CRASH DATA RESEARCH CENTER

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VERIDIAN ON-SITE AIR BAG RELATED CHILD PASSENGER FATALITY INVESTIGATION

VERIDIAN CASE NO. CA00-036

VEHICLE - 1995 PLYMOUTH VOYAGER

LOCATION - STATE OF WEST VIRGINIA

CRASH DATE - MAY, 2000

Contract No. DTNH22-94-D-07058

Prepared for:

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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 on the injury mechanisms that caused the death of a 6 year old female front right passenger of a 1995 Plymouth Voyager. The Plymouth Voyager was equipped with frontal air bags for the driver and front right passenger positions which deployed as a result of an off-set frontal collision with a 1991 Ford Ranger XLT 4x4 pickup truck. The driver of the Plymouth was operating the vehicle northbound on a two lane rural roadway when she allowed the vehicle to cross the centerline into the path of the southbound Ford Ranger. As the Plymouth crossed the centerline, the front right area was impacted by the front right area of the Ford resulting in moderate damage to both vehicles. The restrained 32 year old female driver of the Plymouth initiated a forward and slightly lateral trajectory in response to the 1 o'clock impact force as the expanding air bag contacted the anterior aspect of her right forearm resulting in a contusion. Loading of the manual restraint resulted in an abrasion to the left neck. She also sustained facial abrasions from contact to the deployed driver air bag. The driver was transported to a local hospital for treatment and released. The unrestrained 6 year old female front right passenger of the Plymouth was seated out-of-position, in a forward lean with her head turned to the left. She was further displaced forward by the pre-crash braking actions of the driver. At impact, she was forward within the path of the expanding air bag which struck her upper torso resulting in abrasions and contusions to the upper chest, anterior neck and chin area. The air bag membrane continued to expand against the face resulting in a basilar skull fracture. She was accelerated vertically into the windshield header which resulted in a contusion behind the left ear. The child occupant was transported to a local hospital where she was pronounced deceased shortly after arrival. The second row left and right seating positions of the Plymouth were occupied by a 6 year old female and 14 year old male, respectively. The third row left and right seating positions were occupied by a 13 year old male and 15 year old female, respectively. The rear seated child occupants received multiple soft tissue injuries to the extremities and were transported to a local hospital for treatment and released.			
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BACKGROUND

This on-site investigation focused on the injury mechanisms that caused the death of a 6 year old female front right passenger of a 1995 Plymouth Voyager. The Plymouth Voyager was equipped with frontal air bags for the driver and front right passenger positions which deployed as a result of an off-set frontal collision with a 1991 Ford Ranger XLT 4x4 pickup truck. The driver of the Plymouth was operating the vehicle northbound on a two lane rural roadway when she allowed the vehicle to cross the centerline into the path of the southbound Ford Ranger. As the Plymouth crossed the centerline, the front right area was impacted by the front right area of the Ford resulting in moderate damage to both vehicles. The restrained 32 year old female driver of the Plymouth initiated a forward and slightly lateral trajectory in response to the 1 o'clock impact force as the expanding air bag contacted the anterior aspect of her right forearm resulting in a contusion. Loading of the manual restraint resulted in an abrasion to the left neck. She also sustained facial abrasions from contact to the deployed driver air bag. The driver was transported to a local hospital for treatment and released. The unrestrained 6 year old female front right passenger of the Plymouth was seated out-of-position, in a forward lean with her head turned to the left. She was further displaced forward by the pre-crash braking actions of the driver. At impact, she was forward within the path of the expanding air bag which struck her upper torso resulting in abrasions and contusions to the upper chest, anterior neck and chin area. The air bag membrane continued to expand against the face resulting in a basilar skull fracture. She was accelerated vertically into the windshield header which resulted in a contusion behind the left ear. The child occupant was transported to a local hospital where she was pronounced deceased shortly after arrival. The second row left and right seating positions of the Plymouth were occupied by a 6 year old female and 14 year old male, respectively. The third row left and right seating positions were occupied by a 13 year old male and 15 year old female, respectively. The rear seated child occupants received multiple soft tissue injuries to the extremities and were transported to a local hospital for treatment and released.

The task was initially assigned to the Veridian SCI team following receipt of a congressional notification to NHTSA regarding a possible air bag related child fatality. This investigation was upgraded from a remote effort to an on-site effort following telephone contact with the involved parties to gain access to the stored vehicles that were involved in this crash. The on-site investigator departed on September 13 and concluded field activities on Friday, September 15, 2000.

SUMMARY

Crash Site

This two vehicle crash occurred during the afternoon hours of May, 2000. At the time of the crash, it was daylight with no adverse conditions as the roads were dry. The crash occurred along the centerline of a two lane north/south asphalt roadway with a negative grade for southbound traffic and a hillcrest

located approximately 549.0 meters (600.0 yards) north of the crash site. The roadway curved slightly to the right for northbound traffic. The roadway was bordered by narrow paved shoulders, private driveways, and a service station just south of the crash site **(see Figure 15 - page 13)**. No traffic control was present at the scene which had a posted speed limit of 89 km/h (55 mph).

Pre-Crash

The 32 year old female driver of the 1995 Plymouth Voyager was en route home and operating the vehicle northbound **(Figure 1)** when she slowed to a (driver reported) speed of 8 km/h (5 mph) in anticipation of a left turn (west) into a private driveway. The occupants of the vehicle became distracted by outside activities occurring just off the west pavement edge. Furthermore, an (unspecified) large truck reportedly exited the service station ahead of the Plymouth to proceed northbound. This (non-contact) truck probably blocked the Plymouth driver's northbound view contributing to the pre-crash circumstances. At this point, the Plymouth driver reportedly sneezed and temporarily relinquished control of the vehicle. She subsequently allowed the vehicle to cross the centerline into the path of the southbound Ford Ranger. The Plymouth driver braked and attempted multiple steering maneuvers in anticipation of the impending crash, however, the vehicle partially remained in the southbound lane prior to the collision. The Plymouth's position in the roadway at impact was evidenced by the (post-impact) tire marks documented at the scene.

The 35 year old male driver of the 1991 Ford Ranger XLT 4x4 pickup truck was operating the vehicle southbound **(Figure 2)** at a (driver reported) speed of 89 km/h (55 mph) when he crested the hill and observed the (non-contact) truck exit the service station across his path of travel to proceed northbound. He reportedly "tapped" the brakes to slow the vehicle and passed the non-contact truck approximately 60.0 meters (66.0 yards) north of the crash site. This apparently blocked the Ford driver's full view of the northbound lane as he subsequently observed the Plymouth encroach into his lane of travel. Upon recognition of the impending harmful event, the Ford driver steered left/braked in avoidance and entered the northbound lane. This trajectory was evidenced by 8.6 meters (28.3 feet) of pre-impact brake marks documented at the scene **(Figure 3)**. Using a conservative drag factor of 0.7, his speed at the initiation of braking was calculated to be 66.1 km/h (41.1 mph). Furthermore, the driver stated later during the SCI interview that he steered left during pre-crash maneuvers to avoid the gas pumps and roadside pedestrians located off the west pavement edge.

Figure 1. Northbound approach for the 1995 Plymouth Voyager.

Figure 2. Southbound approach for the 1991 Ford Ranger XLT 4x4 pickup truck.

Crash

As both vehicles crossed the centerline of the two lane rural roadway, the front right area of the Plymouth Voyager was impacted by the front right area of the Ford Ranger resulting in moderate damage to each vehicle. The damage and trajectory algorithm of the WinSMASH reconstruction program computed impact speeds of 1.1 km/h (0.7 mph) for the Plymouth Voyager and 53.3 km/h (33.1 mph) for the Ford Ranger. The inputs for the WinSMASH damage algorithm were entered according to protocol, however, the outputs for vehicle Delta V's seemed low. The computed velocity changes were 20.9 km/h (13.0 mph) and 24.1 km/h (15.0 mph), respectively. Respective longitudinal components were -18.1 km/h (-11.2 mph) and -22.7 km/h (-14.1 mph). The speed change exceeded the threshold required for deployment, therefore, the Plymouth's frontal air bag system deployed.

As the vehicles crushed to maximum engagement, the Plymouth rotated 156 degrees clockwise and came to rest over the centerline 2.6 meters (8.5 feet) south of the point of impact facing southeast. The Ford rotated 22 degrees clockwise and traveled 10.0 meters (32.8 feet) in a southeasterly direction coming to rest on the east shoulder facing south **(Figure 4)**.

Figure 3. Police photo south of the crash site.

Figure 4. Police photo north of the crash site.

Post-Crash

The driver of the Ford Ranger exited the vehicle through the left door under his own power and laid down in the yard adjacent to the final rest position of the vehicle. The driver of the Plymouth Voyager attended to the injured front right child passenger and subsequently exited the vehicle through the right rear door (accompanied by the rear seated child occupants) where she continued assisting the child through the right front window opening. Bystanders first notified police and fire department personnel who arrived within ten minutes of the crash. The injured front right child passenger of the Plymouth was removed from the vehicle through the right rear door in traumatic arrest (with no signs of life) and transported by ambulance (accompanied by the driver) to a local hospital for treatment where she was pronounced deceased shortly after arrival. The remaining child occupants of the Plymouth were transported by ambulance and private vehicle to a local hospital for treatment and released. The Ford driver was initially transported by ambulance to a local hospital for treatment and subsequently transferred by helicopter to a nearby trauma center and released. Both vehicles were towed from the crash site due to disabling damage.

VEHICLE DATA

The 1995 Plymouth Voyager was identified by the vehicle identification number (VIN): 2P4GH2538SR (production number deleted). The driver was reported by police as the owner of the vehicle. The vehicle was a 4-door minivan equipped with front-wheel drive and a 3.0 liter, V-6 engine. At the time of the crash, the odometer had recorded 136,211 km (84,640 miles). The seating was configured with front box-mounted (van type) and rear bench seats (with folding backs). Although the driver's spouse reported no previous crashes or maintenance on the Plymouth's frontal air bag system, the vehicle's history was somewhat unknown prior to the purchase as a salvaged vehicle in late 1995. It should be noted that the vehicle's hood, windshield, left front door and roof "skin" were reportedly replaced after purchase as a salvage in late 1995. A cellular phone was present but not in use at the time of the collision.

VEHICLE DAMAGE

Exterior

Figure 5. Frontal damage to the 1995 Plymouth Voyager.

The 1995 Plymouth Voyager sustained moderate frontal damage as a result of the impact with the Ford Ranger pickup truck **(Figure 5)**. The direct contact damage began at the front right bumper corner and extended 70.0 cm (27.6 in) inboard. The impact deformed the full frontal width resulting in a combined direct and induced damage length (Field L) of 145.0 cm (57.1 in). Six crush measurements were documented at the level of the reinforcement bar *(bumper fascia separation)*: C1= 0 cm, C2= 8.0 cm (3.1 in), C3= 15.0 cm (5.9 in), C4= 33.0 cm (13.0 in), C5= 36.0 cm (14.2 in), C6= 32.0 cm (12.6 in). The Collision Deformation Classification (CDC) for this impact to the Plymouth was 01-FZEW-2 with a principal direction of force of (+) 30 degrees. The hood was displaced up and rearward from the impact force. The grille and right headlight assembly fractured and separated from the vehicle during the crash sequence. The right fender was deformed rearward which restricted the right front wheel/tire (not deflated). This damage pattern also induced buckling along the right A-pillar, roof, door (restricted) and disintegrated the right front window glazing. In addition, hair strands were documented to the right front (lower) window frame approximately 6.4 cm (2.5 in) aft of the side mirror. Along this area of the exterior door panel, a blood trail began which extended to the lower sill *(with blood pooling noted to the pavement in the police photographs)*. Pry marks were also noted to the right front door assembly sustained during post-impact activities. Reduction in the right side wheelbase measured 9.0 cm (3.5 in). The entire windshield was fractured from exterior impact forces and out-of-place along the right portion from (interior) occupant contact and the passenger air bag. The symmetry of the fracture pattern along the upper right portion of the windshield suggests an inferior application of the bonding agent during repairs subsequent to the vehicle's purchase. Hair strands were also documented along the *exterior portion* of the right upper windshield area (with outward bowing) indicative of an occupant ejection.

Figure 6. Frontal damage to the 1991 Ford Ranger XLT 4x4 pickup truck.

The 1991 Ford Ranger XLT 4x4 pickup truck sustained moderate frontal damage as a result of the impact with the Plymouth Voyager **(Figure 6)**. The direct contact damage began at the front right bumper corner and extended 55.0 cm (21.7 in) inboard. The impact deformed the full frontal width resulting in a combined direct and induced damage length (Field L) of 139.0 cm (54.7 in). Six crush measurements were documented at the level of the bumper: C1= 0 cm, C2= 0 cm, C3= 0 cm, C4= 5.0 cm (2.0 in), C5= 11.0 cm (4.3 in), C6= 36.0 cm (14.2 in). The Collision Deformation Classification (CDC) for this impact to the Ford was 01-FZEW-2 with a principal direction of force of (+)20 degrees. The leading edge of the right hood was displaced up and rearward from the impact force. The right fender was deformed rearward which restricted/deflated the right front wheel/tire. Reduction in the right side wheelbase measured 32.5 cm (12.8 in). Elongation of the left side wheelbase measured 11.5 cm (4.5 in). The windshield was fractured along the right lower A-pillar area by exterior impact forces and holed at the right (centered) area by driver contact. The left front brake line was found hanging below the undercarriage and possibly disconnected from the brake caliper, however, uniform pre-impact brake marks documented at the scene suggests it was impact induced separation and not pre-existing.

Interior

Interior damage to the Plymouth Voyager identified through the vehicle inspection was severe and was attributed to occupant contact and minimal component intrusion. The driver's seat was slightly scuffed and deformed to an upright position from rear occupant loading with the right armrest separated from the seat back. A pair of sunglasses were found deformed on the floor. A multitude of contacts were identified to the front right passenger space which involved hair strands and scuff marks along the windshield header *(exterior and interior)*. This contact pattern began at the right A-pillar and extended left towards the rear view mirror which was also fractured and out-of-place.

Figure 7. Contact evidence to the sunvisor and windshield header.

An indentation was documented to the right sunvisor **(Figure 7)** with the aft mirror undamaged. An associated indentation was found to the adjacent roof area. The windshield was fractured from passenger air bag interaction, indicative of an impeded/re-directed deployment pattern. The windshield was also out-of-place along the upper/lower A-pillar area, however, given the symmetry of the fracture pattern in police photos it appeared to be a substandard bonding application, contributing a partial ejection of the front right child passenger. Blood trails/pooling were noted on the front right seat back, door panel, lower window frame *(exterior and interior)* and B-pillar. The concentration of blood in these areas were indicative of the child passenger's head position post-crash. Hair strands, fluid and blood spattering were also documented along the right roof side rail. The front right passenger seat was

also slightly scuffed and deformed to an upright position from rear occupant loading. It should be noted that the right instrument panel and knee bolster were free of contact evidence. Longitudinal intrusion of the right instrument panel and toepan measured 12.0 cm (4.7 in). No rim deformation, column compression or left knee bolster contacts were identified.

Interior damage to the rear occupant space was also extensive and attributed to occupant contact. Extensive (laterally uniform) deformation was identified to the rear portion of the second row seat back attributed to loading by the third row seated occupants.

Interior damage to the Ford Ranger identified through the vehicle inspection was moderate and was attributed to occupant contact and minimal component intrusion **(Figure 8)**. The vehicle's principal direction of force and associated (+)18 degree sideslip (beta) angle contributed to a resultant occupant kinematic pattern towards the front right passenger space. Deformation to the lower portion of the steering wheel rim measured 2.0 cm (0.8 in). The left portion of the steering column cover panel was fractured. The center armrest was displaced to the right. The gearshift knob separated from the floor-mounted transmission gearshift shaft which was also minimally deformed to the right. The rear view mirror was fractured and displaced to the right with an associated fracture site identified to the mid-upper windshield area. The right mid-windshield area was holed by driver contact with hair strands surrounding the fracture site **(Figure 9)**. Scuff marks were documented on the right mid-instrument panel area. Longitudinal intrusions into the front right passenger space involved 17.0 cm (12.2 in) of toepan and 3.0 cm (1.2 in) of instrument panel intrusion. Vertical intrusions into the passenger space involved 5.0 cm (2.0 in) of floor and 8.0 cm (2.2 in) of seat cushion intrusion.

Figure 8. Interior view of the driver space.

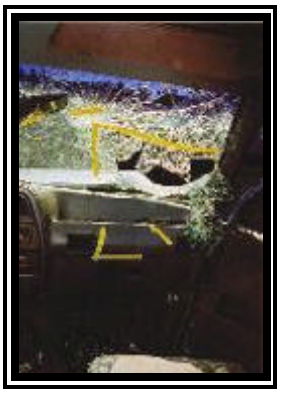

Figure 9. Contact evidence to the front right passenger space.

MANUAL RESTRAINT SYSTEMS

The interior of the Plymouth Voyager consisted of a seven passenger seating configuration with front box-mounted (van type) and rear bench seats (with folding backs). Although heavily stained by mold and weathering, a multitude of pre-existing loading evidence was documented on the webbing of the passenger restraints with minimal routine usage indicators present on the latchplates. The driver 3-point

manual lap and shoulder belt system consisted of a continuous loop belt webbing with a sliding latchplate and dual mode retractors (inertial lock/belt sensitive). Minor abrading was identified on the D-ring of the front left restraint along with dimpling of the shoulder belt webbing. The front right 3-point manual lap and shoulder belt system consisted of a continuous loop belt webbing with a semi-locking latchplate. Although slight dimpling was noted to the lap portion of the front right restraint, there was no loading evidence present on the webbing or D-ring to substantiate usage by the child passenger. The rear outboard seated positions were equipped with 3-point manual lap and shoulder belt systems which consisted of continuous loop belt webbings with semi-locking latchplates. The center rear seating position was equipped with a 2-point manual lap belt with a locking latchplate. The passenger restraint systems also included angled latchplates which allow for placement of a child safety seat.

SUPPLEMENTAL RESTRAINT SYSTEMS

Figure 10. 1995 Plymouth Voyager deployed frontal air bags.

The 1995 Plymouth Voyager was equipped with frontal air bags for the driver and front right passenger positions. The air bags had deployed as a result of the crash **(Figure 10)**. The driver air bag was identified by the part number: PUT11446-02E with a serial number of: TAC319H24236 and housed in the center of the steering wheel with a horizontally oriented flap tear seam (H-configuration). The flaps were nearly symmetrical in shape as the upper flap measured 17.3 cm (6.8 in) in width and 6.2 cm (2.4 in) in height while the lower flap measured 17.3 cm (6.8 in) in width and 6.9 cm (2.7 in) in height. A small scuff mark was documented along the right lower portion (exterior surface) of the upper module cover flap. The diameter of the driver air bag measured 60.2 cm (23.7 in) in its deflated state **(Figure 11)**. Makeup transfers were identified across the upper portion of the air bag face along with multiple black vinyl transfers to the rear lower section of the air bag from expansion within the module. Blood spattering was also noted across the lower portion of the air bag face. The bag was vented by two ports located at the 11 o'clock and 1 o'clock sectors on the rear aspect of the air bag. No internal tether straps were present.

The front right passenger air bag deployed from the right top instrument panel area with a single cover flap design hinged at the forward aspect. The cover flap was rectangular in shape and measured 32.2 cm (12.7 in) in width and 14.5 cm (5.7 in) in height. No contact evidence was identified on the exterior surface of the cover flap or surrounding instrument panel area. The passenger air bag measured 49.0 cm (19.3 in) in width and 77.5 cm (30.5 in) in height in its deflated state **(Figure 12)**. The bag was tethered by two internal straps. No vent ports were present. Although heavily stained by dirt and mold from exposure to the environment post-crash, scuff marks and skin oil were documented along the upper left quadrant of the air bag face along with light colored horizontal fabric transfers to the left mid-portion. Heavy concentrations of blood were noted to the right lower portion of the air bag (front/back) indicative of the child's final rest position post-crash. The top portion of the air bag was abraded from engagement against the windshield.

Figure 11. 1995 Plymouth Voyager deployed driver air bag.

Figure 12. 1995 Plymouth Voyager deployed passenger air bag.

DRIVER DEMOGRAPHICS

Age/Sex:	32 year old female
Height:	163 cm (64 in)
Weight:	59 kg (130 lb)
Seat Track Position:	Middle position
Manual Restraint Use:	3-point lap and shoulder belt system
Usage Source:	Vehicle inspection, driver interview
Eyeware:	Sunglasses
Type of Medical Treatment:	Transported by ambulance to a local hospital and released

Driver Injuries

Injury	*Severity (AIS 90)*	*Injury Mechanism*
*Abrasion under right eye	Minor (290202.1,1)	Sunglasses (indirect air bag contact injury)
*Abrasion under left eye	Minor (290202.1,2)	Sunglasses (indirect air bag contact injury)
*Right eye trauma (NFS) (blood vessel ruptured)	Minor (240499.1,1)	Sunglasses (indirect air bag contact injury)
*Abrasion left neck	Minor (390202.1,2)	Shoulder belt webbing
*Contusion to heart (NFS)	Minor (441002.1,4)	Shoulder belt webbing
*Contusion right anterior forearm (wrist to bicep)	Minor (790402.1,1)	Expanding driver air bag
*Contusion posterior right hand (between thumb and index finger)	Minor (790402.1,1)	Driver air bag module upper cover flap
*Contusion left ankle	Minor (890402.1,2)	Brake pedal

*Source: *-driver*

Driver Kinematics

The 32 year old female driver of the 1995 Plymouth Voyager was restrained by the available 3-point manual lap and shoulder belt system, seated in an upright posture with her right hand placed at the 2 o'clock position on the steering wheel rim. Restraint usage was confirmed by the abrasions to the D-ring, loading marks to the shoulder belt webbing and reported injury pattern to the left neck area.

At impact, the driver initiated a forward and slightly lateral trajectory in response to the 1 o'clock impact force as the expanding air bag contacted the anterior aspect of her right forearm resulting in a contusion, evidenced by the size and location of the injury pattern relative to the driver's stated pre-crash hand placement on the steering wheel rim. The right portion of the upper flap struck her right hand between the thumb and index finger which also produced a contusion as evidenced by the scuff mark documented to this component. Contact to the deployed driver air bag resulted in bilateral contusions below the eyes and an unspecified right subconjunctiva injury, evidenced by the makeup transfers documented across the face of the air bag. Although use of sunglasses could not be confirmed during the SCI interview, their involvement in this injury mechanism was evidenced by the deformed sunglasses and lack of *(supporting)* soft tissue trauma to the *cheeks*. Loading of the manual restraint resulted in an abrasion to the left neck and an unspecified heart contusion. She also sustained a contusion to the left ankle from contact to the brake pedal as evidenced by the driver's stated placement of the right foot on the brake pedal during pre-crash avoidance maneuvers. Following the impact, the driver unbuckled her seat belt and attended to the injured front right child passenger. The driver subsequently exited the vehicle through the right rear door and continued assistance through the right front window opening. The driver was transported by ambulance to a local hospital for treatment and released.

FRONT RIGHT PASSENGER DEMOGRAPHICS

Age/Sex:	6 year old female
Height:	127 cm (50 in)
Weight:	41 kg (90 lb)
Seat Track Position:	Full rearward position
Manual Restraint Use:	None
Usage Source:	Vehicle inspection, police report
Eyeware:	None
Type of Medical Treatment:	Transported to a local hospital (pronounced deceased shortly after arrival)

Front Right Passenger Injuries

Injury	*Severity (AIS 90)*	*Injury Mechanism*
+Basilar skull fracture (NFS) (bleeding from left ear, nose and mouth with brain matter coming from nose)	Serious (150204.3,8)	Expanding front right air bag
^Severe head trauma (NFS)	Unknown (115999.7,0)	Expanding front right air bag
#Contusion forehead	Minor (290402.1,5)	Right sunvisor/roof
^Contusion left cheek	Minor (290402.1,2)	Expanding front right air bag
^Contusion right cheek	Minor (290402.1,1)	Expanding front right air bag
^Contusion behind left ear	Minor (190402.1,2)	Windshield header
*Upper tooth fracture (NFS)	Minor (251404.1,8)	Expanding front right air bag
^Contusion anterior neck	Minor (390402.1,5)	Expanding front right air bag
^Abrasion anterior neck	Minor (390202.1,5)	Expanding front right air bag
^Contusion chin	Minor (290402.1,8)	Expanding front right air bag
^Abrasion chin	Minor (290202.1,8)	Expanding front right air bag
^Upper chest contusion	Minor (490402.1,0)	Expanding front right air bag
#Bilateral contusions to arms (NFS)	Minor (790402.1,3)	Expanding front right air bag
#Bilateral abrasions to arms (NFS)	Minor (790202.1,3)	Expanding front right air bag
#Bilateral contusions anterior legs	Minor (890402.1,3)	Expanding front right air bag
#Bilateral abrasions anterior legs	Minor (890202.1,3)	Expanding front right air bag

*Sources: *-family, +-medical examiner report (non-invasive), #-EMS report, ^-emergency room report*

Front Right Passenger Kinematics

The 6 year old female front right passenger of the 1995 Plymouth Voyager was unrestrained (3-point manual lap and shoulder belt system available) and seated out-of-position, in a forward lean with her head turned to the left towards outside activities. The seat track was adjusted to the full rearward position. Contrary to driver statements made during the SCI interview, lack of restraint usage was determined by the trajectory of the child and contact points within the vehicle. In addition, the lack of blood stains *(and loading evidence)* to the webbing consistent with blood spattering to the right side interior surface indicated the restraint was in the stowed position.

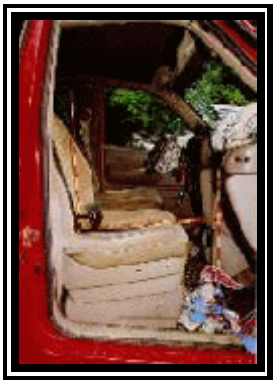

Figure 13. Interior view of the front right passenger space.

The child passenger was further displaced in a forward direction by the pre-crash braking actions of the driver. At impact, the child was in the path of the

expanding air bag which struck her anterior neck and torso area resulting in multiple abrasions and contusions. Two possible mechanisms existed as a source of the basilar skull fracture and unspecified severe head trauma; the expanding air bag (with associated hyper-extension of the neck) or windshield header. Although certain contact was made to the windshield header by the child, this component was ruled out as the source of the fatal injury due to the lack of laceration and underlying skull fracture to the left tempo/parietal region expected as a result of striking such a hard and serrated object with sufficient force to produce a basilar skull fracture. Given the lack of invasive autopsy data, the most probable source was the frontal force of the expanding air bag against the face; confirmed by the extensive brain matter exuding from the nose. Furthermore, this type of injury pattern also results in underlying critical trauma to the brain and cervical spine.

The air bag membrane continued to expand which vertically displaced the unrestrained child into the sunvisor and windshield header **(Figure 13)** with subsequent partial ejection of the head through the right upper windshield area. Contact to the windshield header resulted in a contusion behind the left ear which was evidenced by the location of the injury relative to the scuffs and hair strands documented on this component. Partial ejection of the head was evidenced by the hair strands identified on the exterior surface of the windshield header and symmetrical fracture pattern of the surrounding windshield area, attributed to a weak bonding application. In addition, the interaction with the expanding air bag re-directed the proper deployment path of the membrane and produced the noted abrasions to the top section of the passenger air bag.

During (clockwise) vehicle rotation to final rest, the child passenger continued the kinematic contact pattern to the left across the windshield header area as evidenced by the elongated transfer of hair strands and displaced/fractured rear view mirror. It should be noted that witnesses to the crash reportedly saw the child "float in mid-air" and partially ejected through the (disintegrated) right front window opening as the vehicle spun out to final rest. The child passenger came to rest (against the passenger air bag) between the front right seat cushion and instrument panel, with her head slumped against the right door panel. This position was evidenced by the blood trails/pooling noted to the lower portion of the passenger air bag and window frame *(both interior and exterior)*. After finding no pulse, the driver subsequently moved the child back into the front right seat and repositioned the head against the head rest in attempts to open an airway. This position was evidenced by the blood trails/pooling noted to the front right seat back and B-pillar. Rescue personnel arrived within ten minutes of the crash to find the child in traumatic arrest with no signs of life. Major bleeding was noted to have been coming from the mouth, nose and ears with brain matter coming from the nose. She was removed from the vehicle through the right rear door and subsequently transported by ambulance to a local hospital where she arrived unresponsive with no spontaneous respirations and no pulse. Although the medical examiner later ruled that death was immediate, the child occupant was pronounced deceased approximately one hour following the crash.

REAR SEATED OCCUPANT DEMOGRAPHICS / INJURIES

The 6 year old female second row left passenger of the 1995 Plymouth Voyager was unrestrained (3-point manual lap and shoulder belt system available) and seated in an upright posture with her head turned to the left towards outside activities. Contrary to driver statements, lack of restraint usage was

determined by the trajectory of the child relative to the extensive loading evidence to the second row seat back and lack of significant associated injury to be expected from being "sandwiched" while secured in the restraint harness **(Figure 14)**. At impact, the child initiated a forward and slightly lateral trajectory in response to the 1 o'clock impact force and loaded the driver seat back which resulted in contusions to the posterior forearms and lateral aspect of the left lower leg. This trajectory was evidenced by the indentations and scuff marks documented to this component. The child occupant exited the vehicle under her own power through the right rear door and was subsequently transported two hours later by private vehicle to a local hospital for treatment and released.

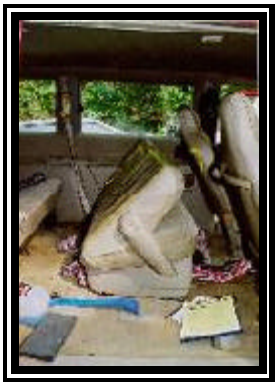

Figure 14. Contact evidence to the middle and front seat backs.

The 14 year old male second row right passenger was unrestrained (3-point manual lap and shoulder belt system available) and seated out-of-position with the head and torso turned to the left towards outside activities. Contrary to driver statements, lack of restraint usage was determined by the trajectory of the child relative to the extensive loading evidence to the second row seat back and lack of significant associated injury to be expected from being "sandwiched" while secured in the restraint harness. At impact, the child initiated a forward and slightly lateral trajectory in response to the 1 o'clock impact force and loaded the front right seat back resulting in a contusion/abrasion to the right knee and posterior wrist. This trajectory was evidenced by the indentations and scuff marks documented to this component. The child occupant exited the vehicle under his own power through the right rear door and was subsequently transported by ambulance to a local hospital for treatment and released.

The third row left seating position was occupied by a 13 year old male who was unrestrained (3-point manual lap and shoulder belt system available) and seated in an upright posture. Lack of restraint usage was determined by the trajectory of the child and extensive loading pattern to the middle seat back. At impact, he initiated a forward and slightly lateral trajectory in response to the 1 o'clock impact force and loaded the middle seat back which resulted in bilateral contusions to the anterior lower legs. The child occupant exited the vehicle under his own power through the right rear door and was subsequently transported two hours later by police vehicle to a local hospital for treatment and released.

The third row right seating position was occupied by a 15 year old female who was unrestrained (3-point manual lap and shoulder belt system available) and seated in an upright posture. Lack of restraint usage was determined by the trajectory of the child and extensive/uniform loading pattern to the middle seat back. At impact, she initiated a forward and slightly lateral trajectory in response to the 1 o'clock impact force and loaded the middle seat back which resulted in bilateral contusions to the anterior lower legs. She also sustained a contusion to the left buttock which was probably a result of occupant rebound into the seat cushion. The child occupant exited the vehicle under her own power through the right rear door and was subsequently transported two hours later by private vehicle to a local hospital for treatment and released.

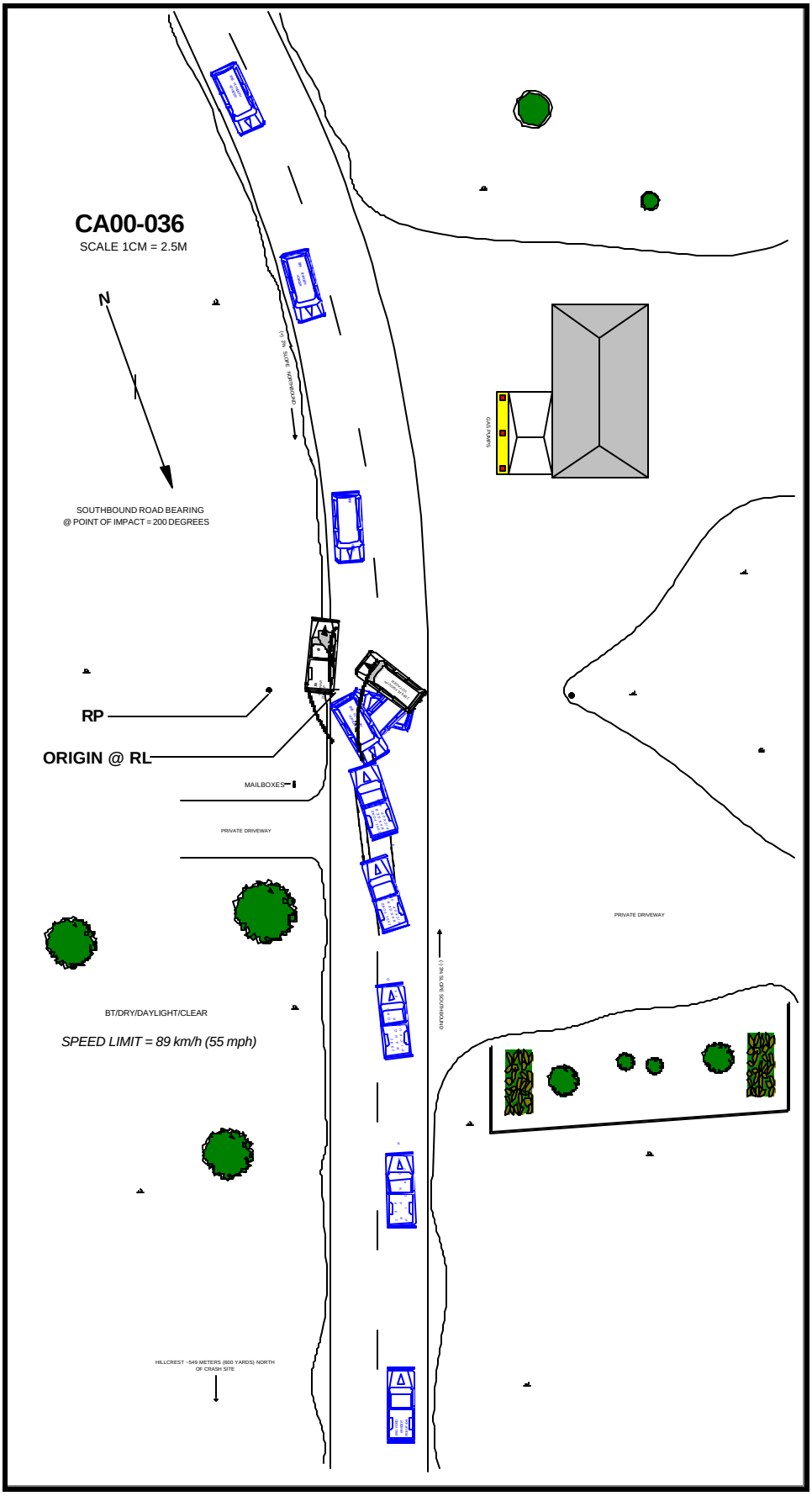

Figure 15. Scene Diagram.