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ON-SITE AIR BAG INVESTIGATION

CASE NUMBER - IN99-087
LOCATION - MISSISSIPPI
VEHICLE - 1996 HYUNDAI ACCENT L
CRASH DATE - August, 1999

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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 be 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. <i>Abstract</i> This report covers an on-site investigation of an air bag deployment crash that involved a 1996 Hyundai Accent L (case vehicle) and a brick mailbox post. This crash is of special interest because the case vehicle's front right, infant passenger (4-month-old female), who was improperly restrained in a rear facing child safety seat, sustained critical brain injuries from her deploying front right passenger air bag module's cover flap, resulting in her death. The case vehicle was traveling east in the eastbound lane of a two-lane, undivided, city street. The case vehicle's driver most likely became distracted while bottle feeding her infant daughter and inadvertently steered onto the south roadside. The front right of the case vehicle impacted the brick mailbox post, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle's front right infant passenger was seated in a rear facing child safety seat (RFCSS) with her seat track located 2 centimeters (0.8 inches) rearward of the forward-most position. She was incorrectly restrained in her RFCSS. Furthermore, the child seat was improperly secured by the available, active, three-point, lap-and-shoulder, safety belt system. She sustained, according to her medical records: a critical nonanatomic brain injury accompanied by intracerebral petechial hemorrhages, fractures to her left and right temporal and parietal bones, and contusions over her left and right scalp at the fracture sites. This occupant's head injuries were caused by contact with the back surface of her RFCSS which was directly contacted by the front right air bag module's cover. The case vehicle's driver (19-year-old female) was seated with her seat track located 2 centimeters (0.8 inches) rearward of the forward-most position, and the vehicle was not equipped with a tilt steering wheel. The driver was not using her available, active, three-point, lap-and-shoulder, safety belt system. According to her interview and her medical records, the injuries sustained by the case vehicle's driver included: contusions to her left knee and right arm, a cervical strain, and an abrasion to her right arm.					
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This on-site investigation was brought to NHTSA's attention on September 14, 1999 by an investigator with the Mississippi State Highway Patrol. This crash involved a 1996 Hyundai Accent L (case vehicle) and a brick mailbox post. The crash occurred in August, 1999, at 4:51 p.m., in Mississippi and was investigated by the applicable city police department. This crash is of special interest because the case vehicle's front right, infant passenger [4-month-old, Black (non-Hispanic) female], who was improperly restrained in a rear facing child safety seat, sustained critical brain injuries from her deploying front right passenger air bag module's cover flap, resulting in her death. This contractor inspected the scene and case vehicle on September 16, 1999. This contractor interviewed the driver of the case vehicle on September 16, 1999. This report is based on the Police Crash Report, interviews with the investigating police officer and the case vehicle's driver, scene and vehicle inspections, occupant kinematic principles, occupant medical records, and this contractor's evaluation of the available evidence.

SUMMARY

The case vehicle was traveling east in the eastbound lane of a two-lane, undivided, city street and intended to continue traveling eastbound. According to the case vehicle's driver, a noncontact truck was westbound, driving in her eastbound lane of travel, and she swerved to the right to avoid it. The case vehicle's driver subsequently drove into a brick mailbox post, located along of the south edge of the road. The case vehicle's driver made no avoidance maneuvers just prior to striking the mailbox post. The crash occurred on the south roadside (see **CRASH DIAGRAM** below). The case vehicle's driver was unable to give any description of the oncoming noncontact truck. Based on police follow-up interviews with surrounding neighbors and other motorist, this account was dismissed. This contractor believes that the driver became distracted while interacting (i.e., bottle feeding) with her infant daughter and inadvertently steered off the south edge of the roadway into the brick mailbox post.

The front right of the case vehicle impacted the brick mailbox post, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. After the initial impact, the case vehicle continued primarily eastward, sideswiping a portion of the crumbling mailbox post with its right quarter panel before swerving back across the street where its left wheels went off the north edge of the roadway. The case vehicle re-entered the roadway and came to rest in the westbound lane, heading east, 67.1 meters (220 feet) further east of the point of impact. The driver stated she was only traveling 32 km.p.h. (20 m.p.h.) when she swerved to the right to avoid the unknown truck. Based on the extent of damage and distance it traveled post crash, it is this contractor's opinion that the case vehicle was traveling in excess of 56 km.p.h. (35 m.p.h.).

The case vehicle was a front wheel drive 1996 Hyundai Accent L, four-door sedan (VIN: KMHVF14N0TU-----). Four-wheel, anti-lock brakes are an option for this model, but the case vehicle was not so equipped. Based on the vehicle inspection, the CDCs for the case vehicle were determined to be: **12-FREW-2 (0)** and **12-RBMS-1 (0)**. The WinSMASH reconstruction program, barrier algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 21.2 m.p.h. (13.2 m.p.h.), -21.2 km.p.h.

(-13.2 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). Although these results should be considered borderline because the NASS, CDS, WinSMASH protocol requires that the struck object be immovable, this contractor's believes the estimate is reasonable. The case vehicle was towed due to damage.

The case vehicle's initial contact with the brick mailbox post involved the front right corner. Direct damage began at the right bumper corner and extended, a measured distance of 41 centimeters (16.1 inches), inwards along the front bumper. Maximum crush was measured as 29 centimeters (11.4 inches) at C₆. The case vehicle's front right bumper corner and right fender were crushed rearward restricting the right front wheel and shortening the wheelbase on the right side 2 centimeters (0.8 inches). The wheelbase on the case vehicle's left side was unchanged. In addition, there was sideswipe damage to the right quarter panel near the swell of the case vehicle's right rear wheel well and rim, including the rear edge of the right rear door just below the "C"-pillar. The direct damage width was 32 centimeters (12.6 inches). The case vehicle's front bumper, bumper fascia, grille, hood, right headlight and turn signal assemblies, and right fender were directly damaged and crushed rearward. The case vehicle's right front tire was physically restricted. The right rear door, right quarter panel, and right rear wheel's rim were directly damaged during the sideswipe that resulted from the continuation of the case vehicle through the brick mailbox post. The left headlight and turn signal assemblies as well and both the right and left fenders sustained induced damage from the vehicle's frontal impact with the brick mailbox. The right windshield's glazing sustained stress cracks, and the glazing in the right front door was disintegrated from the frontal impact.

The case vehicle's driver air bag was located in the steering wheel hub. An inspection of the air bag module's cover flaps and air bag revealed that the cover flaps opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flaps. The driver's air bag was designed with two tethers. The driver's air bag had two vent ports, approximately 2 centimeters (0.8 inches) in diameter, located at the 10:30 and 1:30 o'clock positions. The deployed driver's air bag was essentially round with a diameter of 62 centimeters (24.4 inches). There was no visible contact evidence readily apparent on the driver's air bag.

The front right passenger's air bag was located in the top of the instrument panel. An inspection of the front right air bag module's cover flap and air bag revealed that the cover flap opened at the designated tear points and the front right air bag module's cover flap had a 12 centimeter (4.7 inch) wide horizontal scuff as a direct result of contacting the top, back edge of the front right passenger's rear facing child safety seat. Furthermore, the back surface of the front right air bag had a dark black flap transfer. The front right passenger's air bag was designed with two tethers, each 42 centimeters (16.5 inches) in width. The front right air bag had two vent ports, approximately 5 centimeters (2.0 inches) in diameter, located at the 9:30 and 2:30 o'clock positions. The deployed front right air bag was rectangular with a height of approximately 57 centimeters (22.4 inches) and a width of approximately 47 centimeters (18.5 inches). There was no visible contact evidence readily apparent on the front right air bag.

Inspection of the case vehicle's interior revealed that there was no other evidence of occupant contact on the interior surfaces of the case vehicle.

The **rear facing child safety seat** (RFCSS) was manufactured by Century on February 2, 1999 and was identified by "Prosport 4/1" Model number 11650CN0. The involved child safety seat was improperly used at the time of the crash (i.e., the infant was not properly restrained by the seat's available harness and the RFCSS was not properly secured by the available three-point, lap-and-shoulder, safety belt system). The RFCSS was designed to be used only as a rearward facing infant restraint. The RFCSS consisted of a plastic one-piece shell with a pivoting carrying handle attached to the sides at the mid-point of the shell. The child safety seat was manufactured with a three-point harness, which was attached to the shell, but was improperly attached at the time of the crash. The shell had a foam pad on the back support portion, providing a soft surface for the infant. Also attached to the outboard shell of the RFCSS was an inclinometer which assured the installer that the RFCSS was at the correct 45 degree angle.

An orange warning label was affixed to the outboard side of the carry handle of the RFCSS (i.e., outboard side when in the rearward facing position) which warned against placing the rearward facing restraint in the front seat of a vehicle that was equipped with a front right passenger air bag. The orange label with black writing further advises that serious injury or death could occur if an air bag inflates against a rear facing child restraint. This warning label was not dated. There was another manufacturer's label affixed to the outboard side of the shell that stated that if instructions are missing to call a toll free number to obtain another set of instructions (i.e., the manufacturer's instructions were missing at the time of this contractor's inspection). This label was also not dated. An additional manufacturer's warning label was attached to the underside of the shell, in the inside of the outboard shell support, giving the height and weight limitations [i.e., 2.3-9.1 kilograms and 48-69 centimeters (5-20 pounds and 19-27 inches)] as well as a sketch of the seat's proper placement when located in the front seat, using a locking clip, and in the back center seat. This label was also not dated.

A second warning label was affixed to the cloth pad used to cover the shell of the RFCSS on the inboard side near where the infant's head would be (i.e., when in the rearward facing position), which warned the user to follow the usage instructions or your child could strike the vehicle's interior during a sudden stop or crash. The warning continues to explain the importance of securing the child restraint with a vehicle safety belt, as specified in the manufacturer's instructions, and snugly adjusting the belts provided with the RFCSS around the infant.

Immediately prior to the crash the case vehicle's front right infant passenger [daughter, 60 centimeters and 8 kilograms (23.5 inches, 17 pounds)] was seated in a reclined posture in the rear facing child safety seat (RFCSS) with her back against the child seat's back, her feet extending outward, and presumably both hands holding onto a milk bottle (i.e., a milk bottle was found on the floor next to the seat). Her seat track was located 2 centimeters (0.8 inches) rearward of the forward-most position, and the RFCSS's seat back was near the designated 45 degree angle.

The case vehicle's front right passenger was incorrectly restrained in her **rear facing child safety seat** (RFCSS). First, the child seat was improperly secured to the vehicle by the available, active, three-point, lap-and-shoulder, safety belt system. On-scene photographs taken by the police showed only the lap portion was attached of the three-point belt system. The inspection of the front right passenger's seat belt webbing, "D"-ring, and latch plate showed no evidence of

loading. Second, the RFCSS was improperly located in the front right seat position by having its forward edge placed against the front right passenger air bag module. Third, this contractor found a few additional child safety restraint flaws.

The case vehicle is equipped with a switchable retractor system. There was a patch sewn near the floor end of the front right belt webbing, instructing the user to totally extend the webbing until the retractor switches into the locking mode when used with a child. The case vehicle's driver had no knowledge about having to switch the retractor into the Automatic Locking Retractor (ALR) mode. Based on this contractor's inspection and the interview with the case vehicle's driver, the case vehicle's front right seat belt retractor was not switched to the locking mode at the time of the crash. Additionally, the metal rod used to retain the harness on the back of the RFCSS's was not secured properly allowing the harness webbing to pull out through the slot. The carry handle attached to the RFCSS was found post-crash in the upwards position contrary to instruction labels attached to the outboard side of handle.

In this contractor's opinion, the case vehicle's driver inadvertently steered/drifted to the right while distracted by her infant daughter. The case vehicle's driver never saw the impending impact with the brick mailbox post and, as result, took no evasive action in response thereto. As a result of this slight right steering maneuver and the improper use of the child's available safety belts and the rear facing child safety seat's harness (RFCSS), the RFCSS and infant most likely moved slightly to the left, if at all, just prior to impact. The case vehicle's impact with the brick mailbox post, enabled the improperly secured front right infant passenger to continue forward (i.e., the back of the infant moved forward) and leftward within the RFCSS. The back of RFCSS also tilted downward and to the left against the case vehicle's front right air bag module's cover flap. The deploying cover flap and air bag thrust the RFCSS and infant rearward towards the front right seat back. The attached upright carry handle (mentioned earlier), which was improperly in the upright position, contacted the front right passenger seat back cracking the handle. The front right infant passenger would also have been thrust rearward, possibly contacting the seat back or the inside of the folding umbrella, prior to falling back down into the RFCSS. Because there were no visible facial injuries to the front right infant passenger, the idea that she contacted the carry handle and broke it was discounted. The case vehicle's driver claims that pre-crash the RFCSS's carry handle was in the reclined position against the instrument panel/cover flap. At final rest the driver indicated that she was able to pick up her infant daughter directly out of the RFCSS without taking off her three-point harness. According to the investigating police officer, the bar used to hold the harness webbing was found off of the back of the RFCSS, on the front right seat cushion; however, the plastic shell that held the metal bar was neither broken nor cracked. The case vehicle's driver stated that the RFCSS's harness was properly installed.

The front right occupant was transported by a passing neighbor to the hospital. She sustained critical brain injuries and was pronounced dead three hours and twenty minutes post-crash. According to her medical records, the case vehicle's front right passenger sustained: a critical nonanatomic brain injury accompanied by intracerebral petechial hemorrhages, fractures to her left and right temporal and parietal bones, and contusions over her left and right scalp at the fracture sites. This occupant's head injuries were caused by contact with the back surface of

her RFCSS which was directly contacted by the front right air bag module's cover flap and subsequently by the deploying front right passenger air bag.

The case vehicle's driver [19-year-old, Black (non-Hispanic) female; 155 centimeters and 66 kilograms (61 inches, 145 pounds)] was seated in a slightly reclined posture with her back against the seat back, her left foot on the floor, her right foot on the accelerator, her left hand on the steering wheel, and her right hand tending to her daughter (i.e., front right infant passenger). Her seat track was located 2 centimeters (0.8 inches) rearward of the forward-most position, and the seat back was slightly reclined. The vehicle was not equipped with a tilt steering wheel.

The case vehicle's driver was not using her available, active, three-point, lap-and-shoulder, safety belt system. The driver initially went to the hospital to be with her daughter, but she was treated and released the next day for minor injuries at a different hospital. According to her interview and her medical records, the injuries sustained by the case vehicle's driver included: contusions to her left knee and right arm, a cervical strain, and an abrasion to her right arm.

CRASH CIRCUMSTANCES

The case vehicle was traveling east in the eastbound lane of a two-lane, undivided, city street and intended to continue traveling eastbound (**Figure 1**). According to the case vehicle's driver, a noncontact truck was westbound, driving in her eastbound lane of travel, and she swerved to the right to avoid it. The case vehicle's driver subsequently drove into a brick mailbox post, located along of the south edge of the road (**Figure 2**). The case vehicle's driver made no avoidance maneuvers just prior to striking the mailbox post. The crash occurred on the south roadside (see **CRASH DIAGRAM** below). The case vehicle's driver was unable to give any description of the oncoming noncontact truck. Based on police follow-up interviews with surrounding neighbors and other motorist, this account was dismissed. This contractor believes that the driver became distracted while interacting (i.e., bottle feeding) with her infant daughter and inadvertently steered off the south edge of the roadway into the brick mailbox post.

The city roadway was straight and level (i.e., actual slope was 1.6%, positive to the east) at the area of impact. The pavement was bituminous, but traveled, and the width of the



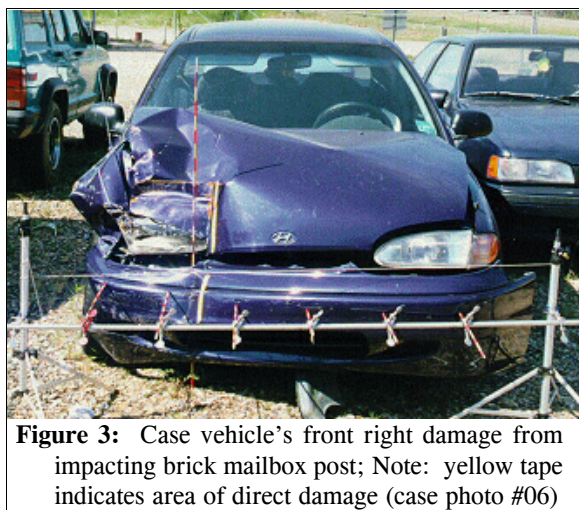
Figure 1: Case vehicle's eastward travel path on residential street; Note: arrow indicates location of replacement mailbox (case photo #01)



Figure 2: On-scene view looking east-northeast from in front of point of impact (POI) with brick mailbox post; Note: case vehicle's final rest position (arrow), fluid trail, and front right tire mark leading from POI (case photo #49)

roadway was 10.6 meters (34.8 feet). The shoulders were not improved (i.e., grass). There were no pavement markings present, the lanes were not divided by a dashed white line, and no edge lines were present. The estimated coefficient of friction was 0.75%. There were no visible traffic controls. The speed limit was 32 km.p.h. (20 m.p.h.) but no regulatory speed limit sign was posted near the crash site. At the time of the crash the light condition was daylight, the atmospheric condition was clear, and the road pavement was dry. Traffic density was light, and the site of the crash was urban residential (i.e., a residential subdivision). In addition, the mailbox post was next to a driveway, and there were driveways all up and down the street near the vicinity of the crash site. The struck brick mailbox post was approximately 56 centimeters (22.0 inches) wide and 122 centimeters (48.0 inches) high. The post was replaced by a conventional wooden mailbox post with plastic box (**Figure 1** above).

The front right (**Figures 3 and 4**) of the case vehicle impacted the brick mailbox post, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle directly impacted only three-fourths of the brick post's width. The case vehicle was going fast enough that after the initial impact, the case vehicle continued primarily eastward, sideswiping a portion of the crumbling mailbox post with its right quarter panel before swerving back across the street where its left wheels went off the north edge of the roadway. The case vehicle re-entered the roadway and came to rest in the westbound lane, heading east (**Figure 1** above), 67.1 meters (220 feet) further east of the point of impact. The driver stated she was only traveling 32 km.p.h. (20 m.p.h.) when she swerved to the right to avoid the unknown truck. Based on the extent of damage and distance it traveled post crash, it is this contractor's opinion that the case vehicle was traveling in excess of 56 km.p.h. (35 m.p.h.).



CASE VEHICLE

The 1996 Hyundai Accent L was a front wheel drive, five-passenger, four-door sedan (VIN: KMHVF14N0TU-----) equipped with a 1.5L, L-4 engine and a four-speed automatic transmission. Braking was achieved by a power-assisted, front disc and rear drum system. Four-wheel, anti-lock brakes are an option for this model, but the case vehicle was not so equipped.

The case vehicle's wheelbase was 240 centimeters (94.5 inches), and the odometer reading at inspection was 81,476 kilometers (50,627 miles). According to the driver, the case vehicle was bought used and she had driven approximately 16,093 kilometers (10,000 miles).

Inspection of the vehicle's interior revealed adjustable front bucket seats with adjustable head restraints; a non-adjustable back bench seat with separate back cushions and integral head restraints for the back outboard seating positions; continuous loop, three-point, lap-and-shoulder, safety belt systems at the front and back outboard positions; and a two-point, lap belt system at the back center position. The front seat belt systems were equipped with manually operated height adjusters for the "D"-rings and both adjusters were located in their upmost positions. The vehicle was equipped with knee bolsters for both the driver and front right passenger, neither of which were deformed. Automatic restraint was provided by a Supplemental Restraint System (SRS) that consisted of a frontal air bag for the driver and front right passenger seating positions. Both frontal air bags deployed as a result of the case vehicle's frontal impact with the brick mailbox post.

CASE VEHICLE DAMAGE

The case vehicle's initial contact with the brick mailbox post involved the front right corner (Figure 3 above). Direct damage began at the right bumper corner and extended, a measured distance of 41 centimeters (16.1 inches), inwards along the front bumper (Figure 4 above). The induced damage (i.e., field L) extended across the case vehicle's entire front bumper a distance of 119 centimeters (46.9 inches); the undeformed end width was determined to be 134 centimeters (52.8 inches). Maximum crush was measured as 29 centimeters (11.4 inches) at C₆. The case vehicle's front right bumper corner and right fender were crushed rearward restricting the right front wheel (Figure 5) and shortening the wheelbase on the right side 2 centimeters (0.8 inches). The wheelbase on the case vehicle's left side was unchanged. In addition, the continuation of the case vehicle through the brick mailbox post resulted in a portion of the brick structure swiping down the right side of the case vehicle directly contacting the right outside rearview mirror and right quarter panel near the flare of the right rear wheel well. Furthermore, there was direct contact to the right rear wheel's rim and the rear edge of the right rear door just below the "C"-pillar (Figure 6). The direct damage width was 31 centimeters (12.2 inches). The case vehicle's front bumper, bumper fascia, grille, hood, right headlight and turn signal assemblies, and right



Figure 5: Case vehicle's front right impact showing restricted right front tire and induced damage to right fender and windshield (case photo #17)



Figure 6: Damage to case vehicle's right quarter panel from sideswiping mailbox (case photo #14)

fender were directly damaged and crushed rearward. The case vehicle's right front tire was physically restricted but not deflated. The left headlight and turn signal assemblies as well as both the right and left fenders sustained induced damage from the vehicle's frontal impact with the brick mailbox. The right windshield's glazing sustained several stress cracks to the lower right corner near the "A"-pillar, and the glazing in the right front door was disintegrated from the frontal impact. Additionally, the roof above the right "B"-pillar was buckled.

Based on the vehicle inspection, the CDCs for the case vehicle were determined to be: **12-FREW-2 (0)** and **12-RBMS-1 (0)**. The WinSMASH reconstruction program, barrier algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 21.2 m.p.h. (13.2 m.p.h.), -21.2 km.p.h. (-13.2 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). Although these results should be considered borderline because the NASS, CDS, WinSMASH protocol requires that the struck object be immovable, this contractor's believes the estimate is reasonable. The case vehicle was towed due to damage.



Figure 7: Vertical view of case vehicle's driver seating area showing no apparent visible contact evidence on deployed air bag or to greenhouse areas (case photo #26)



Figure 8: Case vehicle's front right passenger seating area showing no apparent visible contact evidence on deployed air bag's front surface and greenhouse areas, except for stress fractures to right windshield's glazing (case photo #29)

Inspection of the case vehicle's interior revealed that there was no other discernable evidence of occupant contact on the interior surfaces of the case vehicle (**Figures 7 and 8**). In addition, the

energy absorbing steering column showed no evidence of compression, and there was no evidence of intrusion to the case vehicle's interior. It should be noted, however, that the windshield wiper stalk on the right side of the steering column had been pushed down into the "on" position (i.e., it was not precipitating at time of crash).

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with a Supplemental Restraint System (SRS) that contained frontal air bags at the driver and front right passenger positions. Both air bags deployed as a result of the frontal impact with the brick mailbox post. The case vehicle's driver air bag was located in the steering wheel hub (**Figure 7** above). The module cover consisted of asymmetrical "H"-configuration cover flaps made of thick vinyl with overall dimensions of 15 centimeters (5.9 inches) at the horizontal seam and 7.5 centimeters (3.0 inches) vertically for the upper flap and 6 centimeters (2.4 inches) vertically for the lower flap. An inspection of the air bag module's cover flaps and air bag revealed that the cover flaps opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flaps. The driver's air bag was designed with two tethers, each 12 centimeters (4.7 inches) wide and sewn internally to the center portion of the air bag. The driver's air bag had two vent ports, approximately 2 centimeters (0.8 inches) in diameter, located at the 10:30 and 1:30 o'clock positions. The deployed driver's air bag was essentially round with a diameter of 62 centimeters (24.4 inches). There was no visible contact evidence readily apparent on the driver's air bag (**Figure 9**).



Figure 9: Case vehicle's tethered and vented driver air bag; Note: no apparent physical evidence of contact was found (case photo #25)

The front right passenger's air bag was located in the top of the instrument panel. There was a single, curvilinear, essentially rectangular, modular cover flap. The cover flap was made of a thick vinyl over a thick cardboard type frame. The flap's dimensions were 35 centimeters (13.8 inches) at the forward horizontal seam, and 20 centimeters (7.9 inches) along both vertically-oriented seams. The flap was curved approximately 90 degrees and the apex of the curve was located approximately 15 centimeters (5.9 inches) from the rear horizontal seam (i.e., toward the windshield) while only 5 centimeters (2.0 inches) from the forward horizontal seam. The profile of the case vehicle's instrument panel resulted in a 3 centimeter (1.2 inch) setback of the leading edge of the cover flap relative to the protruding right instrument panel. An inspection

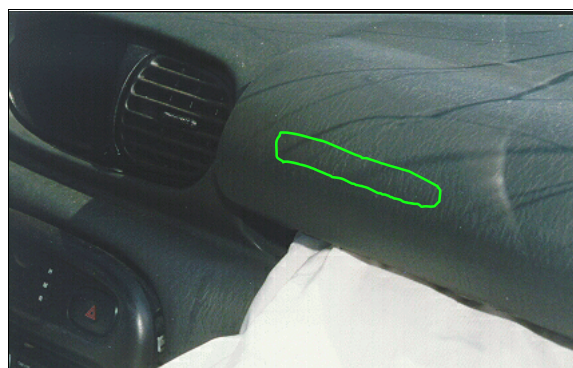


Figure 10: Case vehicle's front right air bag module's cover flap showing slight impression/scuff (highlighted) from contact with top, back edge of Rear Facing Child Safety Seat (case photo #33)

of the front right air bag module's cover flap and air bag revealed that the cover flap opened at the designated tear points and the front right air bag module's cover flap had a 12 centimeter (4.7 inch) wide horizontal scuff as a direct result of contacting the top, back edge of the front right passenger's rear facing child safety seat (**Figure 10** above). Furthermore, the back surface of the front right air bag had a dark black flap transfer. The front right passenger's air bag was designed with two tethers, each 42 centimeters (16.5 inches) in width. The top tether was sewn to the interior face of the air bag at a point that was 13 centimeters (5.1 inches) below the top edge while the second tether was sewn 26 centimeters (10.2 inches) below the top tether. The front right air bag had two vent ports, approximately 5 centimeters (2.0 inches) in diameter, located at the 9:30 and 2:30 o'clock positions. The deployed front right air bag was rectangular with a height of approximately 57 centimeters (22.4 inches) and a width of approximately 47 centimeters (18.5 inches). Because of the contact with the back of the child safety seat, there was no visible contact evidence readily apparent on the front surface of the front right air bag (**Figure 11**).



Figure 11: Case vehicle's front right air bag; Note: no apparent physical evidence of contact was found (case photo #36)

REAR FACING CHILD SAFETY SEAT (RFCSS)

The rear facing child safety seat (RFCSS) was manufactured by Century on February 2, 1999 and was identified by "Prosport 4/1" Model number 11650CN0 (**Figure 12**). The involved child safety seat was improperly used at the time of the crash (i.e., based upon the on-scene police photographs the infant was not properly restrained by the seat's available harness, and the RFCSS was not properly secured by the available three-point, lap-and-shoulder, safety belt system). The RFCSS was designed to be used only as a rearward facing infant restraint. The RFCSS consisted of a plastic one-piece shell with a pivoting carrying handle attached to the sides at the mid-point of the shell. The child safety seat was manufactured with a three-point harness, which was attached to the shell, but was improperly attached at the time of the crash. In addition, the RFCSS was equipped with two slots



Figure 12: Rear Facing Child Safety Seat (RFCSS) used by case vehicle's front right passenger; Note: broken carry handle (case photo #40)

in which the three-point harness was threaded through, depending on the infant's height. In this case, the harness was threaded through the top slot. The shell had a foam pad on the back support portion, providing a soft surface for the infant. Also attached to the outboard shell of the RFCSS was an inclinometer which assured the installer that the RFCSS was at the correct 45 degree angle.

An orange warning label was affixed to the outboard side of the carry handle of the RFCSS (i.e., outboard side when in the rearward facing position) which warned against placing the rearward facing restraint in the front seat of a vehicle that was equipped with a front right passenger air bag. The orange label with black writing further advises that serious injury or death could occur if an air bag inflates against a rear facing child restraint. This warning label was not dated. There was another manufacturer's label affixed to the outboard side of the shell that stated that if instructions are missing to call a toll free number to obtain another set of instructions (i.e., the manufacturer's instructions were missing at the time of this contractor's inspection). This label was also not dated. An additional manufacturer's warning label was attached to the underside of the shell, in the inside of the outboard shell support, giving the height and weight limitations [i.e., 2.3-9.1 kilograms and 48-69 centimeters (5-20 pounds and 19-27 inches)] as well as a sketch of the seat's proper placement when located in the front seat, using a locking clip, and in the back center seat. This label was also not dated.

A second warning label was affixed to the cloth pad used to cover the shell of the RFCSS on the inboard side near where the infant's head would be (i.e., when in the rearward facing position), which warned the user to follow the usage instructions or your child could strike the vehicle's interior during a sudden stop or crash. The warning continues to explain the importance of securing the child restraint with a vehicle safety belt, as specified in the manufacturer's instructions, and snugly adjusting the belts provided with the RFCSS around the infant.

Examination of the RFCSS revealed several anomalies to the structure as a result of the impact from the deploying front right passenger air bag module's cover flap and air bag. The top back edge of the seat back portion which rested against the front right air bag module's cover flap was cracked in two places approximately 12 centimeters (4.7 inches) apart (**Figure 13**). In addition, the carry handle, towards the outboard side, was cracked from contact with the seat back (**Figure 12** above).



Figure 13: Overhead view of case vehicle's RFCSS showing cracks to top of back support from contact with front right air bag module's cover flap (case photo #43)

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

Immediately prior to the crash the case vehicle's front right infant passenger [daughter; 4-month-old, Black (non-Hispanic) female; 60 centimeters and 8 kilograms (23.5 inches, 17 pounds)] was seated (**Figure 14** below) in a reclined posture in the rear facing child safety seat (RFCSS) with her back against the child seat's back, her feet extending outward, and presumably

both hands holding onto a milk bottle (i.e., a milk bottle was found on the floor next to the seat). Her seat track was located 2 centimeters (0.8 inches) rearward of the forward-most position, and the RFCSS's seat back was near the designated 45 degree angle.

The case vehicle's front right passenger was incorrectly restrained in her **rear facing child safety seat (RFCSS)**. First, the child seat was improperly secured to the vehicle by the available, active, three-point, lap-and-shoulder, safety belt system. On-scene photographs taken by the police showed only the lap portion was attached of the three-point belt system (**Figure 15**). The inspection of the front right passenger's seat belt webbing, "D"-ring, and latch plate showed no evidence of loading. Second, the RFCSS was improperly located in the front right seat position by having its forward edge placed against the front right passenger air bag module (**Figure 14**). Third, this contractor found a few additional child safety restraint flaws.

The case vehicle is equipped with a switchable retractor system. There was a patch sewn near the floor end of the front right belt webbing, instructing the user to totally extend the webbing until the retractor switches into the locking mode when used with a child. The case vehicle's driver had no knowledge about having to switch the retractor into the Automatic Locking Retractor (ALR) mode. Based on this contractor's inspection and the interview with the case vehicle's driver, the case vehicle's front right seat belt retractor was not switched to the locking mode at the time of the crash. Additionally, the metal rod used to retain the harness on the back of the RFCSS's was not secured properly allowing the harness webbing to pull out through the slot. The carry handle attached to the RFCSS was found post-crash in the upwards position contrary to instruction labels attached to the outboard side of handle (**Figure 16**).



Figure 14: On-scene view of position of case vehicle's front right, **rear facing child safety seat (RFCSS)** in vehicle; Note: front right air bag module's cover flap contacted back of seat's shell and seat cover and sun umbrella have been pulled away from shell (case photo #54)



Figure 15: On-scene view of case vehicle's, improperly secured (i.e., by lap belt only), front right rear facing child safety seat (RFCSS); Note: carry handle is in up position (case photo #59)



Figure 16: On-scene view of case vehicle's rear facing child safety seat at final rest; Note: carrying handle is in up position and sun umbrella is extended (case photo #55)

In this contractor's opinion, the case vehicle's driver inadvertently steered/drifted to the right while distracted by her infant daughter. The case vehicle's driver never saw the impending impact with the brick mailbox post and, as result, took no evasive action in response thereto. As a result of this slight right steering maneuver and the improper use of the child's available safety belts and the rear facing child safety seat's harness (RFCSS), the RFCSS and infant most likely moved slightly to the left, if at all, just prior to impact. The case vehicle's impact with the brick mailbox post, enabled the improperly secured front right infant passenger to continue forward (i.e., the back of the infant moved forward) and leftward within the RFCSS. The back of RFCSS also tilted downward and to the left against the case vehicle's front right air bag module's cover flap (**Figure 10** above and **Figure 17**). The deploying cover flap and air bag thrust the RFCSS and infant rearward towards the front right seat back. The attached upright carry handle (mentioned earlier), which was improperly in the upright position, contacted the front right passenger seat back cracking the handle. The front right infant passenger would also have been thrust rearward, possibly contacting the seat back or the inside of the folding umbrella, prior to falling back down into the RFCSS. Because there were no visible facial injuries to the front right infant passenger, the idea that she contacted the carry handle and broke it was discounted. The case vehicle's driver claims that pre-crash the RFCSS's carry handle was in the reclined position against the instrument panel/cover flap. At final rest the driver indicated that she was able to pick up her infant daughter directly out of the RFCSS without taking off her three-point harness. According to the investigating police officer, the bar used to hold the harness webbing was found off of the back of the RFCSS, on the front right seat cushion; however, the plastic shell that held the metal bar was neither broken nor cracked. The case vehicle's driver stated that the RFCSS's harness was properly installed.



Figure 17: On-scene view showing proximity of case vehicle front right air bag module's cover flap and cracked back edge of RFCSS (case photo #58)

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The front right occupant was transported by a passing neighbor to the hospital. She sustained critical brain injuries and was pronounced dead three hours and twenty minutes post-crash. According to her medical records, the case vehicle's front right passenger sustained: a critical nonanatomic brain injury accompanied by intracerebral petechial hemorrhages, fractures to her left and right temporal and parietal bones, and contusions over her left and right scalp at the fracture sites. This occupant's head injuries were caused by contact with the back surface of her RFCSS (**Figure 13** above) which was directly contacted by the front right air bag module's cover flap (**Figure 10** above) and subsequently by the deploying front right passenger air bag.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Nonanatomic brain injury ¹ with unconsciousness, pupils fixed and pinpoint, flaccid extremities, and decerebrate posturing	160824.5 critical	Front right module's cover flap	Certain	Emergency room records
2	Hemorrhage, petechial, intracerebral, along left frontal and parietal lobes	140642.4 severe	Front right module's cover flap	Certain	Emergency room records
3	Fractures left temporal and parietal bones with the largest fracture line extending from the left temporal bone into the posterior parietal bone with mild depression and displacement along the fracture line	150404.3 serious	Front right module's cover flap	Certain	Emergency room records
4	Fracture right temporal and parietal bones	150402.2 moderate	Front right module's cover flap	Certain	Emergency room records
5	Contusion {hematoma}, large, left scalp @ fracture site	190402.1 minor	Front right module's cover flap	Certain	Emergency room records
6	Contusion {hematoma}, smaller, right scalp	190402.1 minor	Front right module's cover flap	Certain	Emergency room records

CASE VEHICLE DRIVER KINEMATICS

The case vehicle's driver [19-year-old, Black (non-Hispanic) female; 155 centimeters and 66 kilograms (61 inches, 145 pounds)] was seated in a slightly reclined posture with her back against the seat back, her left foot on the floor, her right foot on the accelerator, her left hand on the steering wheel, and her right hand tending to her daughter (i.e., front right infant passenger). Her seat track was located 2 centimeters (0.8 inches) rearward of the forward-most position, and the seat back was slightly reclined. The vehicle was not equipped with a tilt steering wheel.

The case vehicle's driver was not using her available, active, three-point, lap-and-shoulder, safety belt system. Furthermore, there was no evidence of belt pattern bruising and/or abrasions to the driver's body, and the inspection of the driver's seat belt webbing, "D"-ring, and latch plate showed no evidence of loading.

¹ One physician speculated (no autopsy or subsequent CAT scans) that this patient "probably" had a uncal herniation (i.e., of the brain stem), causing her rapid death. This patient went into cardiac arrest as she was being readied for transport to a medical facility for care by a neurosurgeon, and the medical facility was unable to resuscitate her. Because there was no autopsy and the last brain CAT scans indicated that there was no mass effect, ventricular compression, or midline displacement, this physician's assessment cannot be confirmed.

In this contractor's opinion, the case vehicle's driver inadvertently steered/drifted to the right while distracted by her infant daughter. The case vehicle's driver never saw the impending impact with the brick mailbox post and, as result, took no evasive action in response thereto (i.e., the driver could not remember). As a result of this slight right steering maneuver and independent of the nonuse of her available safety belts, her pre-impact body position most likely moved slightly to the left, if at all, just prior to impact. The case vehicle's impact with the brick mailbox post, enabled the unrestrained driver to continue forward and possibly leftward towards the 0 degree Direction of Principal Force as the case vehicle decelerated. The case vehicle's driver contacted her deploying driver air bag and, as a result, was driven rearwards into her seat back. The case vehicle's driver immediately overcorrected the case vehicle by steering it back onto the roadway. As a result, she most likely leaned to her right as the case vehicle was traversing the street diagonally. Just prior to going off the north edge of the roadway, the driver swerved back to the right causing her to move back to her left. It is entirely possible that during the roadway re-entry, either after the mailbox post impacts or the near departure onto the north roadside, the case vehicle's driver stepped on the accelerator instead of the brake pedal. Given that the case vehicle's right front tire was restricted, stepping on the accelerator instead of the brake could explain the prolonged distance between the initial impact and the case vehicle's final rest position. After re-entering the roadway for the second time, the case vehicle continued down the street in the westbound lane while the driver regained control. At final rest the driver indicated that she ended up near her original seating position.

CASE VEHICLE DRIVER INJURIES

The case vehicle's driver initially went to the hospital to be with her daughter, but she was treated and released the next day for minor injuries at a different hospital. According to her interview and her medical records, the injuries sustained by the case vehicle's driver included: contusions to her left knee and right arm, a cervical strain, and an abrasion to her right arm.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusion, 4 cm (1.2 in) left medial knee	890402.1 minor	Knee bolster, driver's, left of steering column	Probable	Emergency room records
2	Strain ² , acute, cervical	640278.1 minor	Air bag, driver's	Probable	Emergency room records
3	Abrasion right arm, not further specified	790202.1 minor	Air bag, driver's	Probable	Interviewee (same person)

² This occupant's medical records diagnosed myofascial syndrome paracervical muscles. An ICD-9CM code of 723.1 was assigned to this diagnosis, and this code translates to cervicalgia, which means "pain in neck". The medical term, cervicalgia, is not defined in DORLAND'S ILLUSTRATED MEDICAL DICTIONARY but its components are defined as follows:

cervical (cer'vi-cal): 1. pertaining to the neck. 2. pertaining to the neck or cervix of any organ or structure.

-algia: a word termination denoting a painful condition.

Myofascial means pertaining to the facial muscles while paracervical means around the cervical muscles. Although the lesion "strain" is borderline, it is, in this contractor's opinion, the "best fit".

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
4	Contusion right arm, not further specified	790402.1 minor	Air bag, driver's	Probable	Interviewee (same person)

