (6.1-9.4 in) right of center. A fourth large diameter tree impact was located 20-40 cm (8-15.9 in) right of center that overlapped the previously mentioned event. A fifth tree impact was located 51-59 cm (20.1-23.25 in) right of center and the sixth was located 72-86 cm (28.5-33.9 in) right of center. These frontal impacts deformed the hood face and crushed the chrome bumper. The two large diameter trees crushed into the air conditioning condenser. The left aspect of the bumper fractured at the inboard aspect of the left frame rail. The combined induced and direct contact damage was documented along the bumper from the left frame rail to the right corner of the bumper and measured 157 cm (62 in). Six equidistant crush values were documented along this plane and were as follows: C1 = 0 cm, C2 = 22 cm (8.6 in), C3 = 17 cm (6.7 in), C4 = 11 cm (4.3 in), C5 = 6 cm (2.4 in), C6 = 3 cm (1.2 in). The maximum crush at bumper level was located at C2, 30 cm (12 in) left of the centerline.

The upper radiator support was also crushed by the multiple tree impacts. The combined induced and direct damage length (Field L) extended 152 cm (60 in) across the full width of the radiator support. The crush profile at this level was as follows: C1 = 0 cm, C2 = 0 cm, C3 = 10 cm (3.9 in), C4 = 15 cm (5.9 in), C5 = 26 cm (10.2 in), C6 = 39 cm (15.4 in). **Figure 8** is an overall view of the multiple tree impacts to the front of the ambulance.

**Figure 8. Tree impacts and resultant damage to the front of the ambulance.**

**Figure 9. Right front side impact damage to the ambulance.**

The right front fender exhibited tree contact damage that began 10 cm (3.75 in) aft of the leading edge of the fender and extended 121 cm (47.6 in) rearward to the right A-pillar area **(Figure 9)**. The fender was crushed laterally into the substructure and subsequently disengaged as the mounting bolts pulled though the sheet metal at the top of the fender. The aft edge of the fender remained attached to the chassis by two bolts.

The leading edge of the right front door was crushed rearward by the above engagement. The rearward displacement of the door edge resulted in deformation of the hinges with fracturing of the mounting bolts into the door frame. The hinges were deformed rearward to a U-shape. The door was subsequently displaced rearward into the right B-pillar,

crushing the B-pillar approximately 10 cm (4 in) rearward against the body of the patient compartment. The door latch remained engaged during the crash event.

The right door of the Ford chassis impacted the 46 cm (18 in) diameter tree as the vehicle rotated CCW. The lateral impact deformed the door to a U-shape following the separation of the front hinges **(Figure 10)**. The direct contact damage on the door began at the leading edge of the door and extended 52 cm (20.5 in) rearward. A reference line was taped across the damage profile of the door. The measured Field L for this damage pattern was 58 cm (23 in). A crush profile was documented along this profile and was as follows: C1 = 0 cm, C2 = 9 cm (3.5 in), C3 = 20 cm (7.9 in), C4 = 28 cm (11.1 in), C5 = 25 cm (9.75 in), C6 = 0 cm. The maximum crush along this profile was 29 cm (11.5 in) located 65 cm (25.75 in) forward of the rear edge of the separated door. The door sill was crushed approximately 10 cm (4 in); however, the resultant damage was not representative of the lateral impact event. Due to the separation of the door, an accurate Door Sill Differential (DSD) could not be obtained.

**Figure 10. Damage to the right front door area.**

The frame of the ambulance chassis was deflected laterally left as a result of the frontal tree impacts, the undercarriage impacts with the uprooted tree trunks that separated the front axle, and the energy associated with the lateral right side tree impact. The displacement of the frame produced a lateral offset of the patient compartment with respect to the cab of the chassis. The offset between the cab and the patient compartment at the right B-pillar area at the level of the beltline was 41 cm (16.25 in) while the corresponding location at the left side yielded 51 cm (20.25 in) of lateral displacement.

The solid front axle with the front-wheel drive differential separated from the suspension mounts and was rotated CW under the chassis of the ambulance. The left front tire was de-beaded from the OEM steel wheel. The wheel was not deformed and the tire was not cut. The right front wheel was deformed on the inner bead area and the right inner sidewall of the tire was cut over a 20 cm (8 in) long area with a 10 cm (4 in) vertical cut. The tire was flat and de-beaded from the wheel. As the front axle separated and was displaced rearward, the recirculating-ball steering system was compromised. The sector shaft fractured at the base of the steering box above the level of the pitman arm. The fracture line was irregular and appeared to have occurred from stress overload during the crash event.

The Collision Deformation Classifications (CDCs) for this multiple event crash are documented by event in the following table:

| Event Number | Object Contacted | CDC |
|---|---|---|
| 1 | 5 cm (2 in) diameter tree | 12-FCEN-1 |
| 2 | 6 cm (2.5 in) diameter tree | 12-FCEN-1 |
| 3 | 31 cm (12 in) diameter tree | 12-FYEN-1 |
| 4 | 20 cm (8 in) diameter tree | 12-FZEN-1 |
| 5 | Uprooted tree trunks | 00-UDZW-1 |
| 6 | 5 cm (2 in) diameter tree | 12-FREN-1 |
| 7 | 15 cm (6 in) diameter tree | 12-RYAW-2 |
| 8 | 46 cm (18 in) diameter tree | 03-RPAW-4 |

***Exterior - Patient Compartment***

The exterior of the patient compartment sustained minor severity damage associated with this multiple event crash. There was no direct impact damage to the compartment. Isolated dents were noted to the forward wall of the patient compartment from contact with fractured tree branches **(Figure 11)**. A dent was noted to the horizontal roof channel, left of the vehicle's centerline. The rearward compression of the right B-pillar minimally deformed the forward wall. Additional, but minor damage occurred to the forward wall of the patient compartment during the extrication activities as rescue personnel used hydraulic tools to cut the rear edge of the right door to release the latch assembly.

**Figure 11. Isolated damage to the front wall of the patient compartment.**

The sides, rear, and top of the patient compartment were free of damage and all doors and glazing remained closed, intact, and operational post-crash. The rectangular pass-through between the back wall of the cab and the patient compartment was closed off due to the lateral shift of the body on the chassis.

***Interior – 2006 Ford Chassis***

The interior of the Ford ambulance chassis sustained moderate severity damage that was attributed to intrusion, occupant contact, and deployment of the frontal air bag system.

The redesigned frontal air bags deployed from the respective module assemblies. The driver air bag was concealed within an H-configuration module located in the center hub of the steering wheel. The cover flaps opened as designed. The front right passenger air bag deployed from a mid-mount module with a tethered cover flap. The cover flap disengaged from the instrument panel and remained tethered during the deployment event.

The front right passenger compartment was reduced in size by longitudinal and lateral intrusion of frontal and right side components. The maximum intrusion involved 39 cm (15.25 in) of longitudinal displacement of the right toe pan. The maximum lateral intrusion was 34 cm (13.5 in), located at the lower right A-pillar. **Figures 12 and 13** are views of the intrusion into the front right passenger compartment. The intrusions are detailed by location, magnitude and direction in the following table:

| Position | Component | Magnitude | Direction |
|---|---|---|---|
| Front Right | Right toe pan | 39 cm (15.25 in) | Longitudinal |
| Front Right | Lower right A-pillar | 34 cm (13.5 in) | Lateral |
| Front Right | Right door sill | 31 cm (12.4 in) | Lateral |
| Front Right | Right door panel | 25 cm (10 in) | Lateral |
| Front Right | Right mid instrument panel | 25 cm (10 in) | Longitudinal |
| Front Right | Upper roof side rail at A-pillar | 6 cm (2.5 in) | Longitudinal |

**Figure 12. Intrusion of the front right passenger area.**

**Figure 13. Exterior view of the intrusion into the front right passenger compartment.**

The driver initiated a forward trajectory in response to the frontal impacts and loaded the safety belt system. The inertia activated retractor locked at the on-set of the tree impact events. A frictional abrasion was noted the latch plate. The driver loaded the deployed air bag; however, there was no contact evidence or damage to the air bag. The steering column shear capsules were not compressed. Two knee scuffs were present on the knee bolster. The left knee contact was located 17-30 cm (6.5-12 in) left of the right edge of the separated plastic panel and 13-19 cm (5-7.5 in) below the top edge of the bolster. The right knee scuff was located 6-10 cm (2.5-4 in) left of the right edge and 18-22 cm (7-8.5 in) below the top edge of the bolster.

The front right passenger loaded the safety belt system and the deployed front right air bag. There was no loading evidence to these components. Body fluid was present on the lap belt portion of the passenger's belt webbing. The passenger contacted the intruding right front door panel during the side impact event. The panel was separated from the

door and was fractured at various points. The horizontal mounting bracket for the right outside rear view mirror penetrated the passenger compartment as a result of the tree impact. Body fluid was present on the end of this bracket. The mirror separated from the bracket during the event, thus exposing the bracket to the passenger's trajectory.

***Interior - Patient Compartment***

The interior of the patient compartment was not damaged and was not occupied at the time of the crash. The unit was configured with a three-passenger bench seat on the right side of the patient compartment. Each position was equipped with a lap belt. A safety net was affixed to the side wall, ceiling, and the forward edge of the bench seat. The CPR seat was incorporated into the left wall and consisted of a padded seat cushion and back rest with padding for the head on the wall and sides of the integrated cabinets. This position was configured with a lap belt. The rear facing captain's chair was mounted on an adjustable base with fore and aft adjustments. The seat was equipped with a lap belt restraint system. An integrated child restraint system with a five-point harness was incorporated into the seat back. **Figures 14 and 15** are overall views of the patient compartment.

**Figure 14. Overall view of the patient compartment.**

**Figure 15. View of the CPR seat and the rear facing captain's chair.**

The oxygen tank was mounted horizontally under the right side bench seat with the valve facing forward. The offset rear entry doors provided access to this cylinder. The cylinder remained secured in its mounting system and was not damaged.

Located at the forward right corner of the patient compartment was a storage shelf with an aluminum roll-up door. These shelves were accessible from the interior and exterior of the patient compartment.

The ambulance cot was manufactured by Stryker and was equipped with three lateral restraint straps positioned at the chest, pelvic region and lower extremity levels of a patient. The cot was secured to the patient compartment with the forward-mounted antler bracket and the Fernco locking mechanism at the left rear aspect of the cot. The cot and the locking systems remained intact and were not damaged.

A refrigerator was incorporated into the left back corner of the patient compartment. The unit appeared to have been displaced by the crash as it was taped closed to the surrounding cabinet at the time of the SCI inspection.

The side mounted storage cabinets were configured with sliding Plexiglas doors. All doors were intact and undamaged; however, the rear oriented doors were all in the forward position, possibly displaced forward by the frontal impact events.

***Ambulance Controls***

The driver's window was open 9 cm (3.5 in) above the full-down position at the time of the SCI inspection and the glazing remained intact. The front right window was fully closed and was disintegrated by the exterior deformation. Glass fragments were found in the upper weather stripping at the time of the SCI inspection to support the pre-crash status of the glazing.

The positions of the Heat/Ventilation and Air Conditioning (HVAC) controls were noted during the SCI inspection. The temperature mixture control was adjusted to the lower third of the cold position and the fan switch was set to Position 3 of 4. The air circulation control knob was displaced from the instrument panel and was not located within the vehicle. Based on the stalk for this knob, it appeared the switch was turned to the maximum air conditioning position. It should be noted that these positions were the positions at the time of the SCI inspection and may differ from the at-crash positions. The outside temperature at the time of the crash was 8 degrees C (46 degrees F).

The master HVAC control mounted on the left forward wall of the patient compartment was in the off-position. A secondary heat control switch was mounted on a panel above the refrigerator. This rocker switch was in the on-position; however, this panel did not display a function in the digital display with power supplied to the vehicle.

***Frontal Air Bag System***

The ambulance was equipped with redesigned frontal air bags for the driver and front right passenger positions. The frontal air bags deployed during the frontal crash events with the larger diameter trees. The air bag system was controlled by a Restraints Control Module (RCM) that was mounted on the forward tunnel of the chassis under the aftermarket center console. The RCM provided crash sensing and diagnostic functions and had Event Data Recording (EDR) capabilities.

The driver air bag was concealed with an H-configuration module within the center hub of the steering wheel rim. The upper flap was 19 cm (7.5 in) in width at the horizontal tear seam and was 14 cm (5.5 in) vertically. The lower flap had respective measurements of 19 and 5 cm (7.5 and 2 in). The air bag was tethered by two internal straps at the 12 and 6 o'clock sectors with a 17 cm (6.5 in) center reinforcement sewn to the face

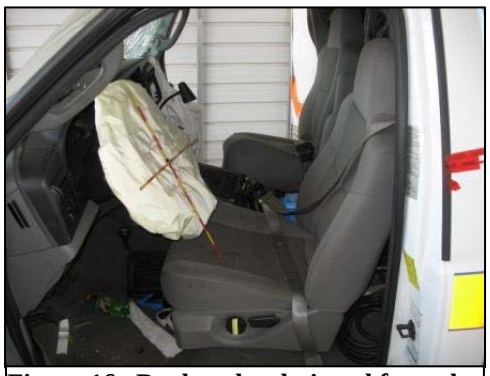


**Figure 16. Deployed redesigned frontal air bags.**

of the air bag. The bag was vented into the passenger compartment by two 3 cm (1 in) diameter vents ports located on the back side of the air bag at the 11 and 1 o'clock sectors. There was no occupant contact evidence or damage to the air bag.

The front right air bag was concealed by a single rectangular cover flap in the right mid instrument panel. The flap was 34 cm (13.5 in) in width and 17 cm (6.5 in) in height. The cover flap was tethered to the instrument panel with four straps. The front right air bag was not tethered or vented directly into the passenger compartment. There was no occupant contact evidence or damage to the front right air bag. **Figure 16** is a lateral left view of the deployed frontal air bags.

***Event Data Recorder***

The EDR from the Ford F-450 was imaged during the SCI investigation utilizing the Bosch Crash Data Retrieval (CDR) tool and software version 3.3. The imaging was obtained through the vehicle's diagnostic link connector that was mounted under the driver's knee bolster. Vehicle 12-volt power was maintained to the chassis as the onboard batteries were not disabled by the first responders. The battery power was low and required a 110-V AC charger to boost the battery output as the vehicle accessories produced a drain to the battery when the ignition switch was turned to the on-position.

The imaged EDR data was limited to confirming frontal air bag deployment, listing no active faults at the command to deploy, and that the passenger air bag switch was in the activated position at the deployment event. The maximum longitudinal delta V of -10.4 km/h (-6.47 mph) was recorded at 86 milliseconds (ms) after Algorithm Enable (AE). The longitudinal acceleration trace was recorded over a 116 ms timeframe. This short duration timeframe did not capture the entire crash event. The pre-crash data recorded by the vehicle's Powertrain Control Module (PCM) was not accessible as the diesel power train was not supported by the CDR software.

***Manual Safety Belt Systems***

The Ford F-450 chassis cab was equipped with 3-point lap and shoulder belt systems for the two front seating positions. The systems consisted of continuous loop webbing with sliding latch plates and B-pillar mounted retractors. The belt webbings were cut by the first responders and the remaining belt retracted into the B-pillars; therefore the retractor types could not be determined. The belt systems were not equipped with pretensioners.

The driver's belt system yielded frictional abrasions on the latch plate from driver loading (**Figure 17)**. There was no loading evidence on the belt webbing. The driver's belt webbing was cut at a point that was 192 cm (75.7 in) above the floor anchor. The front right belt webbing was cut 135 cm (53 in) above the anchor point. There was no loading evidence on the front right belt system (webbing or hardware). Body fluid was present on the lap belt portion of the webbing.

**Figure 17. Frictional abrasion across the driver's latch plate.**

***Occupant Data/Demographics***

***Driver***

| | |
|---|---|
| Age/Sex: | 46-year old/Female |
| Height: | 170 cm (67 in) |
| Weight: | 99 kg (218 lb) |
| Seat Track Position: | Rear track, adjusted 5 cm (2 in) forward of full rear |
| Manual Safety Belt Use: | 3-point lap and shoulder belt system |
| Usage Source: | Vehicle inspection |
| Egress from Vehicle: | Assisted from vehicle by rescue personnel |
| Mode of Transport From Scene: | Ground ambulance |
| Type of Medical Treatment: | Treated at a local hospital and released |

***Driver Injuries***

| Injury | Injury Severity (AIS 90/Update 98) | Injury Source |
|---|---|---|
| Closed head injury with loss of consciousness of less than 1-hour | Moderate (160202.2,0) | Unknown |
| Left elbow contusion | Minor (790402.1,2) | Left door panel (possible) |

*Source – Emergency Room Records*

***Driver Kinematics***

The driver was seated in a rear-track position with the seatback reclined to a measured angle of 16 degrees aft of vertical. She was restrained by the manual 3-point lap and shoulder belt system. Belt usage was determined by the observations of the first responders, loading evidence present of the hardware of the system, and by the cut status of the belt webbing.

During the multiple frontal impact events with trees, the driver air bag deployed. The driver initiated a forward trajectory in response to the crash forces. She loaded the locked (inertia activated retractor) safety belt system as evidenced by the frictional abrasions on the latch plate. Her upper torso and face probably contacted the deployed air bag; however, no contact evidence or injury resulted from this interaction.

As the ambulance rotated CCW and struck the tree with the right side area, the driver responded laterally right toward the 3 o'clock direction of force. There was no contact evidence to support her involvement with interior components. The safety belt system probably limited her lateral movement. The driver sustained a left elbow contusion from possible contact with the left door panel during the crash sequence.

The driver was found in an unconscious state as the first responders arrived on scene. She regained conscious and was assisted from the vehicle and transported by ground ambulance to a local hospital where she was treated for her injuries and released. She sustained a closed head injury with loss of consciousness of less than 1-hour from an unknown source.

***Front Right Passenger***

| | |
|---|---|
| Age/Sex: | 54-year old/Male |
| Height: | 175 cm (69 in) |
| Weight: | 82 kg (180 lb) |
| Seat Track Position: | Full-rear track position |
| Manual Safety Belt Use: | 3-point lap and shoulder belt system |
| Usage Source: | Vehicle inspection |
| Egress from Vehicle: | Removed from vehicle by rescue personnel |
| Mode of Transport From Scene: | Transported by helicopter to a regional trauma center |
| Type of Medical Treatment: | Expired approximately 3-hours post-crash |

***Front Right Passenger Injuries***

| Injury | Injury Source (AIS 90/Update 98) | Injury Source |
|---|---|---|
| Open skull fracture, occipital area, (large laceration to posterior head) | Severe (150406.4,6) | Right side view mirror stalk/tree |
| Right ribs 1 thru 10, displaced fractures with hemo/pneumothorax (800mL blood in right cavity and moderate to large pneumo in right chest) | Severe (450252.4,1) | Intruding right door panel |
| Comminuted right scapula fracture | Moderate (753000.2,1) | Intruding right door panel |
| Manubrium (sternal) fracture | Moderate (450804.2,4) | Intruding right door panel |
| T4 spinous process fracture | Moderate (650418.2,7) | Intruding right door panel |
| T5 spinous process fracture | Moderate (650418.2,7) | Intruding right door panel |
| T6 spinous process fracture | Moderate (650418.2,7) | Intruding right door panel |
| T7 spinous process fracture | Moderate (650418.2,7) | Intruding right door panel |
| T8 spinous process fracture | Moderate (650418.2,7) | Intruding right door panel |
| Large forehead laceration (over right eye) | Minor (290600.1,7) | Right side view mirror stalk/tree |
| Extensive facial fractures, NFS | Minor (250400.1,9) | Right side view mirror stalk/tree |
| Right chest ecchymosis | Minor (490402.1,1) | Intruding right door panel |
| Multiple abrasions to arms | Minor (790202.1,3) | Intruding right door panel |
| Multiple abrasions to legs | Minor (890202.1,3) | Intruding right door panel |

*Source – Hospital medical records, no autopsy performed.*

***Front Right Passenger Kinematics***

The front right passenger was seated in a full-rear track position and was restrained by the 3-point lap and shoulder belt system. Belt usage was supported by the observations of the first responders at the crash site, loading and body fluid evidence on the lap belt portion of the belt system, and the cut status of the shoulder belt webbing prior to the extrication of the passenger.

Prior to the crash, the posture of the front right passenger was unknown. During the frontal impact events, the front right passenger initiated a forward trajectory and loaded the locked safety belt system and the deployed front right air bag. As the ambulance rotated CCW and engaged the large diameter tree with the right front door, he moved laterally right and contacted the intruding right front door. His contact to the upper rear quadrant area of the intruding door panel resulted in displaced fractures of right ribs 1-10 with hemothorax and pneumothorax, a comminuted fracture of the right scapula, a manubrium (sternal) fracture, multiple thoracic spinous process fractures, and right chest ecchymosis. The passenger also sustained multiple abrasions of the upper and lower extremities from contact with the intruding door panel.

The right side impact with the tree displaced the right side view mirror rearward and laterally left. The mirror separated from the mounting stalks as the passenger's head moved laterally right through the disintegrated door glazing opening. The passenger's head was partially ejected and impacted the lower mounting stalk of the mirror and the tree. The mirror stalk penetrated his occipital scalp resulting in an open skull fracture with a large laceration. He also sustained unspecified facial fractures from contact with the mirror stalk and the tree.

The passenger was extricated from the vehicle by rescue personnel and was transported by helicopter to a regional trauma center where he expired approximately 3-hours following the crash.

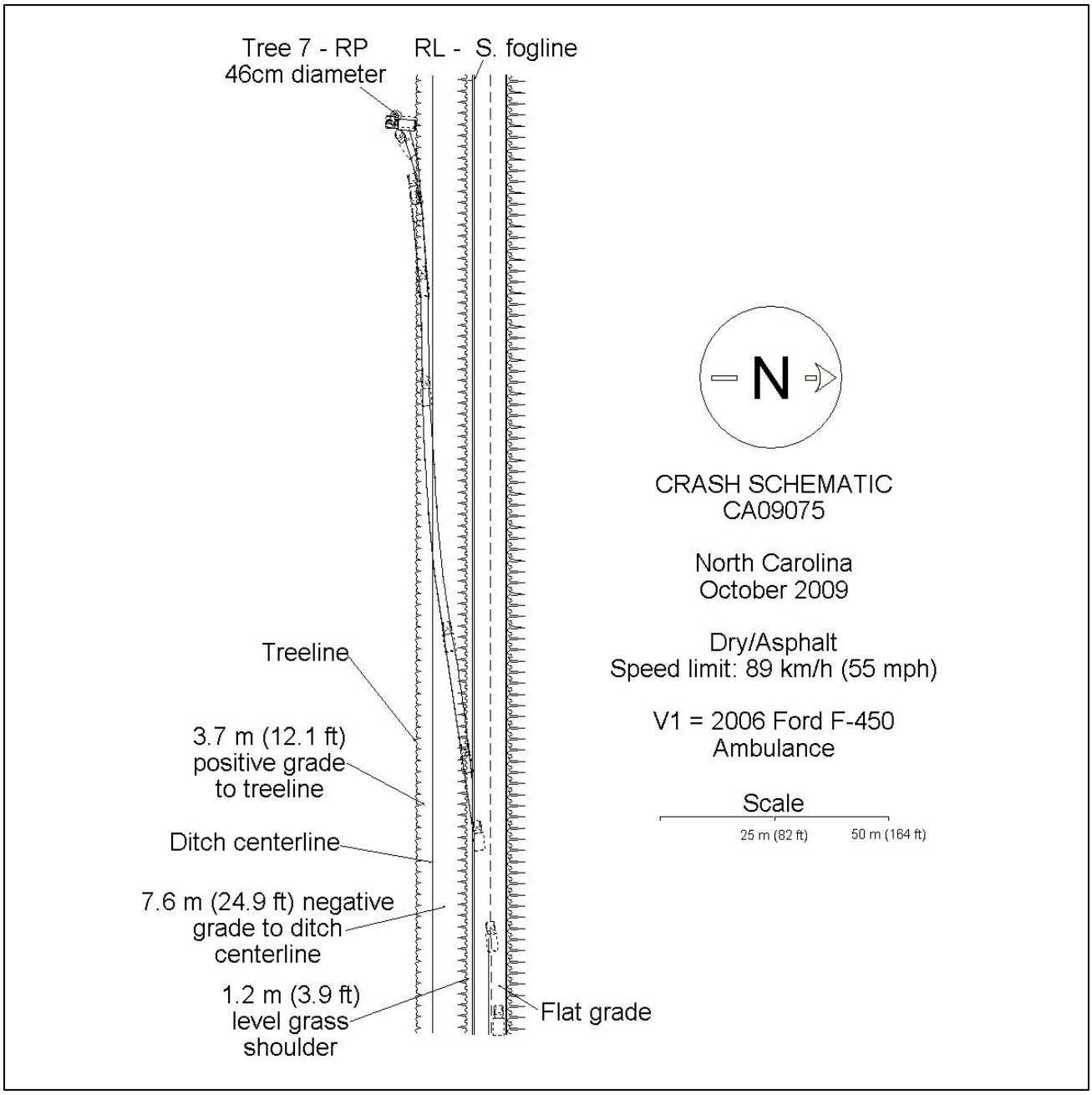



**Figure 18. Crash Schematic**

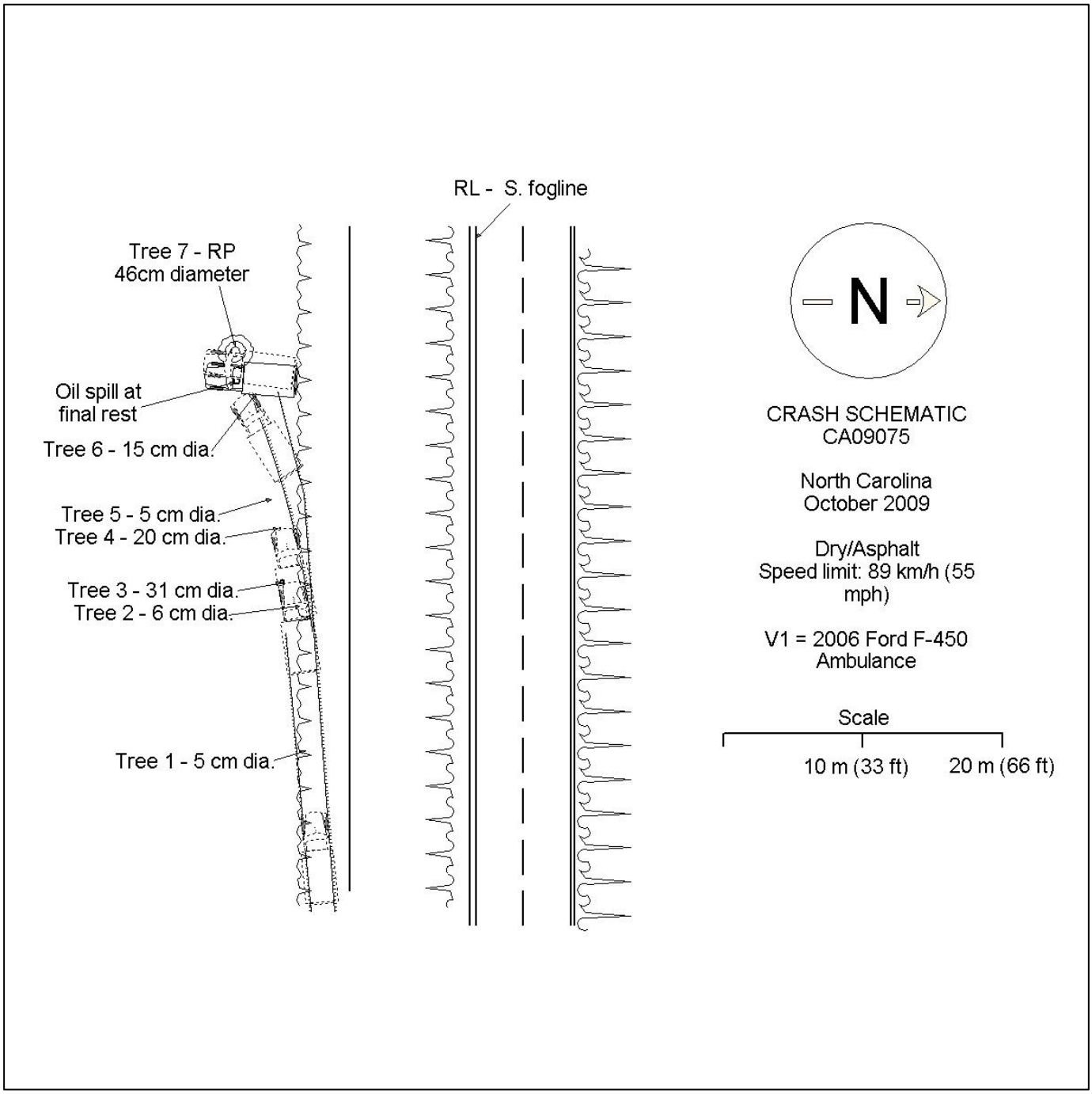



**Figure 19. Enlarged area at impact locations.**

**ATTACHMENT A**

EDR DATA

IMPORTANT NOTICE: Robert Bosch LLC and the manufacturers whose vehicles are accessible using the CDR System urge end users to use the latest production release of the Crash Data Retrieval system software when viewing, printing or exporting any retrieved data from within the CDR program. Using the latest version of the CDR software is the best way to ensure that retrieved data has been translated using the most current information provided by the manufacturers of the vehicles supported by this product.

## CDR File Information

| | |
|---|---|
| User Entered VIN | 1FDXF47P36E****** |
| User | |
| Case Number | CA09075 |
| EDR Data Imaging Date | |
| Crash Date | |
| Filename | CA09075 ACM.CDR |
| Saved on | Thursday, October 29 2009 at 03:00:02 PM |
| Collected with CDR version | Crash Data Retrieval Tool 3.3 |
| Reported with CDR version | Crash Data Retrieval Tool 3.4 |
| EDR Device Type | airbag control module |
| Event(s) recovered | Deployment |

## Comments

No comments entered.

## Data Limitations

The retrieval of this data has been authorized by the vehicle's owner, or other legal authority such as a subpoena or search warrant, as indicated by the CDR tool user on Thursday, October 29 2009 at 03:00:02 PM .

**Important Limitations on Vetronix Crash Data Retrieval (CDR) Tool Capabilities.**

Disclaimer: This Restraint Control Module (RCM) records longitudinal deceleration data for the purpose of understanding the input data the Restraint Control Module used to determine whether or not to deploy restraint devices. This module does not record vehicle speed, throttle position, brake on-off, and other data, which may be recorded in some 1999 model year and later General Motors modules. The deceleration data recorded by Ford's module during a crash can subsequently be mathematically integrated into a longitudinal Delta-V. Delta-V is the change in velocity during the recording time and is NOT the speed the vehicle was traveling before the accident, and is also not the Barrier Equivalent Velocity. The Vetronix CDR Tool will read and interpret both acceleration in G's and Delta-V in mph. RCM's in Ford vehicles that can be read by the Vetronix CDR tool are listed in the Vetronix Help Files.

**Important**

If there is any question that the restraint system did not perform as it was designed to perform, please read the system only through the diagnostic link connector. The Vetronix CDR kit provides an RCM interface cable to plug directly into the restraint control module. The Vetronix CDR RCM Interface Cable connects only power, ground, and memory read pins to the relevant vehicle restraint control module. The other RCM pins normally connect to inputs, such as sensors, and outputs, such as airbags, are not connected when you use the RCM Interface Cable to plug directly into the module. Since the vehicle restraint control module is constantly monitoring airbag system readiness (when powered), it will detect that the sensors and airbags are not connected. The restraint control module may record a new diagnostic trouble code into memory for each device that is not connected. These new diagnostic trouble codes may record over previously written diagnostic trouble codes present prior to the accident and spoil evidence necessary to determine if the restraint system performed in the accident as it was designed to perform. Not only could this prevent Ford from being able to determine if the system performed as it was designed to perform, but, regardless of innocent inadvertence, you could raise issues of evidence spoliation in any litigation that may arise out of the accident. If you cannot read the module via the diagnostic link connector, and if you suspect improper system performance, contact Ford Motor Company and request their assistance to read the module with a proper vehicle simulator attached.

While data stored in RCM's is accurate, accident reconstructionists must be aware of the limitations of the data recorded in Ford's control modules and should compare the recorded data with the physical evidence at the accident scene using professional accident reconstruction techniques (i.e. vehicle crush characteristics, skid marks, etc) before making any assumptions about the import and validity of the data recorded in the module with respect to the crash event being analyzed. The following describes specific limitations that must be considered when analyzing recorded data. Investigators should obtain permission of the vehicle owner or have sufficient legal authority prior to reading any data.

1. There may be no deceleration data recorded in the module.
Loss of power (cut wires, damaged battery, crushed fuse box) to the module during or immediately after the crash may prevent the crash data from being recorded. A backup power supply within the module has sufficient power to continue to analyze the deceleration data and deploy restraint devices if needed, but there is no backup power for recording.

If the deceleration input does not create a vehicle longitudinal Delta-V above 4 mph within 100 milliseconds, there may not be any data recorded.

2. In unusual circumstances, deceleration data stored in the module may be from a crash other than the one you are currently analyzing.
The module will record data from some non-deploy events. If, after the module has recorded data from a non-deploy event, and there is a subsequent event in which there is a loss of power and no new recording is made for that subsequent event, the deceleration data in the module's memory may be from the prior event. If the new, subsequent event is a deploy event and recording has occurred, the deployment times should be recorded. If there are no deployment times recorded, but airbags or other restraint devices are observed to have deployed, the recorded data that you read are most likely from a prior event.

Once an airbag or other restraint device has been commanded to deploy, the data recorded in connection with that deployment are "locked", and subsequent crashes cannot be recorded.

If a vehicle is being repaired, the RCM should be replaced after any crash in which restraint devices deploy. Early printed shop manuals refer to re-using modules by clearing the "crash data memory full" code, but this is no longer true and the latest on-line electronic shop manual directs that modules be replaced.

Crashes that involve multiple impacts will record only one of the impacts. If there is a deployment, the deployment event will be recorded and locked. If no restraint device is commanded to deploy, the recorded data are not "locked", and subsequent impacts may record over any previous recorded data. Further analysis will be required to determine which of the events was actually recorded.

3. The computed longitudinal Delta-V may understate the total Delta-V

Many real-world crashes can last longer than the memory has the capacity to record. Therefore, the actual Delta-V of the event may be higher than the Delta-V calculated and displayed by the Vetronix CDR System output. Review the end of the longitudinal acceleration/deceleration pulse - if it has not settled to zero G's by the end of the recording, the vehicle longitudinal Delta-V is most likely understated. If there is a clear decaying trend line you may choose, at your own risk, to estimate the total Delta-V by extrapolating the decay trend to zero and to calculate the additional Delta-V not captured.

Under some circumstances where power is interrupted, during the recording of data, or the module re-sets during the recording of data, a partial recording may occur. This will be shown as "no data" in the data table and will not be plotted on the graph of acceleration. When some portion of the acceleration data is not recorded, the Delta-V during that time cannot be calculated. A Delta-V will be calculated for the points that are valid, but the user must be aware that the partial Delta-V calculated will further underestimate the actual event total Delta-V.

4. This module records only longitudinal acceleration/deceleration of the vehicle. You must compute lateral or resultant total acceleration based on your estimated Principal Direction of Force (PDOF).

5. Vertical acceleration/decelerations are not recorded. Vehicle spin about a point not centered on the Restraints Control Module sensor may add or subtract from bulk vehicle motion.

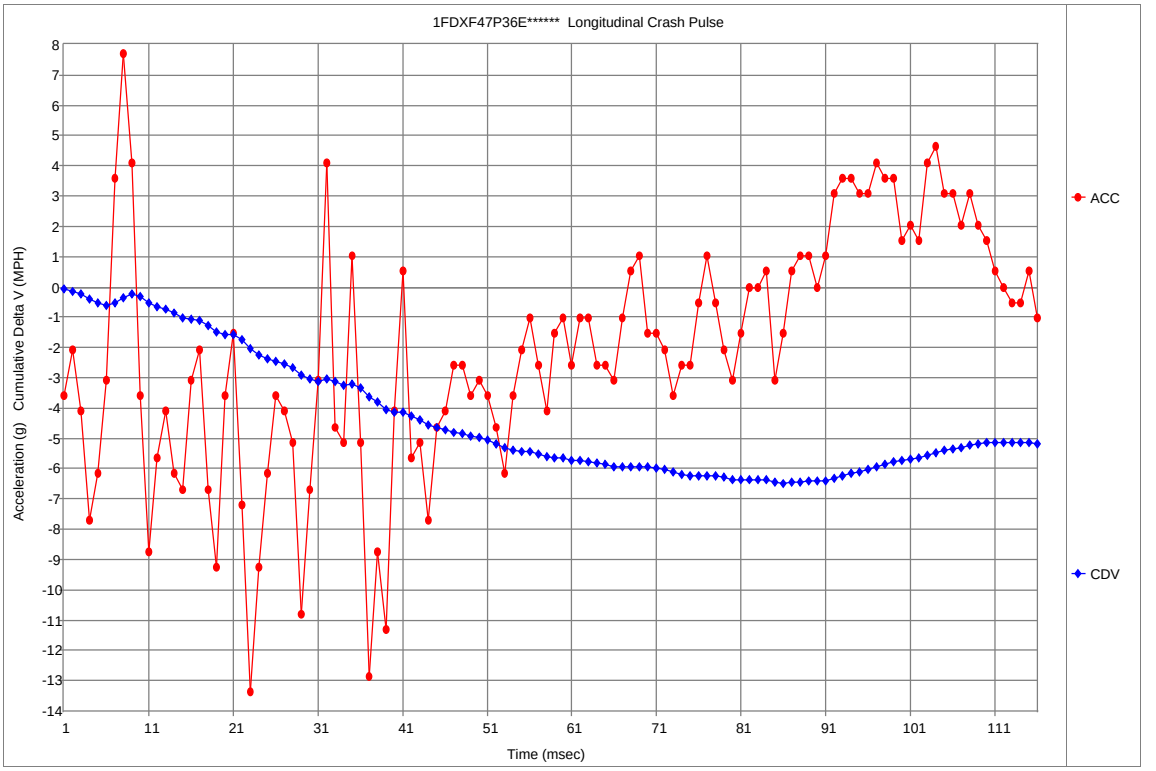
6. This module is not intended to record acceleration/deceleration in a side-impact event. If the side impact generates a longitudinal deceleration component sufficient to wake up the frontal deployment algorithm, there may be a recording of longitudinal deceleration in a side impact event.

Any Longitudinal Delta-V determined by using data read from the air bag module should be verified with physical evidence from the crash (such as vehicle crush, skid marks) and assumed accident sequence. Multiple impacts, angular collisions, side impacts, vehicle spin, etc should be considered in addition to the data read from the air bag module.

02001_RCM-1_r001

## System Status At Deployment

| | |
|---|---|
| Diagnostic codes active when event occurred | 0 |
| Passenger Airbag Switch Position During Event | Activated |
| Time From Side Safing Decision to Left (Driver) Side Bag Deployment (msec) | Not Deployed |
| Frontal and Pretensioner Fire time (ms) | 0 |


1FDXF47P36E****** Longitudinal Crash Pulse
Acceleration (g) Cumulative Delta V (MPH)
Time (msec)
ACC
CDV

# Crash Pulse Data

| Milliseconds | Long. Acceleration (Gs) | Long. Cumulative Delta V (MPH) |
|---|---|---|
| 1 | -3.60 | -0.08 |
| 2 | -2.06 | -0.12 |
| 3 | -4.11 | -0.21 |
| 4 | -7.71 | -0.38 |
| 5 | -6.17 | -0.52 |
| 6 | -3.08 | -0.59 |
| 7 | 3.60 | -0.51 |
| 8 | 7.71 | -0.34 |
| 9 | 4.11 | -0.25 |
| 10 | -3.60 | -0.33 |
| 11 | -8.74 | -0.52 |
| 12 | -5.65 | -0.64 |
| 13 | -4.11 | -0.73 |
| 14 | -6.17 | -0.87 |
| 15 | -6.68 | -1.02 |
| 16 | -3.08 | -1.08 |
| 17 | -2.06 | -1.13 |
| 18 | -6.68 | -1.28 |
| 19 | -9.25 | -1.48 |
| 20 | -3.60 | -1.56 |
| 21 | -1.54 | -1.59 |
| 22 | -7.20 | -1.75 |
| 23 | -13.36 | -2.04 |
| 24 | -9.25 | -2.25 |
| 25 | -6.17 | -2.38 |
| 26 | -3.60 | -2.46 |
| 27 | -4.11 | -2.55 |
| 28 | -5.14 | -2.66 |
| 29 | -10.79 | -2.90 |
| 30 | -6.68 | -3.05 |
| 31 | -3.08 | -3.11 |
| 32 | 4.11 | -3.02 |
| 33 | -4.63 | -3.13 |
| 34 | -5.14 | -3.24 |
| 35 | 1.03 | -3.22 |
| 36 | -5.14 | -3.33 |
| 37 | -12.85 | -3.61 |
| 38 | -8.74 | -3.80 |
| 39 | -11.31 | -4.05 |
| 40 | -4.11 | -4.14 |
| 41 | 0.51 | -4.13 |
| 42 | -5.65 | -4.25 |
| 43 | -5.14 | -4.37 |
| 44 | -7.71 | -4.54 |
| 45 | -4.63 | -4.64 |
| 46 | -4.11 | -4.73 |
| 47 | -2.57 | -4.78 |
| 48 | -2.57 | -4.84 |
| 49 | -3.60 | -4.92 |
| 50 | -3.08 | -4.99 |
| 51 | -3.60 | -5.07 |
| 52 | -4.63 | -5.17 |

| Milliseconds | Long. Acceleration (Gs) | Long. Cumulative Delta V (MPH) |
|---|---|---|
| 53 | -6.17 | -5.30 |
| 54 | -3.60 | -5.38 |
| 55 | -2.06 | -5.43 |
| 56 | -1.03 | -5.45 |
| 57 | -2.57 | -5.51 |
| 58 | -4.11 | -5.60 |
| 59 | -1.54 | -5.63 |
| 60 | -1.03 | -5.65 |
| 61 | -2.57 | -5.71 |
| 62 | -1.03 | -5.73 |
| 63 | -1.03 | -5.76 |
| 64 | -2.57 | -5.81 |
| 65 | -2.57 | -5.87 |
| 66 | -3.08 | -5.94 |
| 67 | -1.03 | -5.96 |
| 68 | 0.51 | -5.95 |
| 69 | 1.03 | -5.92 |
| 70 | -1.54 | -5.96 |
| 71 | -1.54 | -5.99 |
| 72 | -2.06 | -6.04 |
| 73 | -3.60 | -6.12 |
| 74 | -2.57 | -6.17 |
| 75 | -2.57 | -6.23 |
| 76 | -0.51 | -6.24 |
| 77 | 1.03 | -6.22 |
| 78 | -0.51 | -6.23 |
| 79 | -2.06 | -6.27 |
| 80 | -3.08 | -6.34 |
| 81 | -1.54 | -6.38 |
| 82 | 0.00 | -6.38 |
| 83 | 0.00 | -6.38 |
| 84 | 0.51 | -6.36 |
| 85 | -3.08 | -6.43 |
| 86 | -1.54 | -6.47 |
| 87 | 0.51 | -6.45 |
| 88 | 1.03 | -6.43 |
| 89 | 1.03 | -6.41 |
| 90 | 0.00 | -6.41 |
| 91 | 1.03 | -6.39 |
| 92 | 3.08 | -6.32 |
| 93 | 3.60 | -6.24 |
| 94 | 3.60 | -6.16 |
| 95 | 3.08 | -6.09 |
| 96 | 3.08 | -6.03 |
| 97 | 4.11 | -5.94 |
| 98 | 3.60 | -5.86 |
| 99 | 3.60 | -5.78 |
| 100 | 1.54 | -5.74 |
| 101 | 2.06 | -5.70 |
| 102 | 1.54 | -5.67 |
| 103 | 4.11 | -5.57 |
| 104 | 4.63 | -5.47 |
| 105 | 3.08 | -5.41 |
| 106 | 3.08 | -5.34 |
| 107 | 2.06 | -5.29 |

| Milliseconds | Long. Acceleration (Gs) | Long. Cumulative Delta V (MPH) |
|---|---|---|
| 108 | 3.08 | -5.22 |
| 109 | 2.06 | -5.18 |
| 110 | 1.54 | -5.15 |
| 111 | 0.51 | -5.13 |
| 112 | 0.00 | -5.13 |
| 113 | -0.51 | -5.15 |
| 114 | -0.51 | -5.16 |
| 115 | 0.51 | -5.15 |
| 116 | -1.03 | -5.17 |