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CALSPAN ON-SITE CHILD SAFETY SEAT CRASH INVESTIGATION
SCI CASE NO: CA05-064

VEHICLE: 2000 DODGE CARAVAN
LOCATION: NEW YORK
CRASH DATE: DECEMBER, 2005

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points are coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

TECHNICAL REPORT STANDARD TITLE PAGE

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16. Abstract This investigation focused on the crash dynamics, injury sources, and the performance of three Child Safety Seats (CSS) that were in use by the child occupants of a 2000 Dodge Caravan. The Dodge Caravan was involved in a side-impact crash with a 1997 Ford E150 Cargo van. The Dodge turned left across the path of the Ford resulting in an impact with the front of the Ford striking the right side of the Dodge in a 3/12 o'clock impact configuration. The Dodge Caravan was occupied by a 29 year old unrestrained driver, an unrestrained 29 year old front right passenger, 2 year old twins (each restrained in a forward-facing CSS in Row 2) and a 4 year old male seated in a backless booster seat (restrained by the vehicle's safety belt) in the right position of Row 3. During the crash sequence, the 4 year old was ejected from the vehicle. He was found approximately 10 m (30 ft) from the vehicle's final rest position. He sustained two fractured ribs and multiple contusions. The 2 year old seated on the right side of Row 2 sustained an unspecified closed head injury. The 2 year old seated on the left side of Row 2 was not injured and was not transported. The driver and front passenger of the Caravan had police reported complaints of pain and were transported for examination. The driver of the Ford was transported to a local hospital, examined and released.			
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BACKGROUND

This investigation focused on the crash dynamics, injury sources, and the performance of three Child Safety Seats (CSS) that were in use by the child occupants of a 2000 Dodge Caravan. The Dodge Caravan, **Figure 1**, was involved in a side-impact crash with a 1997 Ford E150 Cargo van. The Dodge turned left across the path of the Ford resulting in an impact with the front of the Ford striking the right side of the Dodge in a 3/12 o'clock impact configuration. The Dodge Caravan was occupied by a 29 year old unrestrained driver, an unrestrained 29 year old front right passenger, 2 year old female twins (each restrained in a forward-facing CSS in Row 2) and a 4 year old male seated in a backless booster seat (restrained by the vehicle's safety belt) in the right position of Row 3. During the crash sequence, the 4 year old was ejected from the vehicle. He was found approximately 10 m (30 ft) from the vehicle's final rest position. He sustained two fractured ribs and multiple contusions. The 2 year old seated on the right side of Row 2 sustained an unspecified closed head injury. The 2 year old seated on the left side of Row 2 was not injured and was not transported. The driver and front passenger of the Caravan sustained minor injury and were transported for examination. The driver of the Ford was transported to a local hospital, examined and released.

Figure 1: Right oblique view of the Dodge Caravan.

The crash was identified through an internet news media article by the Crash Investigation Division of the National Highway Traffic Safety Administration on December 12, 2005. The Calspan Special Crash Investigations team was notified of the crash the same day and an on-site crash investigation was assigned due to the agency's high interest in child passenger safety. Cooperation with the investigating police department was established, and the vehicles and child safety seats were available for inspection. The on-site portion of the investigation took place December 14, 2005.

SUMMARY

VEHICLE DATA

2000 Dodge Caravan

The 2000 Dodge Grand Caravan was identified by the Vehicle Identification Number (VIN): 2B4GP25R8YR (production sequence deleted). The four-door, seven passenger minivan was configured on the 288 cm (113.3 in) wheelbase and was equipped with the SE level trim package. The power train consisted of a 3.3 liter/V6 engine linked to a four-speed automatic transmission. The service brakes were a front disc/rear drum system with ABS. The seating configuration consisted of two manual bucket seats in the front row, a two passenger bench seat in the second row, and a third row three passenger bench seat. The manual restraint system consisted of three-point lap and shoulder belts in the six outboard positions and a third row center lap belt. The frontal air bag system consisted of redesigned driver and front right passenger air bags. The vehicle was manufactured in October 1999. The digital odometer could not be read due to a lack of electrical power. The Caravan was equipped with a P205/75R14 tires. The left front and right front tires were a Delta Vista and a General Ameriway XT, respectively. The left rear and right rear tires were Cooper Trendsetter SE. The recommended tire pressure was 241 kPa (35 PSI). The specific measured tire data was as follows:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	172 kPa (25 PSI)	6 mm (8/32)	No	None
LR	117 kPa (17 PSI)	5 mm (6/32)	No	None
RF	124 kPa (18 PSI)	6 mm (8/32)	No	None
RR	0 kPa	6 mm (8/32)	No	Direct impact damage, Wheel separated at axle

At the time of the crash, three children were in transport in three Child Safety Seats (CSS), **Figure 2**, restrained within the Dodge. The Caravan was the only vehicle used to transport the children. The harness straps of the respective seats were adjusted approximately two weeks prior to the crash and the vehicle's safety belts were periodically checked and tightened as necessary. The parents (driver and front passenger) were not familiar with Child Safety Seat check points. Two year old twins were restrained in Row 2 of the Dodge in forward facing CSS's. An Evenflo Ultara Convertible Child Safety Seat was restrained in the Row 2 left position. A Cosco High Back Belt Positioning Booster seat with an integral 5-point harness was in the Row 2 right. In the right position of Row 3, the 4 year old seat was seated in a Backless Booster Seat restrained by the vehicle's three-point lap and shoulder safety belt. This seat was purchased approximately 3 weeks prior to the crash.

Figure 2: View of the Child Safety Seats.

1997 Ford E150 Cargo Van

The 1997 Ford E150 Cargo Van was identified by the Vehicle Identification Number (VIN): 1FTEE1461VH (production sequence deleted). The 454 kg (1/2 ton), 4x2 rear wheel drive cargo van was configured on a 351 cm (138 in) wheelbase and had a Gross Vehicle Weight Rating (GVWR) of 3,039 kg (6,700 lb). The power train consisted of a conventionally mounted 4.6 liter/V8 engine linked to a four-speed automatic transmission. The van was manufactured in June 1997. The odometer reading was 243,473 km (151,291 miles). The vehicle's interior consisted of two buckets seats equipped with manual three point lap and shoulder restraints in the front row. The interior volume aft of the front row was open and was used to transport tools and construction equipment. The vehicle was equipped with frontal air bags for the driver and front right passenger that deployed as a result of the impact. The Ford was equipped with Futura Adventurer P235/75R15 tires with OEM steel wheels. The recommended tire pressures were 241 kPa (35 PSI) front and 283 kPa (41 PSI) rear. The specific measured tire data was as follows:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	193 kPa (28 PSI)	5 mm (6/32)	No	None
LR	0 kPA	6 mm (7/32)	No	None
RF	193 kPa (28 PSI)	3 mm (4/32)	No	None
RR	214 kPa (31 PSI)	6 mm (7/32)	No	None

CRASH SITE

This two-vehicle crash occurred during the morning hours of December, 2005. At the time of the crash, the weather was clear and the road surface was wet from an overnight frost. The crash occurred on a two-lane asphalt north/south state roadway. The width of the respective travel lanes measured 3.7 m (12 ft). The road was delineated by a broken yellow centerline and white fog lines. The road had a positive grade estimated at percent in the northbound direction. The west side of the road was bordered by a 2.1 m (6.8 ft) wide shoulder. A child care center and a parking lot were located on the west side of the road. A circular driveway provided assess into the center. The crash occurred at the north-most entrance/exit to the facility. A series of three parallel gouge marks identified the point of impact and post-crash trajectory of the Caravan. The length of the longest mark measured 4.5 m (14.6 ft). This mark began 1.6 ft west of the fog line and was directed to the southwest. The marks were attributed to post-impact contact from the right rear suspension of the Caravan. There was a 29 m x 13 m (96 ft x 43 ft) area of grass in the center of the circular drive immediately outboard the west shoulder. This grass area was the final rest locations of the respective vehicles. The speed limit in the area of the crash was 56 km/h (35 mph). **Figure 3** is a northbound trajectory view of the Dodge Caravan approaching the north driveway entrance. The **Figure 4** is a northward lookback from the area of final rest to the point of impact.

Figure 3: Northbound trajectory view.

Figure 4: Northward view from final rest to the POI.

CRASH SEQUENCE

Pre-Crash

The 2000 Dodge Caravan was northbound driven by a 29 year old male. The vehicle was occupied by a 29 year old female in the front right position, a 2 year old female in a convertible CSS in the row 2 left position, a 2 year old female in a high back belt positioning booster seat in the row 2 right position, and a 4 year old male in a backless booster seat in the row 3 right position. The driver of the Caravan was in the process of transporting his children to the child care center located on the west side of the road. The 1997 Ford E150 van was southbound driven by a 44 year old male and occupied by a 29 year old male front right passenger. The crash occurred when the driver of the Caravan turned left across the path of a Ford. The driver intended to enter the driveway of the child care center. The Caravan driver reported that visibility was not an issue, he simply was in error. The driver of the Ford steered to the right in an attempt to avoid the encroaching Dodge. A schematic of the crash is included at the end of this report as **Figure 16**.

Crash

The full frontal plane of the Ford struck the aft aspect of the Caravan's right side in a 3/12 o'clock impact configuration. The Principle Direction of the impact Force (PDOF) was 80 degrees and 350 degrees for the Dodge and Ford, respectively. The force of the impact caused the deployment of the frontal air bags in the Ford. The impact force aft of the Caravan's center of gravity resulted in a clockwise rotation of the vehicle and redirected the Dodge to the southwest. The Dodge rotated approximately 180 degrees and came to rest in the grass island facing southeast approximately 21.3 m (70 ft) from the point of impact. The Ford continued along its southwest trajectory and came to rest facing southwest approximately 19.8 m (65 ft) from the point of impact. The severity of the impact (delta V) was calculated by the Damage Algorithm of the WINSMASH model. The total delta V Dodge was 31 km/h (19.3 mph) and the resolved longitudinal and lateral components were –5 km/h (-3.1 mph) and -31 km/h (-19.3 mph), respectively. The total delta V of the Ford was 26 km/h (16.2 mph). Its longitudinal and lateral delta V components were –26 km/h (-16.2 mph) and 5 km/h (3.1 mph), respectively.

Post-Crash

Employees from the child care center heard the crash, exited the building and were the first responders to the scene. The police and ambulance personnel were notified and arrived a short time later. During the crash sequence, the 4 year old was ejected from the backless booster seat. Reportedly, he was found approximately 10 m (30 ft) from the vehicle. The driver reported that he exited the vehicle and ran to check the condition of the 4 year old and then ran back to attend to the front right passenger. The two year old twins were reportedly removed from the vehicle by a child care worker while still in the child seats to await the ambulance. The 2 year old seated on the right (near) side of row 2 was reportedly unconscious. The 4 year old child and the 2 year old were transported via life-flight to a pediatric trauma center. The 4 year old child sustained two fractured ribs and multiple contusions and was hospitalized for three days. The 2 year old was hospitalized for three days with a reported closed head injury. The 2 year old on the left (far) side of row 2 was not injured. The driver and front right passenger of the Caravan had police reported minor injuries and were also transported for examination. The driver of the Ford was not injured. Both vehicles sustained disabling damage and were towed.

2000 DODGE CARAVAN

Exterior Damage

Figure 5 is an overall right side view of the Dodge Caravan. **Figure 6** is a close-up right side view of the direct damage. The right side plane of the vehicle sustained 186 cm (73.2 in) of direct contact damage that began at the right B-pillar and extended rearward to a point 44 cm (17.3 in) aft of the right rear axle. The combined width of the direct and induced damage measured 324 cm (127.5 in). The induced damage began at the right A-pillar location 43 cm (17.0 in) aft of the right front axle. The elevation of the direct contact was centered 61 cm (24 in) above the ground (consistent with the front bumper of the Ford). The crush profile measured at the mid door elevation was at follows: C1 = 4 cm (1.6 in), C2 = 39 cm (15.4 in), C3 = 53 cm (20.9in), C4 = 44 cm (17.3 in), C5 = 15 cm (5.9 in), C6 = 1 cm (0.4 in). The maximum crush measured 55 cm (21.6 in) at was located at the left C-pillar location. The force of the impact separated the right rear wheel and tire at the axle housing. The right side doors and rear tailgate were jammed shut. The backlight and all the right side window glazings disintegrated. The left doors were operational. There was no change in either wheelbase dimension. The Collision Deformation Classification (CDC) of the impact was 03-RZAW-3.

Figure 5: Right side view of the Dodge.

Figure 6: Close-up view of the direct damage.

1997 FORD E150 CARGO VAN

Exterior Damage

Figure 7: Oblique view of the Ford.

Figure 7 is a front left oblique view of the Ford. The direct contact damage to the Ford extended across the entire 175 cm (69 in) frontal end width of the vehicle. The damage was managed primarily by the vehicle's structures forward of the radiator support plane. The damaged components included: the front bumper, head lamp assemblies, center grill hood and both the left and right front fenders. The frontal structure was swayed to the right approximately 5 cm (2 in) due to lateral momentum of the Dodge. The residual crush profile measured along the front bumper was as follows: C1 = 13 cm (5.1 in), C2 = 3 cm (1.2 in), C3 = 3 cm (1.2 in), C4 = 0, C5 = 5 cm (2.0 in), C6 = 10 cm (3.9 in). There was no change in the respective wheelbase dimensions. All doors remained closed during the crash sequence and were operational post-crash. The windshield was not fractured and all the side glazing was intact. The CDC of the Ford was 12-FDEW1.

2000 DODGE CARAVAN

Interior Damage

The interior damage to the Dodge consisted of right intrusion of the right side structures as a result of the lateral impact force and the identified occupant contact points. The frontal air bags were not commanded to deploy in the side impact crash. The right side intrusion extended longitudinally from the right B-pillar to the right D-pillar and effected the right seat position in all three rows. The magnitude of the intrusion to the right side components is identified in the following table:

Seat Position	***Component***	***Lateral Magnitude***
Row 1 Right	Forward-most aspect of the right door panel	1 cm (0.5 in)
Row 1 Right	Right B-pillar	20 cm (8.0 in)
Row 2 Right	Right rear door panel at seat bight	18 cm (7.0 in)
Row 3 Right	Right C-pillar	17 cm (6.5 in)
Row 3 Right	Right side panel	18 cm (7.2 in)
Row 3 Right	Right D-pillar	22 cm (8.5 in)

Figure 8 is a left lateral view across the front row of the Dodge. The front row of the Caravan consisted of two bucket seats with integral head restraints. The driver seat was adjusted to a rear track position that measured 6 cm (2.5 in) forward of full rear. The total seat track travel measured 23 cm (9 in). The seat back angle measured 15 degrees aft of vertical and was measured 36 cm (14 in) above the seat bight. The horizontal distance from the seat back to the center of the steering wheel rim measured 61 cm (24 in). The redesigned driver air bag located in the center of the steering wheel rim was not commanded to deploy. The tilt steering wheel was adjusted to the center position. There was no steering wheel rim deformation and there was no steering column shear capsule displacement. The driver's knee bolster did not exhibit any contact evidence.

Figure 8: Left lateral view across Row 1.

The arm rest attached to the inboard aspect of the driver seat was deflected to the right 8 cm (3 in) by contact with the driver's abdomen. The retractable cup holder located in the center console immediately below the radio was deformed to the right and could not be closed. The damage to the drink tray was attributed to contact with the driver's right knee.

The front right passenger seat was adjusted to a rear track position consistent with the driver seat 6 cm (2.5 in) forward of full rear. The seat back was reclined 20 degrees. The right B-pillar was in contact with the outboard aspect of the seat. The floor pan under the seat was deformed laterally. The floor pan deformation extended to the rear cargo area.

A 24 cm x 9 cm (9.5 in x 3.5 in) area of contact was noted to the aft aspect of the right front door panel at the door lock. The vinyl/plastic of the door panel was fractured. This contact was attributed to the right arm/shoulder region of the front right passenger. There was no noted contact evidence to the glove box door/bolster area. The designed front right passenger air bag in the right aspect of the instrument panel was not commanded to deploy in the lateral impact.

The vehicle's second row consisted of a two passenger bench seat with a folding back and adjustable head restraints, **Figure 9**. The head restraints were in the full down position. The seat back angle measured 15 degrees. The horizontal distance from the seat back of Row 2 to the seat back of Row 1 measured 67 cm (26.5 in). The interior panel of the sliding right rear door was fractured. A 17 cm (6.5 in) long region of blood transfer was noted to the top forward aspect of the right door panel at the door lock. This blood transfer was the only noted contact within the second row. There was no contact to the front seat backs.

Figure 9: Lateral view of Row 2.

The third row of the Dodge consisted of a three passenger fixed bench seat. **Figure 10** is a view looking rearward into the seat. The seat back angle measured 28 degrees. The horizontal distance from the seat back of Row 3 to the seat back of Row 2 measured 70 cm (27.5 in). Note the right side intrusion and seat deformation. The interior side panel was deformed and fractured. The right aspect of the seat was deformed and compressed inboard 5 cm (2 in) at the seat bight. This compression resulted in the inboard movement of the safety belt anchor that in-turn introduced slack in the belt system. The slack safety belt and the centrifugal force of the post-impact resulted in the ejection of the child passenger through the right rear window opening. There were no occupant contacts identified in the third row seating area.

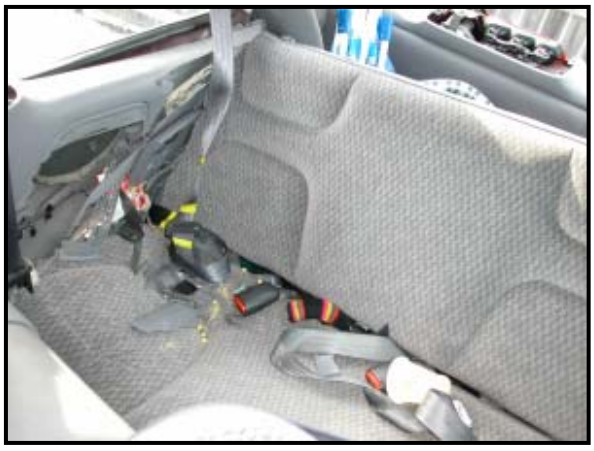

Figure 10: View of the Row 3 right position.

Manual Restraint Systems

The manual restraint systems in the 2000 Dodge Caravan consisted of three-point lap and shoulder safety belts in the six outboard positions and a third row center lap belt. The driver's restraint consisted of continuous loop webbing, a sliding latch plate, an adjustable D-ring and an Emergency Locking Retractor (ELR) located in the base of the B-pillar. The webbing was stowed at inspection. The D-ring was in the full up position. Examination of the webbing was

unremarkable for crash related evidence. The latch plate examination revealed historical use evidence; however, no crash related evidence. The driver stated in his interview that he was unrestrained and this statement was consistent with the results of the inspection.

The front right passenger restraint consisted of continuous loop webbing, a light-weight locking latch plate, an adjustable D-ring and an ELR retractor. The D-ring was in the full up position. Upon inspection, the webbing was stowed in the retractor and the webbing was captured in this position due to the right side deformation. The webbing was in contact with the outboard aspect of the seat and the retractor was locked. It was not possible for the restraint to have been in use at the time of the crash. In her interview, the front right passenger confirmed that she was unrestrained.

The manual restraints in Row 2 each consisted of continuous loop webbing, a light-weight locking latch plate, an adjustable D-ring and an ELR retractor. The manual restraint for the Row 2 left position was stowed in the retractor and the retractor was operational. The D-ring was in the full up position and its friction surface was not abraded. The safety belt was in use at the time of the crash and was used to restrain an Evenflo Ultara Convertible Child Safety Seat (CCSS) in a forward facing mode. The webbing exhibited frictional abrasion where the webbing was in contact with the forward facing belt path of the CSS during the ride down of the crash. The abrasions measured 5 cm (2 in) in width and were located 67 cm (26.5 in) and 91 cm (35.7 in) above the outboard floor anchor respectively. The friction surface of the latch plate hardware exhibited a minor abrasion.

The safety belt for the right position was in use at the time of the crash and was used to restrain a Dorel High Back Belt Positioning Booster Seat (HBBPB). The webbing was in the extended position upon initial inspection and the retractor was locked due to deformation. The retractor was in contact with the Row 3 seat. Examination of the webbing revealed abrasions consistent with its contact with the belt path of the HBBPB. The abrasions measured 5 to 8 cm (2 to 3 in) in width and were located 70 cm (27.5 in) and 108 cm (42.5 in) above the floor anchor, respectively. A crease related to the buckled position of the latch plate was located 121 cm (47.5 in) above the anchor. A 20 cm (8 in) long section of the webbing near the D-ring exhibited minor dicing cuts from its exposure to the disintegrated window glazing. The surface of the D-ring was not abraded.

The manual restraints in Row 3 right position consisted of continuous loop webbing, a light-weight locking latch plate, a fixed D-ring and an ELR retractor. The restraint was in use at the time of the crash and used to restrain the 4 year male seated on the Cosco Backless Booster Seat (BBS). The webbing was in the extended and locked position upon initial inspection. The retractor was locked due to the D-pillar deformation. Examination of the webbing revealed loading evidence across the lap section of the buckled restraint. This 30 cm (12 in) webbing section was located from 6 cm (2.5 in) below the stop button to 24 cm (9.5 in) above the stop button. A webbing crease identified the location of the buckled latch plate. Its location measured 30 cm (12 in) above the stop button. The surface of the D-ring was not abraded.

Figures 11 and 12 are views of the child safety seats reinstalled in Row 2 and Row 3 of the vehicle, respectively. The BBS in Row 3 could not be properly positioned and re-buckled due to

the right side deformation. The intrusion of the right side caused the floor anchor of the Row 3 right safety belt to move inboard and reduced the width between the floor anchor and belt buckle. The deformed position of the anchor introduced belt slack into the lap portion of the safety belt during the crash. The slack belt allowed the 4 year old child to be ejected out through the right rear window opening due to the lateral impact force and rotation of the vehicle.

Figure 11: Right view across Row 2.

Figure 12: View of the Row 3 right position.

CHILD SEAT DATA

Row2 Left – Evenflo Ultara

The Evenflo Ultara Convertible Child Safety Seat (CCSS) was manufactured in August 2, 1994 and was identified by the serial number: 235-386P2. Refer to **Figure 13**. The seat was designed to be used for rear-facing or forward facing use dependant on the age of the child. The seat was configured with an adjustable base, and a tray shield. The instruction labels on the seat had been removed by repeated washing.

Figure 13: Evenflo Ultara.

The CCSS was installed in a forward-facing mode and was restrained by the vehicle's three-point safety belt through the forward facing belt path. It was occupied by a 2 year old female with an approximate weight of 11 kg (25 lb). The base was adjusted to the forward facing mode. Inspection of the belt path identified abrasions consistent with safety belt use. The harness straps of the CCSS were adjusted to the top slots. The straps were in good condition and were not roped or twisted. There was no evidence of loading to the straps. Inspection of the shell was unremarkable for crash related evidence.

Row2 Right– Dorel High Back Belt Positioning Booster

The Dorel High Back Belt Positioning Booster (HBBPB), **Figure 14**, was manufactured on February 4, 2002 and was identified by the Model number: 02-441-WAL. The seat and internal five-point harness was labeled for use by toddlers weighing 10 kg – 18 kg (22 lb - 40 lb) with a height of 102 cm (40 in) or less. When used in this manner the seat was restrained by the vehicle's safety belt through the belt path designed in the back of the seat's shell. The HBBPB was also labeled for use by a child 14 kg – 36 kg (30 lb – 80 lb) and 94 cm – 130 cm (37 in to 51 in) in height (whose mid-point of the head was not above the level of the seat back). When used in this manner the seat was used strictly as a belt positioner and the vehicle's safety belt restrained both the seat and child together.

Figure 14: Dorel Booster.

The 2 year old child was restrained by the seat's internal five-point harness at the time of the crash. The harness straps were adjusted to the top slots and were roped and twisted throughout their length. Inspection of the straps was unremarkable for crash related evidence. The belt path through the rear aspect of the shell exhibited minor abrasions from interaction with the vehicle's safety belt. The right (outboard) aspect of the shell exhibited abrasions from contact with the intruding side door panel. Stress marks were observed on the left (inboard) side of the shell from probable contact with the right side of the adjacent Evenflo CCSS during the impact. Minor blood evidence was located on the right aspect of the shell's base.

Row3 Right – Cosco Backless Belt Positioning Booster

The Cosco Highrise Backless Belt Positioning Booster Seat (BBS) was manufactured on June 9, 2005 and was purchased three weeks prior to the crash. Refer to **Figure 15**. The BBS was identified by the Model number: 22-296-WAL and Serial number: BB1C 237055. The seat was labeled for use by a child over 1 year in age weighing 14 kg – 45 kg (30 lb - 100 lb) with a height of 74 cm – 145 cm (29 in – 57 in). The BBS was occupied by a 4 year old male and he was restrained by the vehicle's safety belt.

Figure 15: Cosco Highrise Backless Booster.

Examination of the seat revealed the right arm rest was fractured due to its contact with the intruding right side panel. Minor abrasions to the shell were noted within the molded cut outs for the lap belt path and to the forward aspect of the inboard side due to probable interaction with the safety belt buckle.

OCCUPANT DEMOGRAPHICS

Row 1

	Driver	***Front Right Passenger***
Age/Sex:	29 year old/Male	29 year old/Female
Height:	185 cm (73 in)	168 cm (69 in)
Weight:	98 kg (200 lb)	70 kg (155 lb)
Seat Position:	Rear track	Rear track
Manual Restraint Use:	None	None
Usage Source:	SCI inspection, interview	SCI inspection, interview
Medical Treatment:	Transported and released	Transported and released

Row 2

Position in Vehicle:	***Left***	***Right***
Age/Sex:	2 year old/female (twins)	2 year old/female (twins)
Height:	Unknown	Unknown
Weight:	16 kg (36 lb)	11 kg (25 lb)
Child Safety Seat:	Convertible	High-back Belt Positioning Booster
Restraint Use:	3-point harness/Tray shield	5-point harness
Usage Source:	SCI inspection	SCI inspection
Medical Treatment:	Not injured	Hospitalized 2 days with unspecified closed head injury

Row 3

Position in Vehicle:	***Left***	***Right***
Age/Sex:	Not Occupied	4 year old/male
Height:	----	104 cm (41 in)
Weight:	----	18 kg (40 lb)
Child Safety Seat:	----	Backless Booster
Restraint Use:	----	3-point lap and shoulder
Usage Source:	----	SCI inspection
Medical Treatment:	----	Hospitalized for 3 days with unspecified right rib fractures,

DRIVER INJURY

Injury	***Injury Severity (AIS 98 Update)***	***Injury Source***
Right hip contusion	Minor (890402.1,1)	Inboard arm rest
Lower back pain	Not AIS codeable	Crash force
Minor laceration of the left 5th finger	Minor (790602.1,2)	Unknown

Note: the above injuries were identified during an interview with the driver. Medical records were not available.

DRIVER KINEMATICS

The 29 year old male driver was seated in a rear track position and was unrestrained. He steered the Dodge left across the path of the Ford precipitating the side impact crash. The driver responded to the 3 o'clock direction of the impact force by initiating a right trajectory. The driver's right hip contacted the arm rest attached to the inboard aspect of the driver seat. This contact resulted in a right hip contusion and a right deflection of the arm rest. The driver then rebounded back into the driver seat and came to rest. He exited the vehicle under his own power.

FRONT RIGHT PASSENGER INJURY

Injury	***Injury Severity (AIS 98 Update)***	***Injury Source***
Unspecified general pain / soreness	Not AIS codeable	Crash force

Note: the above injuries were identified during an interview with the front right passenger. Medical records were not available.

FRONT RIGHT PASSENGER KINEMATICS

The 29 year old female front right passenger was seated in a rear track position in an upright posture. She was not utilizing the manual safety belt. Upon impact, the right responded to the 3 o'clock direction of the impact force by initiating a rightward trajectory. The right flank of the passenger contacted and loaded the right door panel. This loading resulted in her general pain and soreness. As the vehicle rotated counterclockwise upon separation, the passenger remained in contact with the door panel and rode down the force of the crash. The passenger then rebounded back into the seat where she came to rest.

ROW 2 LEFT CHILD PASSENGER INJURY

This child passenger was not injured in the crash.

ROW 2 LEFT CHILD PASSENGER KINEMATICS

This 2 year old passenger was restrained by the tray shield of a convertible Child Safety Seat. Upon impact, the child responded to the 3 o'clock direction of the impact by initiating a rightward trajectory. The child loaded the right side of the child seat shell and the tray shield and rode down the force of the impact. The child did not sustain any injuries.

ROW 2 RIGHT CHILD PASSENGER INJURY

Injury	*Injury Severity (AIS 98 Update)*	*Injury Source*
Laceration of the right temple, NFS	Minor (190600.1,1)	Intruding right side panel
Closed head injury, not further specified	Unknown (115099.7,0)	Intruding right side panel

Note: the above injuries were identified during an interview with the front right passenger. Medical records were not available.

ROW 2 RIGHT CHILD PASSENGER KINEMATICS

This 2 year old child passenger was restrained by the 5-point harness of a forward facing High back Belt Positioning Booster Seat. Upon impact, the child initiated a trajectory to the right in response to the 3 o'clock direction of the impact and loaded the harness straps of the booster seat. Coincident to this, the right side structure of the Dodge was intruding as a result of the impact. The intruded right side contacted and loaded the right side of the booster seat evidenced by the abrasions to the shell. This contact further displaced the child to the right and into contact with the right side. As the vehicle rotated counterclockwise, the child's head flexed forward and down contacting the right door panel. This contact resulted in the closed head injury and minor laceration of the right temple. Blood evidence was noted on the forward aspect of the right door panel. The child then rebounded back into the booster seat shell and came to rest.

The first responders to the crash removed the child from the vehicle where she was restrained within the booster seat and reported that she was initially unconscious. She was life-flighted to a regional pediatric trauma center and hospitalized for two days. Medical records were requested but could not be obtained.

ROW 3 RIGHT CHILD PASSENGER INJURY

Injury	*Injury Severity (AIS 98 Update)*	*Injury Source*
Two right rib fractures, unknown location	Moderate (450220.2,1)	Intruding right side panel
Contusion right lower extremity, NFS	Minor (890402.1,1)	Intruding right side panel
Contusion, Right shoulder/collarbone, NFS	Minor (790402.1,1)	Seat belt loading

Note: the above injuries were identified during an interview with the front right passenger. Medical records were not available.

ROW 3 RIGHT CHILD PASSENGER KINEMATICS

The 4 year old male child was seated in an upright posture on a backless booster seat and was restrained by the vehicle's three-point lap and shoulder belt. The booster seat was purchased approximately three weeks prior to the crash for the child and was appropriate for his age, height,

and weight. Upon impact, the child initiated a rightward trajectory in response to the 3 o'clock direction of the impact force. The force of the impact locked the safety belt's inertial retractor. Coincident to this pattern, the right side structures of the interior was intruding as a result of the impact. The child loaded the intruding structures with his right flank resulting in the rib fractures and the lower extremity contusion. The right arm rest of the booster seat was fractured by this contact.

As a result of the intrusion and floor pan deformation, the floor anchor of the Row 3 right safety belt was displaced inboard. The movement of the floor anchor altered the geometry of the locked safety belt and introduced slack into the lap portion webbing. As the crash ensued and the vehicle rotated counterclockwise upon separation, the 4 year old child loaded the slack belt system with his lower extremities and right shoulder. The combined force of the impact coupled with the centrifugal force of the rotation ejected the child from the slack belt system through the right rear window opening. The child reportedly came to rest approximately 9 m (30 ft) from the final rest location of the Dodge. He was transported via life-flight to a regional pediatric trauma center. He was hospitalized for three days and then released.

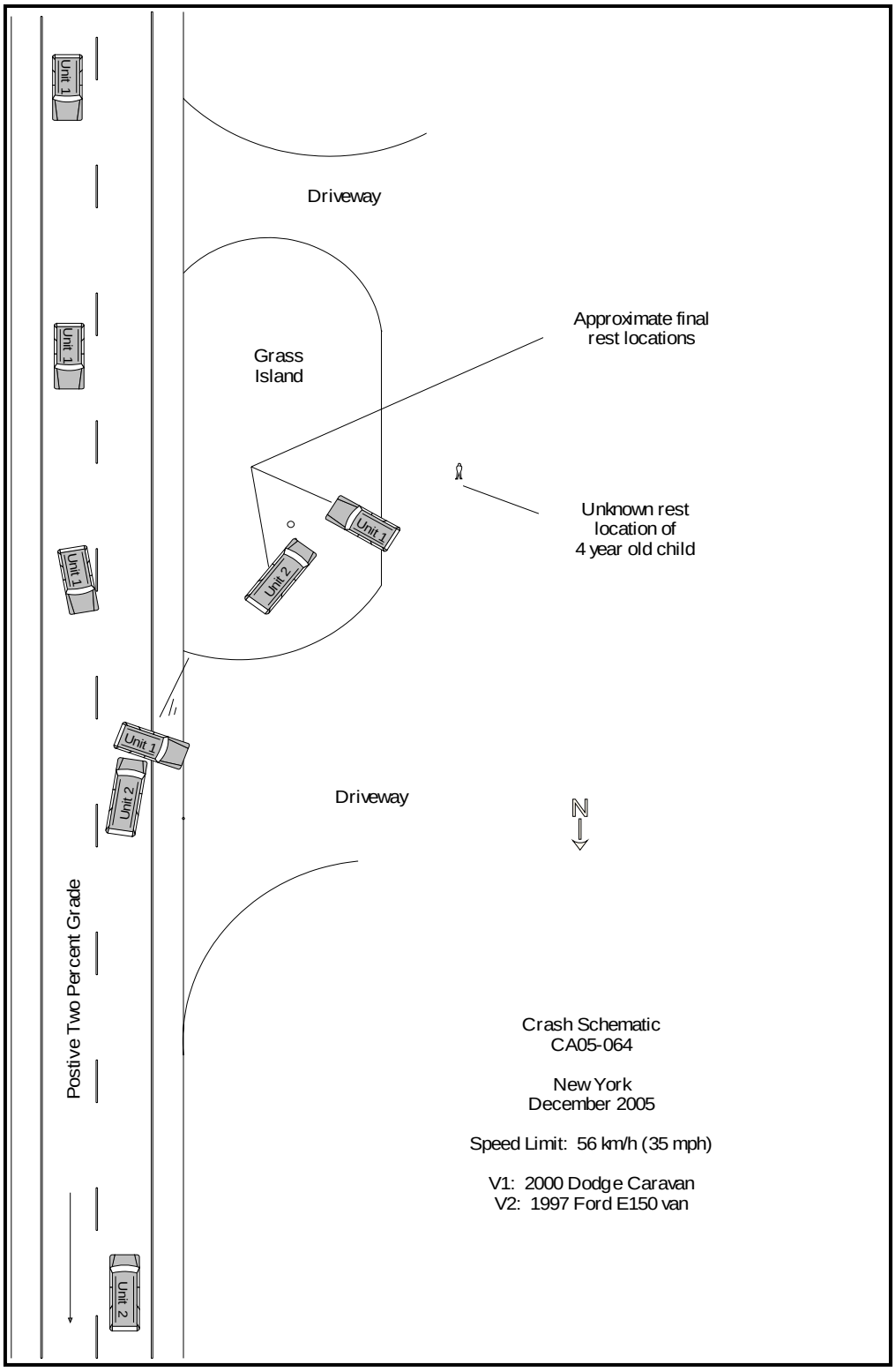

Figure 16: Crash Schematic.