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ON-SITE CHILD SAFETY SEAT INVESTIGATION

CASE NUMBER - IN-03-034
LOCATION - INDIANA
VEHICLE - 1988 CHRYSLER LEBARON
CRASH DATE - March 2003

Submitted:

August 31, 2007

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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.

Technical Report Documentation Page

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16. *Abstract*

This report covers an on-site child safety seat investigation of a crash that involved a 1988 Chrysler LeBaron (case vehicle) and a 2001 Dodge Ram (other vehicle). This crash is of special interest because the case vehicle's front right passenger (3-year-old, female), who was seated, restrained, and secured in a child safety seat, sustained critical brain injuries during the crash, resulting in her death. The trafficway on which both vehicles were traveling was a two-lane, undivided, county roadway, traversing in a northwesterly and southeasterly direction. The case vehicle was traveling southeast in the southeastbound lane. The Dodge was traveling northwest in the northwestbound lane. The case vehicle's driver ran off the right side of the roadway, overcorrected first to her left and then to her right, causing the case vehicle to rotate slightly clockwise and yaw along the northwestbound lane. The driver of the Dodge Ram observed the case vehicle and steered toward the right shoulder and braked. The crash occurred in the northwestbound lane of the roadway. The left side of the case vehicle was impacted by the front left corner of the Dodge. The front right child passenger was seated in a child safety seat. The exact position of her seat track could not be determined because of the vehicle's intrusion. The front right passenger was restrained by the child seat's five-point harness. The forward-facing child safety seat was secured by her available, active, two-point, lap belt. The child safety seat was not secured by the non-motorized, passive, two-point, shoulder belt. The front right passenger sustained, according to her medical records, critical injuries which included: a critical nonanatomic brain injury, an open left parietal skull fracture, and fractures to her left clavicle, humerus, radius, and ulna. In addition, she sustained multiple contusions to her extremities. This occupant's primary brain and skull injuries were most likely caused by her contact with the case vehicle's steering wheel rim. The case vehicle's driver (19-year-old, female) was seated but the exact position of her seat track and tilt steering wheel are unknown because of the intrusion to her seating position. She was not using either her available, active, two-point, lap belt or her available, passive, non-motorized, two-point, shoulder belt. She sustained critical injuries and was pronounced dead approximately 4 hours post-crash. According to her medical records, she sustained two critical brain injuries and cerebral lacerations, contusions, and edema. She had severe skull and pelvic fractures in addition to numerous facial, chest, vertebral, and extremity fractures. She had multiple lacerations to her chest and abdominal organs, and an atlanto-occipital dislocation. Finally, she sustained multiple integumentary abrasions, contusions, and lacerations. This occupant's primary head, brain, and skull injuries were caused by her contact with the case vehicle's left "A"-pillar and/or left roof side rail.

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BACKGROUND

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This investigation was brought to NHTSA's attention prior to August 2003 by unknown means. This crash involved a 1988 Chrysler LeBaron (case vehicle) and a 2001 Dodge Ram (other vehicle). The crash occurred in March 2003 at 5:51 p.m., in Indiana and was investigated by the applicable county Sheriff Department. This crash is of special interest because the case vehicle's front right passenger [3-year-old, White (non-Hispanic) female], who was seated in a child safety seat, sustained critical brain injuries during the crash, resulting in her death. This contractor inspected the scene and vehicles on August 7, 2003. This contractor discussed the crash with one of the investigating police officers and father of the case vehicle's driver on the same date. This report is based on the Police Crash Report, a discussion with the investigating police officer and the driver's father, scene and vehicle inspections, occupant kinematic principles, occupant medical records, and this contractor's evaluation of the evidence.

SUMMARY

Crash Environment: The trafficway on which both vehicles were traveling was a two-lane, undivided, county roadway, traversing in a northwesterly and southeasterly direction. The northwest-southeast roadway had one through lane in both directions. At the time of the crash the light condition was daylight, the atmospheric condition was cloudy, and the roadway pavement was dry. Traffic density was not determined, and the site of the crash was a combination of rural residential and agricultural; see **CRASH DIAGRAM** at end.

Pre-Crash: The case vehicle was traveling southeast in the southeastbound lane of the two-lane roadway and intended to proceed straight ahead. The Dodge was traveling northwest in the northwestbound lane of the same two-lane roadway and intended to continue straight ahead. Based on the available evidence, the case vehicle ran off the right (southwest) side of the roadway, returned to the pavement, and then crossed the center line into the northwestbound lane. The scene inspection indicates that the case vehicle's driver steered to the right and braked (with lock-up), attempting to avoid the crash. As a result of her evasive maneuvers, the case vehicle rotated slightly clockwise and yawed along the northwestbound lane. The driver of the Dodge pickup observed the case vehicle re-enter the roadway and come toward her vehicle. As a result, she steered toward the right (northeast) shoulder and braked, attempting to avoid the crash. The crash occurred in the northwestbound lane of the roadway.

Crash: The left side of the case vehicle was impacted by the front left corner of the Dodge. The case vehicle was equipped with automatic, two-point, shoulder belts and manual, two-point, lap belts. No supplemental restraint systems (air bags) were available.

Post-Crash: The case vehicle rotated slightly counterclockwise post-impact and came to rest on the roadway, straddling the northwestbound lane, heading south-southeast. The Dodge rotated counterclockwise post-impact and came to rest on the right (northeast) shoulder, heading in a westerly direction. During the rotation, the left front of the case vehicle side slapped the Dodge's driver door.

Case Vehicle: The 1988 Chrysler LeBaron was a front wheel drive, two-door coupe (VIN: 3C3CJ41K9JT------). The case vehicle was not equipped with anti-lock brakes or driver or front right passenger supplemental restraints (air bags).

Vehicle Exterior: Based on the vehicle inspection, the CDCs for the case vehicle were determined to be: **91-LDAW-6** (**330** degrees) for the initial impact with the Dodge and **09-LFEW-1** (**270** degrees) for the side slap impact. The WinSMASH reconstruction program, damage only algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 66.0 km.p.h. (41.0 m.p.h.), -57.2 km.p.h. (-35.5 m.p.h.), and +33.0 km.p.h. (+20.5 m.p.h.). Based on the vehicle inspection, this collision fits the reconstruction model, and the calculated longitudinal Delta V appears to be reasonable. The case vehicle was towed due to damage.

Exterior Damage: The case vehicle's initial contact with the Dodge involved the left side with the damage distributed almost along the entire side. Direct damage began at the left front bumper corner and extended 351 centimeters (138.2 inches) along the left side, ending 33 centimeters (13.0 inches) behind the left rear axle. Crush was measured both at the sill and above the sill, and positions C_2 and C_3 required averaging. The residual average maximum crush was measured as 67 centimeters (26.4 inches) at C_3. The actual maximum crush was measured as 88 centimeters (34.6 inches) at C_3. The wheelbase on the case vehicle's left side was shortened 35 centimeters (13.8 inches) while the right side was extended 5 centimeters (2.0 inches). The case vehicle's entire left side, hood, and left "A"-pillar were directly damaged and crushed inward. In addition, the driver's door sustained latch and hinge failure as a result of the pocketing created by the impact with the Dodge pickup. There was induced damage to the left headlight and turn signal assemblies, the hood, the roof, the truck, and the left "B" and "C"-pillars. Remote buckling was also found on the hood and roof. Furthermore, the right front door was pried open by rescue personnel, and the case vehicle's right quarter panel was damaged at the storage facility.

The vehicle manufacturer's recommended tire size was: P195/70R14, but tire size P205/60R15 was optional; the tire size that the case vehicle was equipped with could not be determined. Furthermore, it is unknown if any of the case vehicle's tires had been damaged, deflated, or physically restricted because all of the tires had been removed from the vehicle prior to this contractor's inspection.

Tire	*Measured Pressure*		*Recommend Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kPa	psi	kPa	psi	milli-meters	32nd of an inch			
LF	Unk	Unk	200	29	Unk	Unk	Missing	Unknown	Unknown
RF	Unk	Unk	200	29	Unk	Unk	Missing	Unknown	Unknown
LR	Unk	Unk	200	29	Unk	Unk	Missing	Unknown	Unknown
RR	Unk	Unk	200	29	Unk	Unk	Missing	Unknown	Unknown

Vehicle Interior: Inspection of the case vehicle's interior revealed contact evidence on the steering wheel rim (i.e., hair and blood), hub (i.e., blood), left "A"-pillar (i.e., hair and a scuff mark), and on the left door armrest and interior door's surface (i.e., scuff). The steering wheel hub and left "A"-pillar and door contacts were from the case vehicle's driver. There was no apparent contact evidence to the center or right instrument panels, the windshield's header, or the front sun visors of the case vehicle. There were multiple intrusions to the case vehicle's interior. Lateral intrusions to the driver's seating area involved the left instrument panel, left "A"-pillar, left roof side rail, the left side panel forward of the "A"-pillar, the interior surface of the driver's door, and the front seat back and seat cushion. The largest of these intrusions involved the driver's door panel and was approximately 65 centimeters (25.6 inches). There was also lateral intrusion into the back left seating area from the left "B" and "C"-pillars, the left roof side rail, and the side panel rear of the left "B"-pillar. The largest of these intrusions involved the left "B"-pillar and was also approximately 65 centimeters (25.6 inches). The driver's seating area was also intruded longitudinally. Intrusions included the steering wheel assembly, the left instrument panel, and the left "A"-pillar. The left "A"-pillar intruded approximately 58 centimeters (22.8 inches) longitudinally. The upper half of the steering wheel rim was deformed approximately 10 centimeters (3.9 inches), but this deformation was primarily attributed to the vehicle's lateral intrusion. Finally, the steering column was distorted but its compression could not be determined because of the severity of longitudinal and lateral intrusions.

Supplemental Restraints: The case vehicle was not equipped with any supplemental restraints (air bags).

Child Safety Seat: The front right passenger was seated in a forward-facing child seat with a five-point harness. The seat was manufactured by Cosco, on April 4, 2001. The Model number was 02-442 WAL, and this model can also be configured as a high-back, belt-positioning booster seat. The forward-facing seat was designed with a five-point harness which latched between the child's legs into a protruding buckle. The seat did not have a top tether or any lower attachments. There were two sets of slots to thread the harness through. The harness belts were threaded through the top slots. The child seat was in the upright position.

According to the vehicle inspection, the latch plate for this seating position's lap belt was the "sewn" type. The case vehicle's manual lap belt system had an **Emergency Locking Retractor** (ELR). Because the case vehicle's driver died as a result of the crash, it is unknown whether she had read the child seat's instruction manual or the vehicle's manual on installation of a child safety seat using the vehicle's seat belts. According to a discussion with the driver's father, the driver most likely installed the child seat and had placed the child in the seat prior to the crash. According to the responding police officers, the child seat was "fairly snug" and that no "heavy-duty locking clip" was used on this passenger's safety belt.

The forward-facing child safety seat consisted of a one-piece plastic shell. A close inspection of the child safety seat revealed no apparent damage or fractures to the shell. In addition, no damage or fractures were noted along the seat's path for the vehicle's safety belt. There was a manufacturers label affixed to the bottom right side of the forward-facing child seat giving the child seat's **height and weight limitations** [i.e., weight: between 10 and 18 kilograms (20-40

pounds), and height: less than 101.6 centimeters (40 inches)–when used with the internal five-point harness; **OR** weight: between 13.6 and 36.3 kilograms (30-80 pounds), and height: between 94.0 and 129.5 centimeters (37-51 inches)–when used without the internal five-point harness as a belt-positioning booster seat]. This label was not dated. The manufacturer's instructions for this child safety seat were not available on the back of the seat at the time of this contractor's inspection.

Other Vehicle: The 2001 Dodge Ram 1500 was a rear wheel drive (4x2), two-door, regular cab, pickup truck (VIN: 1B7HC16Z91S------). Two wheel, anti-lock brakes were standard on this model, and four wheel, anti-lock brakes were an option but it is unknown if it was so equipped.

Vehicle Exterior: Based on the vehicle inspection, the CDCs for the Dodge pickup were determined to be: **12-FDEW-2** (**350** degrees) for the initial impact with the case vehicle and **09-LPLW-1** (**270** degrees) for the side slap impact. The WinSMASH reconstruction program, damage only algorithm, was used on the Dodge's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 42.0 km.p.h. (26.1 m.p.h.), -41.4 km.p.h. (-25.7 m.p.h.), and +7.3 km.p.h. (+4.5 m.p.h.). Based on the vehicle inspection, this collision fits the reconstruction model, and the calculated longitudinal Delta V appears to be reasonable. The Dodge was towed due to damage.

Exterior Damage: The Dodge's initial contact with the case vehicle involved the entire front with the damage distributed all the way across. Direct damage began at the front left bumper corner and extended, a measured distance of 116 centimeters (45.7 inches), along the front bumper. Residual maximum crush was measured as 39 centimeters (15.4 inches) at C_2. The wheelbase on the Dodge's left side was shortened approximately 37 centimeters (14.6 inches) while the right side was extended approximately 5 centimeters (2.0 inches). The Dodge pickup's front bumper, bumper fascia, grille, hood, radiator, and left headlight and turn signal assemblies were directly damaged and crushed rearward.

The vehicle manufacturer's recommended tire size was: P225/75R16, but tire size P245/75R16 was optional; the Dodge was equipped with tire size: LT235/85R16. The Dodge's tire data are shown in the table below. In addition, the Dodge's left front tire was damaged, deflated, and physically restricted.

Tire	*Measured Pressure*		*Recommend Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kPa	psi	kPa	psi	milli-meters	32nd of an inch			
LF	0	0	283	41	6	8	Sidewall torn; rim bent	Yes	Yes
RF	352	51	283	41	5	6	None	No	No
LR	338	49	283	41	14	18	None	No	No
RR	331	48	283	41	13	16	None	No	No

Case Vehicle's Front Right Passenger: Immediately prior to the crash the case vehicle's front right child passenger [3-year-old, White (non-Hispanic) female; 107 centimeters and 20 kilograms (42 inches, 44 pounds)] was seated in a child safety seat. However, her exact posture is unknown. Discussions with a wrecker driver and Emergency Medical Technician, who were present at the crash scene, indicated that the child was not properly restrained in this device, but they provided no specifics in this regard. Based on this contractor's inspection, this occupant was primarily seated upright with her back against or near the seat back with her feet hanging down over the front edge of the child seat, most likely angled downward. In addition, the exact position of her hands is unknown. The exact position of her seat track and seat back could not be determined because of the vehicle's intrusion.

Based on the vehicle inspection, the case vehicle's front right passenger was restrained by the child seat's five-point harness. The forward-facing child safety seat was secured by the available, active, two-point, lap belt with an **ELR** retractor. The child safety seat was not secured by the non-motorized, passive, two-point, shoulder belt. Furthermore, the passive shoulder belt was not secured to the door frame. A "heavy duty locking clip" was not used, yet according to the responding police officers, the child seat was "fairly snug". The inspection of the front right passenger's seat belt system showed that the child seat was still secured by the vehicle's lap belt.

The case vehicle's driver steered to the left to re-enter the roadway and then steered back to the right and braked, attempting to avoid the crash. As a result of these attempted avoidance maneuvers and the use of her child safety seat and restraints, the front right passenger most likely moved to her right, then back to her left, and forward, loading her harness restraints, just prior to impact. The case vehicle's primary impact with the Dodge pickup enabled the case vehicle's front right child passenger along with the child safety seat to continue forward and leftward along a path opposite the case vehicle's **330** degree Direction of Principal Force as the case vehicle decelerated. In addition, the child seat and child passenger most likely moved/tipped forward and leftward during the collision, perhaps contributed to by some spooling out of the lap belt due to the nonuse of the "heavy duty locking clip". As the case vehicle bowed and rotated counterclockwise, this occupant most likely moved slightly to her left, but her movement was also constrained by the use of her child seat restraints and the vehicle's safety belt. The side slap impact caused some additional leftward movement but also served to redirect this occupant to her right as the case vehicle continued to rotate counterclockwise to final rest. The inspection of the vehicle's interior indicates that when the child seat tipped forward and to the left, and the child's head most likely impacted the steering wheel rim near the rim's 5 o'clock position causing the child's skull and brain lesions. Otherwise, there was no apparent evidence of this occupant's contact found to the vehicle's interior. The exact posture of the front right passenger at final rest is unknown. She was unable to exit the case vehicle because of her injuries.

The front right passenger was transported by ambulance to the hospital. According to the EMT, this passenger was essentially dead at the scene but was taken to a local hospital where she was pronounced dead approximately 1 and ½ hours post-crash. According to her medical records, the injuries sustained by the case vehicle's front right passenger included: a critical nonanatomic brain injury, an open left parietal skull fracture, and fractures to her left clavicle, humerus, radius, and ulna. In addition, she sustained multiple contusions to her extremities. According to the

investigating police officers, they believe that this occupant was struck by the case vehicle's driver who was rebounding backwards and to her right from the interior of the case vehicle. Although this inter-occupant contact most likely occurred, in this contractor's opinion this occupant's primary brain and skull injuries were most likely caused by her contact with the case vehicle's steering wheel rim in an area where the rim was connected to one of the steering wheel's spokes. In addition, the left clavicle fracture was caused by the child seat's harness straps.

Case Vehicle's Driver: The exact posture of the case vehicle's driver [19-year-old, White (non-Hispanic) female; 157 centimeters and 54 kilograms (62 inches, 120 pounds)] immediately prior to the crash is unknown, but she was most likely seated in a primarily upright posture with her back leaning forward from the seat back, her left foot on the floor, her right foot on the brake, and at least one of her hands on the steering wheel. The exact position of her seat track and seat back are unknown because of the intrusion to her seating position. The case vehicle was equipped with a tilt steering wheel, but its exact position prior to the crash is unknown.

The case vehicle's driver was not using either her available, active, two-point, lap belt or her available, passive, non-motorized, two-point, shoulder belt. Furthermore, the inspection of the driver's safety belts showed that the manual, lap belt and the automatic shoulder belt were stuck between the driver's seat and the center console. In addition, the driver's lap belt could not be pulled out of the retractor, indicating that it was jammed in the non-used position.

The case vehicle's driver steered to the left to re-enter the roadway and then steered back to the right and braked, attempting to avoid the crash. As a result of these attempted avoidance maneuvers and the nonuse of her available safety belts, the driver most likely moved slightly to her right, then back to her left, and forward, bracing against the steering wheel, just prior to impact. The case vehicle's primary impact with the Dodge pickup enabled the case vehicle's driver to continue forward, leftward, and upward along a path opposite the case vehicle's **330** degree Direction of Principal Force as the case vehicle decelerated. As a result, the driver impacted her intruding steering wheel and column and contacted the intruding left "A"-pillar and interior surface of her door. As the case vehicle bowed and rotated counterclockwise, this occupant was driven backwards and to her right by the intruding left side surfaces. The side slap impact most likely had minimal affect upon the driver's movement because of the severity of the intrusions from the initial impact. The driver most likely impacted the right side of her seat back, which had moved forward longitudinally as a result of being twisted counterclockwise by the vehicle's left intrusions. In this contractor's opinion, the unrestrained driver continued to rebound to her right, obliquely toward the left side of the front right seat, and most likely contacted the restrained and secured front right passenger. The exact posture of the driver at final rest is unknown. She was unable to exit the case vehicle because of her injuries.

The driver was transported by ambulance to a local hospital, then flown by helicopter to a metropolitan trauma center. She sustained critical injuries and was pronounced dead 4 hours and 11 minutes post-crash. According to her medical records, the brain injuries sustained by the case vehicle's driver included: a critical nonanatomic injury, diffuse axonal injury, cerebral lacerations and contusions, and brain edema. She sustained multiple fractures, including a complex basilar skull fracture, a depressed left frontal bone fracture, left hemi-LeFort III fracture, bilateral

mandibular fractures, left 1st rib fracture, complex pelvic fractures, and fractures to the transverse process of L_5, left elbow, left distal radius and ulna, left 4th metacarpal, and left 4th phalanx. Furthermore, she had an atlanto-occipital dislocation and a dislocated left rdaiocarpal joint. In addition, she sustained chest and abdominal injuries which included left pleural lacerations and contusions and lacerations to her left adrenal gland, left kidney, spleen, and uterus. Finally, she sustained multiple integumentary abrasions, contusions, and lacerations. This occupant's primary head, brain, and skull injuries were caused by her contact with the case vehicle's left "A"-pillar and/or left roof side rail.

Dodge pickup's Occupants: According to the Police Crash Report, it is not known if the Dodge's driver [35-year-old, (unknown race and/or ethnic origin) female] or the **two** (i.e., report did not distinguish which was left or right of the other) **front right** passengers [11 and 14-year-old, (unknown race and/or ethnic origin) males, respectively] were restrained by their available, active, three-point, lap-and-shoulder, safety belt systems. The driver was transported to a hospital for medical treatment with police-reported "B" (non-incapacitating-evident) injuries. Neither of the two other occupants of this vehicle were transported by ambulance to the hospital, but both were listed as sustaining police-reported "B" (non-incapacitating-evident) injuries as a result of this crash.

Figure 1: Case vehicle's southeasterly travel path in southeastbound lane approaching hill crest; Note: vehicle ran-off-road to right and driver overcorrected upon re-entry (case photo #01)

Figure 2: Dodge pickup's northwesterly travel path in northwestbound lane approaching hill crest; Note: arrows indicate approximate location of hill crest (red) and sag (blue)–further to northwest (case photo #05)

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which both vehicles were traveling was a two-lane, undivided, county roadway, traversing in a northwesterly and southeasterly direction. The northwest-southeast roadway had one through lane in both directions. The county roadway was straight and level [i.e., actual slope was 0.8%, positive to the southeast (an upgrade in the case vehicle's direction of travel–**Figure 1**), and 0.8% negative to the northwest for the Dodge pickup–**Figure 2**] near the area of impact. The pavement was bituminous but polished, and the width of the travel lanes for both vehicles was approximately 3.15 meters (10.3 feet)–the width of the roadway was 6.3 meters (20.7 feet). The shoulders were not improved {i.e., grass, except for a few centimeters [approximately 10 (4 inches)] of pavement}. The roadway was not bordered by curbs. Pavement markings consisted of faded double solid yellow center lines for both the

northwest and southeast through lanes. In addition, solid white edge lines were present. The estimated coefficient of friction was 0.65. There were no visible traffic controls in the immediate area of the crash. The statutory speed limit was 89 km.p.h. (55 m.p.h.). 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 cloudy, and the roadway pavement was dry. Traffic density was not determined, and the site of the crash was a combination of rural residential and agricultural; see **CRASH DIAGRAM** at end.

Figure 3: Case vehicle's east-southeasterly travel path, near hill crest, across centerline; Note: arrows indicate beginning (blue) of straight line yaw mark and approximate point of impact (red) with Dodge pickup (case photo #01b)

Figure 4: Case vehicle's straight line yaw mark in northwestbound lane; Note: arrow indicates approximate point of impact near hill crest (case photo #02)

Figure 5: West-northwesterly view from northeast roadside, near hill crest, showing impact location between case vehicle and Dodge pickup (case photo #04)

Pre-Crash: The case vehicle was traveling southeast in the southeastbound lane of the two-lane roadway and intended to proceed straight ahead (**Figure 1** above). The Dodge was traveling northwest in the northwestbound lane of the same two-lane roadway and intended to continue straight ahead (**Figure 2** above). Based on the available evidence, the case vehicle ran off the right (southwest) side of the roadway, returned to the pavement, and then crossed the center line into the northwestbound lane (**Figure 3**). The scene inspection indicates that the case vehicle's driver steered to the right and braked (with lock-up), attempting to avoid the crash. As a result of her evasive maneuvers, the case vehicle rotated slightly clockwise and yawed along the northwestbound lane (**Figure 4**). The driver of the Dodge pickup observed the case vehicle re-enter the roadway and come toward her vehicle. As a result, she steered toward the right (northeast) shoulder and braked, attempting to avoid the crash. The crash occurred in the northwestbound lane of the roadway (**Figure 5**).

Crash: The left side (**Figure 6**) of the case vehicle was impacted by the front left corner of the Dodge (**Figure 7**). The case vehicle was equipped with automatic, two-point, shoulder belts and manual, two-point, lap belts. No supplemental restraint systems (air bags) were available.

Figure 6: Case vehicle's left side impact viewed from front showing leftward shift (case photo #08a)

Figure 7: Dodge pickup's frontal damage from impact with case vehicle left side; Note: greatest crush occurred at front left corner (case photo #59)

Post-Crash: The case vehicle rotated slightly counterclockwise post-impact and came to rest on the roadway, straddling the northwestbound lane, heading south-southeast. The Dodge rotated counterclockwise post-impact and came to rest on the right (northeast) shoulder, heading in a westerly direction (**Figure 8**). During the rotation, the left front of the case vehicle side slapped the Dodge's driver door.

Figure 8: Newspaper photograph of final rest positions of case vehicle (left) and Dodge pickup (right); Note: tire yaw mark near case vehicle's right front door (case photo #00)

CASE VEHICLE

The 1988 Chrysler LeBaron was a front wheel drive, five-passenger, two-door coupe (VIN: 3C3CJ41K9JT------) equipped with a 2.5L, I-4 engine and a three-speed automatic transmission. Four-wheel, anti-lock brakes were not available for this model. Braking was achieved by a power-assisted, front disc and rear drum system. The case vehicle's wheelbase was 255 centimeters (100.3 inches), and the odometer reading at inspection was 177,113 kilometers (110,053 miles).

Inspection of the vehicle's interior revealed adjustable front bucket seats with folding backs and adjustable head restraints; a non-adjustable back bench seat without any head restraints for the back seating positions; two-point, non-motorized, automatic, shoulder belts at the front outboard seating positions; and two-point, lap belt systems at all five front and back positions. The automatic, front shoulder belt systems did not have "D"-rings but instead were fixed to the vertically-oriented back section of each front window frame. Thus, the case vehicle was not

equipped with manually operated, upper anchorage adjusters. In addition, the case vehicle was not equipped with driver or front right passenger supplemental restraints (air bags) or knee bolsters.

CASE VEHICLE DAMAGE

Figure 9: Case vehicle's left side damage forward of left "B"-pillar with contour gauge set above sill level; Note: initial contact with Dodge began forward of front axle (case photo #12)

Figure 10: Case vehicle's left side damage from left "A"-pillar rearward with contour gauge set at sill level (case photo #13)

Figure 11: Reference line view from front of case vehicle's left side damage with contour gauge set above sill level (case photo #10)

Figure 12: Overhead view of case vehicle's left side damage and crush pocket on driver's door; Note: arrows indicate difference between crush at sill and crush above sill level (case photo #22)

Exterior Damage: The case vehicle's initial contact with the Dodge involved the left side with the damage distributed almost along the entire side (**Figures 9** and **10**). Direct damage began at the left front bumper corner and extended 351 centimeters (138.2 inches) along the left side, ending 33 centimeters (13.0 inches) behind the left rear axle (**Figure 11**). Crush was measured both at the sill and above the sill, and positions C_2 and C_3 required averaging (**Figure 12**). The residual average maximum crush was measured as 67 centimeters (26.4 inches) at C_3. The actual

maximum crush was measured as 88 centimeters (34.6 inches) at C_3. The table below shows the case vehicle's crush profile.

Units	Event	Direct Damage		Field L	C_1	C_2	C_3	C_4	C_5	C_6	Direct	Field L
		Width CDC	Max Crush								±D	±D
cm	1	351	88	351	5	43	67	57	25	0	35	35
in		138.2	34.6	138.2	2.0	16.9	26.4	22.4	9.8	0.0	13.8	13.8

Figure 13: Case vehicle's left side damage from left "A"-pillar rearward with contour gauge set above sill level; Note: arrow indicates door latch failure (case photo #16)

Figure 14: Close-up of door latch failure on case vehicle's driver door (case photo #24)

Figure 15: Close-up of door hinge failure (arrows) on case vehicle's driver door (case photo #25)

Figure 16: Overhead view of case vehicle's right front door which was pried open (arrows) by rescue personnel (case photo #29)

The wheelbase on the case vehicle's left side was shortened 35 centimeters (13.8 inches) while the right side was extended 5 centimeters (2.0 inches). The case vehicle's entire left side, hood, and left "A"-pillar were directly damaged and crushed inward. In addition, the driver's door sustained latch (**Figures 13** and **14**) and hinge failure (**Figure 15**) as a result of the pocketing created by the impact with the Dodge pickup. There was induced damage to the left headlight and

turn signal assemblies, the hood, the roof, the truck, and the left "B" and "C"-pillars. Remote buckling was also found on the hood and roof. Furthermore, the right front door was pried open by rescue personnel (**Figure 16** above), and the case vehicle's right quarter panel was damaged at the storage facility.

The vehicle manufacturer's recommended tire size was: P195/70R14, but tire size P205/60R15 was optional; the tire size that the case vehicle was equipped with could not be determined. Furthermore, it is unknown if any of the case vehicle's tires had been damaged, deflated, or physically restricted because all of the tires had been removed from the vehicle prior to this contractor's inspection.

Tire	*Measured Pressure*		*Recommend Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kPa	psi	kPa	psi	milli-meters	32nd of an inch			
LF	Unk	Unk	200	29	Unk	Unk	Missing	Unknown	Unknown
RF	Unk	Unk	200	29	Unk	Unk	Missing	Unknown	Unknown
LR	Unk	Unk	200	29	Unk	Unk	Missing	Unknown	Unknown
RR	Unk	Unk	200	29	Unk	Unk	Missing	Unknown	Unknown

Figure 17: Case vehicle's driver seating area showing extensive intrusion and contact evidence on steering wheel rim and left "A"-pillar; Note: top of rim is toward 9 o'clock position and plastic cover for wheel hub is absent (case photo #32)

Figure 18: Close-up of contact evidence on case vehicle's deformed steering wheel rim (case photo #37)

Vehicle Interior: Inspection of the case vehicle's interior revealed contact evidence on the steering wheel rim (i.e., hair and blood–**Figures 17** and **18**), hub (i.e., blood–**Figure 19** below), left "A"-pillar (i.e., hair and a scuff mark–**Figure 17** and **Figure 20** below), and on the left door armrest and interior door's surface (i.e., scuff–**Figure 20** below). The steering wheel hub and left "A"-

pillar and door contacts were from the case vehicle's driver. There was no apparent contact evidence to the center or right instrument panels, the windshield's header, or the front sun visors of the case vehicle. There were multiple intrusions to the case vehicle's interior. Lateral intrusions to the driver's seating area involved the left instrument panel, left "A"-pillar, left roof side rail, the left side panel forward of the "A"-pillar, the interior surface of the driver's door, and the front seat back and seat cushion (**Figure 20**). The largest of these intrusions involved the driver's door panel and was approximately 65 centimeters (25.6 inches). There was also lateral intrusion into the back left seating area from the left "B" and "C"-pillars, the left roof side rail, and the side panel rear of the left "B"-pillar. The largest of these intrusions involved the left "B"-pillar and was also approximately 65 centimeters (25.6 inches). The driver's seating area was also intruded longitudinally. Intrusions included the steering wheel assembly, the left instrument panel, and the left "A"-pillar. The left "A"-pillar intruded approximately 58 centimeters (22.8 inches) longitudinally. The upper half of the steering wheel rim was deformed approximately 10 centimeters (3.9 inches), but this deformation was primarily attributed to the vehicle's lateral intrusion. Finally, the steering column was distorted (**Figure 21**) but its compression could not be determined because of the severity of longitudinal and lateral intrusions.

Damage Classification: Based on the vehicle inspection, the CDCs for the case vehicle were determined to be: **91-LDAW-6** (**330** degrees) for the initial impact with the Dodge and **09-LFEW-1** (**270** degrees) for the side slap impact. The WinSMASH reconstruction program, damage only algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 66.0 km.p.h. (41.0 m.p.h.), -57.2 km.p.h. (-35.5 m.p.h.), and +33.0 km.p.h. (+20.5 m.p.h.). Based on the vehicle inspection, this collision fits the

Figure 19: Overhead view of plastic piece that covered case vehicle's steering wheel hub showing evidence of occupant contact (case photo #42)

Figure 20: Case vehicle's front seating area viewed from right showing twisted driver's seat, distorted steering wheel rim, contact to left "A"-pillar, and hidden (arrow) contact to side door panel; Note: front right head restraint missing (case photo #45)

Figure 21: Overhead view of case vehicle's steering column and center console; Note: damage to steering column, steering wheel rim and hub, holed windshield's glazing, and intrusion of driver's seat onto center console (case photo #36)

reconstruction model, and the calculated longitudinal Delta V appears to be reasonable. The case vehicle was towed due to damage.

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was not equipped with any supplemental restraints (air bags).

CHILD SAFETY SEAT

The front right passenger was seated in a forward-facing child seat with a five-point harness (**Figure 22**). The seat was manufactured by Cosco, on April 4, 2001. The Model number was 02-442 WAL, and this model can also be configured as a high-back, belt-positioning booster seat. The forward-facing seat was designed with a five-point harness which latched between the child's legs into a protruding buckle (**Figure 23**). The seat did not have a top tether or any lower attachments. There were two sets of slots to thread the harness through. The harness belts were threaded through the top slots. The child seat was in the upright position.

Figure 22: Frontal view of Cosco forward-facing, high-back, combination child seat–configured with five-point harness, used by case vehicle's front right passenger showing harness straps cut by rescue personnel (case photo #47)

According to the vehicle inspection, the latch plate for this seating position's lap belt was the "sewn" type. The case vehicle's manual lap belt system had an **Emergency Locking Retractor** (ELR). Because the case vehicle's driver died as a result of the crash, it is unknown whether she had read the child seat's instruction manual or the vehicle's manual on installation of a child safety seat using the vehicle's seat belts. According to a discussion with the driver's father, the driver most likely installed the child seat and had placed the child in the seat prior to the crash. According to the responding police officers, the child seat was "fairly snug" and that no "heavy-duty locking clip" was used on this passenger's safety belt (**Figure 24** below).

Figure 23: Overhead view from back of Cosco child safety seat used by case vehicle's front right passenger; Note: harness straps cut by rescue personnel (case photo #48)

The forward-facing child safety seat consisted of a one-piece plastic shell. A close

inspection of the child safety seat revealed no apparent damage or fractures to the shell (**Figure 24**). In addition, no damage or fractures were noted along the seat's path for the vehicle's safety belt (**Figure 25**). There was a manufacturers label affixed to the bottom right side of the forward-facing child seat giving the child seat's **height and weight limitations** [i.e., weight: between 10 and 18 kilograms (20-40 pounds), and height: less than 101.6 centimeters (40 inches)–when used with the internal five-point harness; **OR** weight: between 13.6 and 36.3 kilograms (30-80 pounds), and height: between 94.0 and 129.5 centimeters (37-51 inches)–when used without the internal five-point harness as a belt-positioning booster seat]. This label was not dated (**Figure 26**). The manufacturer's instructions for this child safety seat were not available on the back of the seat at the time of this contractor's inspection.

Figure 24: Back surface of Cosco child safety seat showing harness straps positioned through upper slots and no apparent damage to child seat; Note: locking clip secured on seat back (case photo #55)

Figure 25: Overhead view of Cosco child safety seat's right side showing locations for securing vehicle's safety belts when seat used as forward-facing seat (red arrow) with harness straps or as belt-positioning booster seat (blue arrows) without harness straps (case photo #50)

Figure 26: Instructions on Cosco child safety seat providing information pertaining to make/model, height/weight restrictions, and integration of vehicle's safety belts with child seat (case photo #58)

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

Immediately prior to the crash the case vehicle's front right child passenger [3-year-old, White (non-Hispanic) female; 107 centimeters and 20 kilograms (42 inches, 44 pounds)] was seated in a child safety seat. However, her exact posture is unknown. Discussions with a wrecker driver and Emergency Medical Technician, who were present at the crash scene, indicated that the child was not properly restrained in this device,

but they provided no specifics in this regard. Based on this contractor's inspection, this occupant was primarily seated upright with her back against or near the seat back with her feet hanging down over the front edge of the child seat, most likely angled downward. In addition, the exact position of her hands is unknown. The exact position of her seat track and seat back could not be determined because of the vehicle's intrusion.

Based on the vehicle inspection, the case vehicle's front right passenger was restrained by the child seat's five-point harness (**Figures 22** and **23** above). The forward-facing child safety seat was secured by the available, active, two-point, lap belt (**Figure 27**) with an **ELR** retractor. The child safety seat was not secured by the non-motorized, passive, two-point, shoulder belt. Furthermore, the passive shoulder belt was not secured to the door frame (**Figure 28**). A "heavy duty locking clip" was not used, yet according to the responding police officers, the child seat was "fairly snug". The inspection of the front right passenger's seat belt system showed that the child seat was still secured by the vehicle's lap belt.

Figure 27: Overhead view of case vehicle's manual, front right lap belt which was used to secure Cosco child safety seat used by front right passenger (case photo #46)

Figure 28: Case vehicle's right front door showing door-mounted buckle for non-motorized front right shoulder belt (case photo #46a)

The case vehicle's driver steered to the left to re-enter the roadway and then steered back to the right and braked, attempting to avoid the crash. As a result of these attempted avoidance maneuvers and the use of her child safety seat and restraints, the front right passenger most likely moved to her right, then back to her left, and forward, loading her harness restraints, just prior to impact. The case vehicle's primary impact with the Dodge pickup enabled the case vehicle's front right child passenger along with the child safety seat to continue forward and leftward along a path opposite the case vehicle's **330** degree Direction of Principal Force as the case vehicle decelerated. In addition, the child seat and child passenger most likely moved/tipped forward and leftward during the collision, perhaps contributed to by some spooling out of the lap belt due to the nonuse of the "heavy duty locking clip". As the case vehicle bowed and rotated counterclockwise, this occupant most likely moved slightly to her left, but her movement was also constrained by the use of her child seat restraints and the vehicle's safety belt. The side slap impact caused some additional leftward movement but also served to redirect this occupant to her right as the case vehicle continued to rotate counterclockwise to final rest. The inspection of the vehicle's interior indicates that when the child seat tipped forward and to the left, and the child's head most likely impacted the steering wheel rim near the rim's 5 o'clock position causing the child's skull and brain lesions

(**Figure 29**). Otherwise, there was no apparent evidence of this occupant's contact found to the vehicle's interior. The exact posture of the front right passenger at final rest is unknown. She was unable to exit the case vehicle because of her injuries.

Figure 29: Case vehicle's front right passenger seating area showing extensive intrusion to instrument panel and contact to steering wheel rim; Note: no apparent evidence of occupant contact to either center or right instrument panels (case photo #33)

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The front right passenger was transported by ambulance to the hospital. According to the EMT, this passenger was essentially dead at the scene but was taken to a local hospital where she was pronounced dead approximately 1 and ½ hours post-crash. According to her medical records, the injuries sustained by the case vehicle's front right passenger included: a critical nonanatomic brain injury, an open left parietal skull fracture, and fractures to her left clavicle, humerus, radius, and ulna. In addition, she sustained multiple contusions to her extremities. According to the investigating police officers, they believe that this occupant was struck by the case vehicle's driver who was rebounding backwards and to her right from the interior of the case vehicle. Although this inter-occupant contact most likely occurred, in this contractor's opinion this occupant's primary brain and skull injuries were most likely caused by her contact with the case vehicle's steering wheel rim in an area where the rim was connected to one of the steering wheel's spokes. In addition, the left clavicle fracture was caused by the child seat's harness straps.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Nonanatomic brain injury with unconsciousness, unresponsive to painful stimuli, pupils fixed, GCS=3	critical 160824.5,0	Steering wheel rim and spokes	Probable	Emergency room records
2	Fracture, open[1], left parietal bone	severe 150406.4,2	Steering wheel rim and spokes	Probable	Emergency room records
3	Fracture, mid-shaft, left clavicle	moderate 752200.2,2	Child safety seat harness straps	Certain	Emergency room records
4	Fracture, oblique, shaft, left distal humerus with lateral angulation	moderate 752602.2,2	Other occupant: driver	Possible	Emergency room records

[1] There was a large [20 cm (8 in)] laceration along the left parietal scalp which curled around the side of the head. In addition, part of the left parietal bone was missing and grey matter was observed to be present.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
5 6	Fracture left distal radius and Fracture left distal ulna, not further specified	moderate 752802.2,2 753202.2,2	Floor-mounted transmission selector lever	Possible	Emergency room records
7	Contusions, multiple, extremities not further specified	minor 990400.1,9	Unknown contact mechanism	Unknown	Emergency room records

CASE VEHICLE DRIVER KINEMATICS

The exact posture of the case vehicle's driver [19-year-old, White (non-Hispanic) female; 157 centimeters and 54 kilograms (62 inches, 120 pounds)] immediately prior to the crash is unknown, but she was most likely seated in a primarily upright posture with her back leaning forward from the seat back, her left foot on the floor, her right foot on the brake, and at least one of her hands on the steering wheel. The exact position of her seat track and seat back are unknown because of the intrusion to her seating position. The case vehicle was equipped with a tilt steering wheel, but its exact position prior to the crash is also unknown.

The case vehicle's driver was not using either her available, active, two-point, lap belt or her available, passive, non-motorized, two-point, shoulder belt. Furthermore, the inspection of the driver's safety belts showed that the manual, lap belt and the automatic shoulder belt were stuck between the driver's seat and the center console (**Figure 30**). In addition, the driver's lap belt could not be pulled out of the retractor, indicating that it was jammed in the non-used position.

Figure 30: Webbing from case vehicle driver's automatic, shoulder belt showing webbing lodged between intruded driver seat and center console, indicating webbing not in use at time of crash (case photo #44)

The case vehicle's driver steered to the left to re-enter the roadway and then steered back to the right and braked, attempting to avoid the crash. As a result of these attempted avoidance maneuvers and the nonuse of her available safety belts, the driver most likely moved slightly to her right, then back to her left, and forward, bracing against the steering wheel, just prior to impact. The case vehicle's primary impact with the Dodge pickup enabled the case vehicle's driver to continue forward, leftward, and upward along a path opposite the case vehicle's **330** degree Direction of Principal Force as the case vehicle decelerated. As a result, the driver impacted her intruding steering wheel and column and contacted the intruding left "A"-pillar (**Figures 31** and **32** below) and interior surface of her door (**Figure 20** above). As the case vehicle bowed and rotated counterclockwise, this occupant was driven backwards and to her right by the intruding left side surfaces. The side slap impact most likely had minimal affect upon the driver's

movement because of the severity of the intrusions from the initial impact. The driver most likely impacted the right side of her seat back, which had moved forward longitudinally as a result of being twisted counterclockwise by the vehicle's left intrusions. In this contractor's opinion, the unrestrained driver continued to rebound to her right, obliquely toward the left side of the front right seat, and most likely contacted the restrained and secured front right passenger. The exact posture of the driver at final rest is unknown. She was unable to exit the case vehicle because of her injuries.

Figure 31: Contact evidence along case vehicle's left "A"-pillar deposited by case vehicle's driver (case photo #38)

Figure 32: Close-up of contact evidence on case vehicle's left "A"-pillar deposited by case vehicle's driver; Note: hair on "A"-pillar (case photo #39)

CASE VEHICLE DRIVER INJURIES

The driver was transported by ambulance to a local hospital, then flown by helicopter to a metropolitan trauma center. She sustained critical injuries and was pronounced dead 4 hours and 11 minutes post-crash. According to her medical records, the brain injuries sustained by the case vehicle's driver included: a critical nonanatomic injury, diffuse axonal injury, cerebral lacerations and contusions, and brain edema. She sustained multiple fractures, including a complex basilar skull fracture, a depressed left frontal bone fracture, left hemi-LeFort III fracture, bilateral mandibular fractures, left 1st rib fracture, complex pelvic fractures, and fractures to the transverse process of L_5, left elbow, left distal radius and ulna, left 4th metacarpal, and left 4th phalanx. Furthermore, she had an atlanto-occipital dislocation and a dislocated left rdaiocarpal joint. In addition, she sustained chest and abdominal injuries which included left pleural lacerations and contusions and lacerations to her left adrenal gland, left kidney, spleen, and uterus. Finally, she sustained multiple integumentary abrasions, contusions, and lacerations. This occupant's primary head, brain, and skull injuries were caused by her contact with the case vehicle's left "A"-pillar and/or left roof side rail.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Nonanatomic brain injury with unconsciousness, decerebrate posturing, unresponsive to painful stimuli, unequal pupils, GCS=3	critical 160824.5,0	Left "A"-pillar and/or roof, left front side rail	Certain	Emergency room records
2	Injury, diffuse axonal {white matter shearing}, right and left cerebrum, not further specified	critical 140628.5,3	Left "A"-pillar and/or roof, left front side rail	Certain	Emergency room records
3 4	Lacerations, cortical, bilateral orbital (inferior) surfaces of frontal lobes (left and right)	severe 140688.4,1 140688.4,2	Left "A"-pillar and/or roof, left front side rail	Certain	Autopsy
5	Contusions, small, cortical, bilateral orbital (inferior) surfaces of frontal lobes (left and right) and inferior right temporal lobe	serious 140622.3,3	Left "A"-pillar and/or roof, left front side rail	Certain	Autopsy
6	Contusion, large, right occipital pole, not further specified	severe 140608.4,1	Other occupant: front right	Probable	Autopsy
7	Edema, cerebral, mild with flattening of gyri and narrowing of sulci	serious 140662.3,9	Left "A"-pillar and/or roof, left front side rail	Probable	Autopsy
8	Lacerations, multiple, left parietal pleura, not further specified	moderate 441800.2,2	Steering wheel hub and/or spokes and rim	Certain	Autopsy
9	Contusions, abundant, left pleura, not further specified as to parietal or visceral or locations; no pulmonary contusions	moderate 441804.2,2	Steering wheel hub and/or spokes and rim	Certain	Autopsy
10	Laceration {fragmented} left adrenal gland	serious 540226.3,2	Steering wheel hub and/or spokes and rim	Probable	Autopsy
11	Laceration {rupture} left kidney capsule in superior and mid portions, extending into hilum with laceration of kidney	severe 541626.4,2	Steering wheel hub and/or spokes and rim	Certain	Autopsy
12	Laceration, small, splenic capsule, grade II, not further specified	moderate 544222.2,2	Steering wheel hub and/or spokes and rim	Probable	Autopsy
13	Laceration uterus, anterior surface, not further specified	moderate 545220.2,8	Steering wheel hub and/or spokes and rim	Probable	Autopsy

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
14	Fracture, complex, basilar skull extending from petrous ridge of right posterior cranial fossa through right sphenoid and lateral ethmoid bones of right middle cranial fossa, and into left and right anterior cranial fossa ending in left frontal bone	severe 150206.4,8	Left "A"-pillar and/or roof, left front side rail	Certain	Autopsy[2]
15	Fracture, depressed, left frontal bone involving frontal sinus and both anterior and posterior walls	serious 150404.3,5	Left "A"-pillar and/or roof, left front side rail	Certain	Emergency[3] room records
16	Fracture left hemi LeFort III facial fracture, including nose, orbit, maxilla, and zygoma	serious 250808.3,4	Left "A"-pillar and/or roof, left front side rail	Certain	Emergency[3] room records
17	Fracture, comminuted, left mandible through symphysis into left body and right mandibular body, comminuted, anterior to right angle	moderate 250612.2,3	Left "A"-pillar and/or roof, left front side rail	Certain	Emergency[3] room records
18	Dislocation[4], partial, mild-to-moderate, atlanto-occipital	moderate 650208.2,6	Left "A"-pillar and/or roof, left front side rail {indirect injury}	Certain	Autopsy
19	Fracture left 1st rib, not further specified, with 500 ml of left hemothorax and collapsed left lung	minor 450214.3,2	Left "A"-pillar and/or roof, left front side rail	Probable	Autopsy

[2] A large portion of the lesion's specifics was provided by emergency room imagery.

[3] No radiographs were taken during the autopsy. Autopsy findings were based on palpation and/or observation. Specifically, the autopsy cited fractures involving the left frontal bone, left periorbital, mandible (not further specified), and multiple left and right pelvic fractures.

[4] This occupant's spinal cord was not examined during the autopsy.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
20	Fracture, complex, pelvis including right and left, superior and inferior pubic rami, extending into left and right acetabulum with left pelvic wing displaced medially **and** comminuted fracture left sacral ala involving left sacroiliac joint with displacement of left hemi-pelvis and a diastasis fracture of right sacroiliac joint with extensive abdominal and retroperitoneal hemorrhage	severe 852606.4,0	Knee bolster, driver's {indirect injury}	Probable	Emergency[3] room records
21	Fracture transverse process of L_5, not further specified	moderate 650620.2,8	Noncontact injury: rotational impact forces	Probable	Emergency room records
22	Fracture left elbow, not further specified	moderate 753202.2,2	Left front window sill	Probable	Autopsy
23	Fracture, comminuted, left distal radius	serious 752804.3,2	Left front window sill	Probable	Emergency room records
24	Fracture, transverse, left distal ulna involving left ulnar styloid process	moderate 753202.2,2	Left front window sill	Probable	Emergency room records
25	Dislocation left radiocarpal joint	moderate 751430.2,2	Left front window sill	Probable	Emergency room records
26	Fracture left 4th metacarpal bone	moderate 752002.2,2	Left side interior surface, excluding hardware and/or armrest	Probable	Emergency room records
27	Fracture left 4th proximal phalanx	minor 752404.1,2	Left side interior surface, excluding hardware and/or armrest	Probable	Emergency room records
28	Abrasions, multiple, face, including 12.7 x 10.2 cm (5 x 4 in) extending from lower left cheek to left forehead between nose and left ear; 7.6 x 5.1 cm (3 x 2 in) right cheek; and beneath chin in midline	minor 290202.1,0	Left "A"-pillar and/or roof, left front side rail	Certain	Autopsy

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
29	Laceration, 6.4 cm (2.5 in) left temple extending through left eyebrow	minor 290602.1,2	Left "A"-pillar and/or roof, left front side rail	Certain	Autopsy
30	Laceration, 3.2 cm (1.25 in) corner left eye, over eyelid	minor 297602.1,2	Left "A"-pillar and/or roof, left front side rail	Certain	Autopsy
31	Laceration, 6.4 cm (2.5 in) left cheek to nose, posterior to nasal ala	minor 290600.1,2	Left "A"-pillar and/or roof, left front side rail	Certain	Autopsy
32	Laceration beneath chin within abrasion	minor 290602.1,8	Left "A"-pillar and/or roof, left front side rail	Probable	Autopsy
33	Abrasions pubic region, not further specified	minor 590202.1,8	Steering wheel rim	Probable	EMS treatment record
34	Contusion {bruised} abdomen, not further specified	minor 590402.1,9	Steering wheel hub and/or spokes and rim	Certain	Emergency room records
35	Abrasion, 6.4 cm (2.5 in), left pelvis within contusion below	minor 890202.1,2	Left side interior hardware and/or armrest	Probable	Autopsy
36	Contusion, 6.5 x 5 cm (2.6 x 2.0 in) on left pelvis	minor 890402.1,2	Left side interior hardware and/or armrest	Probable	Autopsy
37	Abrasions left and right thighs, including 27.9 x 15.2 cm (11 x 6 in) right medial thigh	minor 890202.1,3	Steering wheel rim	Probable	Autopsy
38	Abrasion left shin	minor 890202.1,2	Left instrument panel and below	Probable	Emergency room records
39	Contusions, multiple, left leg from 6.4 cm to 53.3 cm (2.5 to 21 in), not further specified	minor 890402.1,2	Left instrument panel and below	Probable	Autopsy

OTHER VEHICLE

Based on the VIN, manufacturer's specifications, and the vehicle's exterior inspection, the 2001 Dodge Ram 1500 was a rear wheel drive (4x2), two-passenger, two-door, regular cab, short bed, pickup truck (VIN: 1B7HC16Z91S------) equipped with a 5.9L, V-8 engine and a four-speed automatic transmission with overdrive. Two wheel, anti-lock brakes were standard on this model, and four wheel, anti-lock brakes were an option but this model was not so equipped. Braking was achieved by a power-assisted, front disc and rear drum system. The case vehicle's wheelbase was

301 centimeters (118.7 inches), and the odometer reading at inspection is unknown because the Dodge's interior was not inspected. The vehicle was equipped with knee bolsters for both the driver and front right passenger seating positions and an air bag **ON/OFF** switch. Automatic restraint was provided by a Supplemental Restraint System (SRS) that consisted of redesigned frontal air bags for the driver and front right passenger seating positions. The Dodge was not equipped with front, seat back-mounted, side impact air bags or side-inflatable curtain air bags. Both frontal air bags deployed as a result of the Dodge's frontal impact with the case vehicle. Furthermore, the Dodge was equipped with bucket seats with manual, three-point, lap-and-shoulder, safety belt systems for driver and front right passenger seating positions.

Figure 33: Reference line view from left with contour gauge at bumper level showing Dodge's oblique crush profile and damaged and restricted left front tire (case photo #62)

Figure 34: Overhead view of Dodge pickup's frontal damage with contour gauge set at bumper level (case photo #69)

Exterior Damage: The Dodge's initial contact with the case vehicle involved the entire front with the damage distributed all the way across (**Figure 7** above). Direct damage began at the front left bumper corner and extended, a measured distance of 116 centimeters (45.7 inches), along the front bumper (**Figure 33**). Residual maximum crush was measured as 39 centimeters (15.4 inches) at C_2 (**Figure 34**). The table below shows the other vehicle's crush profile.

Units	Event	Direct Damage		Field L	C_1	C_2	C_3	C_4	C_5	C_6	Direct	Field L
		Width CDC	Max Crush								±D	±D
cm	1	116	39	172	35	39	38	34	14	0	0	0
in		45.7	15.4	67.7	13.8	15.4	15.0	13.4	5.5	0.0	0.0	0.0

The wheelbase on the Dodge's left side was shortened approximately 37 centimeters (14.6 inches–**Figure 35** below) while the right side was extended approximately 5 centimeters (2.0 inches). The Dodge pickup's front bumper, bumper fascia, grille, hood, radiator, and left headlight and turn signal assemblies were directly damaged and crushed rearward (**Figure 33**).

The vehicle manufacturer's recommended tire size was: P225/75R16, but tire size P245/75R16 was optional; the Dodge was equipped with tire size: LT235/85R16. The Dodge's

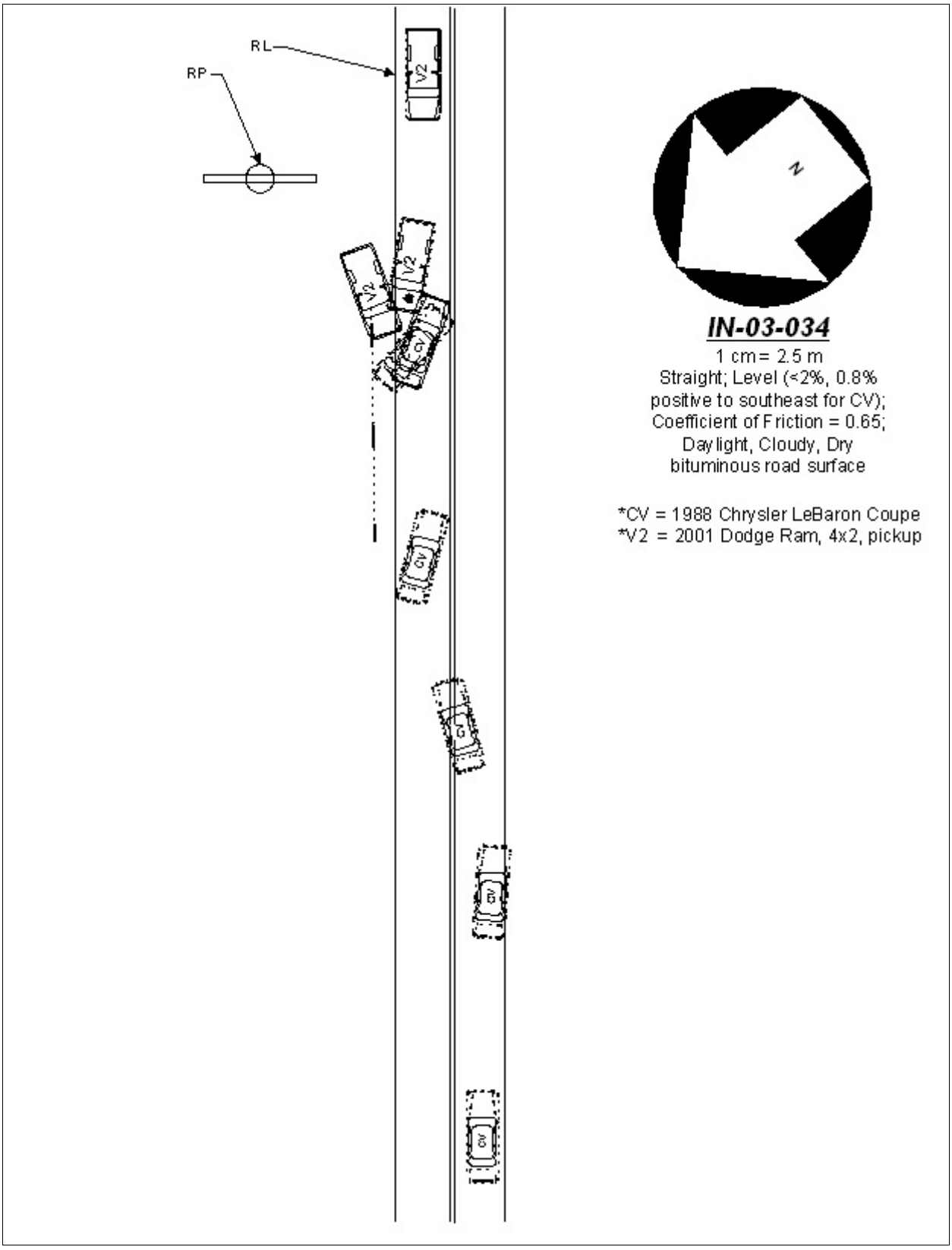
tire data are shown in the table below. In addition, the Dodge's left front tire was damaged, deflated, and physically restricted.

Tire	*Measured Pressure*		*Recommend Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kPa	psi	kPa	psi	milli-meters	32nd of an inch			
LF	0	0	283	41	6	8	Sidewall torn; rim bent	Yes	Yes
RF	352	51	283	41	5	6	None	No	No
LR	338	49	283	41	14	18	None	No	No
RR	331	48	283	41	13	16	None	No	No

Damage Classification: Based on the vehicle inspection, the CDCs for the Dodge pickup were determined to be: **12-FDEW-2** (**350** degrees) for the initial impact (**Figure 7** above) with the case vehicle and **09-LPLW-1** (**270** degrees) for the side slap impact (**Figure 35**). The WinSMASH reconstruction program, damage only algorithm, was used on the Dodge's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 42.0 km.p.h. (26.1 m.p.h.), -41.4 km.p.h. (-25.7 m.p.h.), and +7.3 km.p.h. (+4.5 m.p.h.). Based on the vehicle inspection, this collision fits the reconstruction model, and the calculated longitudinal Delta V appears to be reasonable. The Dodge was towed due to damage.

Figure 35: Dodge pickup's side slap damage from left front of case vehicle; Note: damaged, deflated left front tire and induced damage (rearward movement) to driver's door from frontal impact (case photo #63)

Dodge pickup's Occupants: According to the Police Crash Report, it is not known if the Dodge's driver [35-year-old, (unknown race and/or ethnic origin) female] or the **two** (i.e., report did not distinguish which was left or right of the other) **front right** passengers [11 and 14-year-old, (unknown race and/or ethnic origin) males, respectively] were restrained by their available, active, three-point, lap-and-shoulder, safety belt systems. The driver was transported to a hospital for medical treatment with police-reported "B" (non-incapacitating-evident) injuries. Neither of the two other occupants of this vehicle were transported by ambulance to the hospital, but both were listed as sustaining police-reported "B" (non-incapacitating-evident) injuries as a result of this crash.


RL
RP
V2
V2
V2
CV
CV
CV
CV
CV
N
IN-03-034
1 cm = 2.5 m
Straight; Level (<2%, 0.8% positive to southeast for CV); Coefficient of Friction = 0.65; Daylight, Cloudy, Dry bituminous road surface
*CV = 1988 Chrysler LeBaron Coupe
*V2 = 2001 Dodge Ram, 4x2, pickup