On-Site Child Safety Seat Investigation
Dynamic Science, Inc. (DSI) / Case Number: DS07004
2005 Dodge Grand Caravan
Oregon
January 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

1. Report No.	2. Government Accession No.	3. Recipient Catalog No.
DS07004		

4. Title and Subtitle	5. Report Date
On-Site Child Safety Seat Investigation	May 8, 2008
	6. Performing Organization Report No.

7. Author(s)	8. Performing Organization Report No.
Dynamic Science, Inc.	

9. Performing Organization name and Address	10. Work Unit No. (TRAIS)
Dynamic Science, Inc. 299 West Cerritos Avenue Anaheim, CA 92805	11. Contract or Grant no. DTNH22-07-00045

12. Sponsoring Agency Name and Address	13. Type of report and period Covered [Report Month, Year]
U.S. Dept. of Transportation National Highway Traffic Safety Administration 1200 New Jersey Ave, SE Washington, DC 20590	14. Sponsoring Agency Code

15. Supplemental Notes

16. Abstract

This on-site investigation focused on two forward facing child booster seats that were installed in the second row of a 2005 Dodge Grand Caravan. The Dodge was being driven by a restrained 39-year-old female. The second row left occupant was a 5-year-old female seated in a booster safety seat (BSS). The second row right occupant was a 4-year-old female and was also seated in a BSS. The other vehicle was a 2004 Ford F350 that was towing a horse trailer and was being driven by a 28-year-old female. This two vehicle crash occurred in January 2007 hours on a north/south section of roadway. The Dodge Caravan was traveling in the southbound lane and the Ford F350 was traveling in the northbound lane. The driver of the Dodge entered an area of ice patches and lost control of the vehicle. The front end of the Ford contacted the right side of the Dodge. The driver of the Dodge sustained moderate injuries and sought treatment later. The 5-year-old female seated in the second row left position sustained serious injuries. The 4-year-old female seated in the second row right position sustained serious injuries. The driver of the Ford F350 was not injured in the crash. The Dodge Caravan was towed from the scene and was declared a total loss by the insurance company. The Ford F350 was towed from the scene and was declared a total loss.

17. Key Words	18. Distribution Statement
Booster seat, child seat, injury	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No of pages	22. Price

Dynamic Science, Inc.
Crash Investigation
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BACKGROUND

This on-site investigation focused on two forward facing child booster seats that were installed in the second row of a 2005 Dodge Grand Caravan. The Caravan was being driven by a restrained 39-year-old female. The second row left occupant was a 5-year-old female seated in a booster safety seat (BSS). The second row right occupant was a 4-year-old female also seated in a BSS. The Dodge was traveling south on a two-lane state highway. The other vehicle was a 2004 Ford F350 Super Duty crew cab pickup being driven by a restrained 28-year-old female. The Ford was pulling a horse trailer that contained two horses and was traveling north. As the Dodge entered an area of roadway that had patches of ice, the driver lost control of the vehicle. The Dodge rotated counter-clockwise, crossed the center line and traveled into the northbound lane. The front end of the Ford contacted the right side of the Dodge. The driver of the Dodge sustained moderate injuries in the collision. The 5-year-old female seated in the second row left position sustained serious injuries. The 4-year-old female seated in the second row right position sustained serious injuries. The driver of the Ford F350 was not injured in the crash.

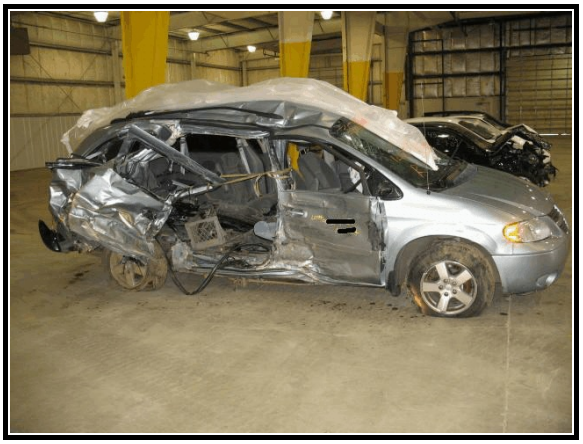


Figure 1. 2005 Dodge Grand Caravan, right side damage

Figure 2. 2004 Ford F350 Super Duty pickup, front/right damage

This Child Safety Seat investigation was identified by DSI personnel and forwarded to NHTSA on January 20, 2007. On January 23, 2007, DSI was instructed to locate the vehicles and booster seats. DSI located both vehicles and the booster seats, and on February 7, 2007 obtained permission to conduct the inspections. DSI was assigned the case on February 8, 2007. The Dodge Caravan (**Figure 1**) was inspected on February 15, 2007. The Ford F350 (**Figure 2**) inspection and field work were completed on February 16, 2007. Data from the Ford's Event Data Recorder (EDR) was downloaded using the Vetronix tool and is included as Attachment 2 in this report. The driver of the Dodge Caravan was initially contacted on October 10, 2007. She stated she could be interviewed following litigation relating to the crash. The interview was completed on April 22, 2008.

SUMMARY

Crash Site

This two vehicle crash occurred in January 2007 at 0858 hours on a section of roadway in a rural area of Oregon. The crash scene was a two lane, two way, undivided section of a state highway. The roadway ran north and south. The travel lanes were separated by two painted solid yellow lane lines. The roadway was bordered by painted solid white fog lines and asphalt shoulders. Adjacent to the shoulders were dirt and grassy areas that sloped down and away from the roadway.

Figure 3. Approach of Ford F350 to area of impact (north)

The roadway surface was comprised of asphalt. In the pre-crash areas, the northbound lane had a negative 4.4% grade and the southbound lane had a 1.2% grade. The crash occurred during daylight hours under clear weather conditions. According to both drivers' statements to police, the travel lanes were icy. The posted speed limit on this section of roadway was 64 km/h (40 mph).

Pre-Crash

The Dodge Caravan was traveling in the southbound lane at a driver estimated speed of 56 km/h (35 mph). The Ford F350 was traveling in the northbound lane (**Figure 3**) at a driver estimated speed of approximately 32 km/h (20 mph). The driver of the Dodge was negotiating a slight left-hand curve when she contacted an ice patch and lost control of the vehicle. The Dodge rotated counterclockwise and slid into the northbound travel lane. The Ford reportedly braked but could not avoid contact with the Dodge.

Crash

The front end of the Ford contacted the right side of the Dodge. There was intra-unit contact between the Ford and the horse trailer. The Dodge sustained undercarriage damage from contact with the ground. The Dodge came to rest off the highway, facing west. The Ford came to rest facing east with its front end on the sloped shoulder and its rear tires and trailer on the roadway (**Figure 4**). The impact resulted in sufficient longitudinal deceleration of the Dodge to command the deployment of the driver's front air bag and inflatable knee bolster. The Ford's driver and passenger front air bags also deployed during the impact.

Post-Crash

The driver of the Dodge sustained moderate injuries and sought treatment later. The 5-year-old female seated in the second row left position sustained serious injuries, and was transported by ambulance to a local hospital. The 4-year-old female seated in the second row right position was

found seated on her booster seat following the crash. The 4-year-old sustained serious injuries, and was transported by air ambulance to a local hospital. During the impact, the Dodge's second row seat was torn from its anchorage and was pushed rearward into the right rear area of the vehicle.

The driver of the Ford was not injured in the crash.

The Dodge Caravan was towed from the scene and declared a total loss by the insurance company. The Ford F350 was towed from the crash to a salvage yard, then later was transported to a repair facility.

Figure 4. Vehicles at final rest (police photo)

Vehicle Data - 2005 Dodge Grand Caravan

The 2005 Dodge Grand Caravan was identified by the Vehicle Identification Number (VIN): 2D4GP44L55Rxxxxxx. The Dodge Grand Caravan is a front wheel drive, four-door minivan with a rear liftgate and seating for seven. The case vehicle was equipped with a 3.8 liter 6-cylinder engine, a 4-speed automatic transmission, 4-wheel anti-lock brakes, a stability control feature (TRAC) (**Figure 5**) and a tilt steering wheel. The vehicle mileage could not be determined due to lack of power to the vehicle.

Figure 5. TRAC stability control Override switch (located on top of steering column)

The Caravan was configured with Firestone FR380 P215/65R16 tires on the front axle and Bridgestone Turanza EL42 P215/65R16 tires on the rear. The vehicle manufacturer's recommended cold tire pressure is 248 kPa (36 psi) for the front and rear. The specific tire information is as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	221 kPa (32 psi)	5 mm (6/32 in)	No	None
LR	221 kPa (32 psi)	5 mm (6/32 in)	No	None
RR	Tire flat	5 mm (6/32 in)	Yes	Holed
RF	Tire flat	5 mm (6/32 in)	No	None

The seating in the Dodge Grand Caravan was configured with front row bucket seats, two second row box mounted bucket seats and a third row 60/40 split bench with separate backs. The seat covers were fabric. The second and third row seats were part of the Dodge Caravan's Stow n' Go feature which allowed the seats to fold down into storage compartments in order to increase cargo capacity.

All seven seating positions were equipped with adjustable head restraints. The driver's seat was adjusted to between the middle and fully forward track position. The right front seat was adjusted to the fully rearward track position. The second row left seat was adjusted to the fully rearward track position. The second row right pre-crash seat track position could not be determined due to damage. The third row bench seats did not have adjustable seat tracks.

The driver's seat back angle was positioned 16 degrees from vertical and the seat cushion angle was 16 degrees from horizontal. The front right passenger's pre-crash seat back angle could not be determined due to damage; the seat bottom angle was positioned 14 degrees from horizontal. The second row left seat back was at a 7 degree angle; the seat cushion was at an 11 degree angle. The second row right pre-crash seat back and seat cushion angles could not be determined due to damage. The third row seat backs and seat cushions were deformed due to damage. The third row seats were not in the stowed position at the time of the crash, but were pushed rearward by the intruding second row right seat.

The second row seats and the third row outboard seats were equipped with the lower anchor points that were part of this vehicle's Lower Anchors and Tethers for Children (LATCH) system. The second row seat tether anchors were located on the back of each seat cushion. All three third row seats were equipped with tether anchor points located on the back of the seat cushions.

Vehicle Damage - 2005 Dodge Grand Caravan

Exterior Damage

The Dodge Caravan sustained right side damage as a result of the impact with the Ford F350. The direct damage began 182 cm (71.7 in) aft of the right front axle, and extended forward 112 cm (44.1 in). The right rear door locking mechanisms were damaged from the force of the impact, and the door was peeled rearward, resulting in passenger compartment integrity loss. The right wheelbase was lengthened by 2 cm (0.8 in). The left wheelbase was lengthened by 1 cm (0.4 in).

Six crush measurements were documented at the right sill level, beginning 262 cm (103.1 in) aft of the right front axle, and extending forward 205 cm (80.7 in) (**Figure 6**). The crush measurements were as follows: C1=10 cm (3.9 in), C2=4 cm (1.6 in), C3=5 cm (2.0 in), C4=12 cm (4.7 in), C5=11 cm (4.3 in), C6=5 cm (2.0 in). The maximum lateral crush at the sill level measured 12 cm (4.7 in) and was located at C4.

Six crush measurements were documented at the mid-door level, beginning 164 cm (64.6 in) aft of the right front axle, and extending forward 110 cm (43.3 in)(**Figure 7**). The crush measurements were documented at this level as follows: C1=41 cm (16.1 in), C2=33 cm (13.0 in), C3=27 cm (10.6 in), C4=16 cm (6.3 in), C5=8 cm (3.1 in), C6=0 cm. The maximum lateral crush at the mid-door level measured 41 cm (16.1 in) and was located at C1.

Due to the right rear door latch failure and the 13 cm (5.1 in) or more difference between the sill level crush and the maximum crush above the sill, the lateral crush resulting from this crash event was documented at both the sill and mid-door levels. Due to the rearward movement of the right rear door, mid-door level crush measurements were not obtained aft of the B-pillar area. Therefore, an additional crush profile was taken at the mid-door level from the forward most deflection point to the right B pillar.

The crush measurements taken at the sill and mid-door levels were then averaged. The averaged crush measurements were as follows: C1=26 cm (10.2 in), C2=19 cm (7.5 in), C3=16 cm (6.3 in), C4=16 cm (6.3 in), C5=8 cm (3.1 in), C6=0 cm. The averaged maximum lateral crush at the mid-door level measured 41 cm (16.1 in) and was located at C1. The Collision Deformation Classification (CDC) for this impact was 01RPAW3. The Ford was out of scope of the Winsmash program because it was pulling a trailer. Therefore, a barrier equivalent algorithm of the Winsmash program was used and computed a barrier equivalent speed (BES) of 19 kmph (11.8 mph).

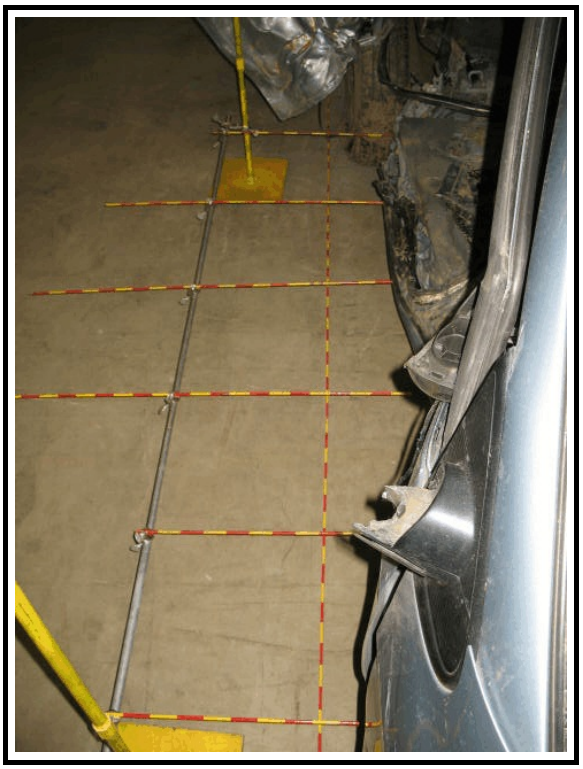


Figure 6. Right side crush profile (sill level)

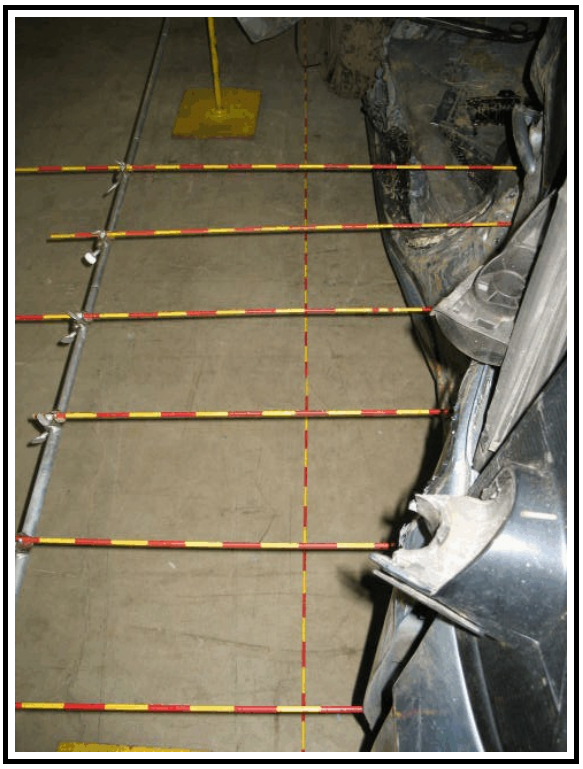


Figure 7. Right side crush profile (mid-door level)

The Dodge Caravan sustained minor undercarriage damage as a result of the impact between the left rear undercarriage and the ground (**Figure 8**). The direct damage began 371 cm (146.1 in) aft of the left front axle and extended 23 cm (9.1 in) rearward. The maximum vertical crush was located 394 cm (155.1 in) aft of the left front axle. There was 2 cm (0.8 in) of vertical crush at this location. The CDC for this impact was 00UBDW2.

Figure 8. Dodge Caravan - undercarriage damage

Interior Damage

The Dodge sustained interior damage as a result of occupant contact, passenger compartment intrusion and normal air bag deployment related damage.

There were scuffs found on the plastic knee bolster cover, likely due to contact with the driver's knees and lower legs (**Figure 9**). There was a faint scratch on the left instrument panel, possibly due to contact from the driver's left hand. There was a faint scuff found on the second row right seat head restraint. A blonde hair was found in the same area as the scuff.

Figure 9. Scuffs to lower left instrument panel/knee bolster cover

The driver seat belt and both second row passenger seat belts showed signs of historical usage during the crash. The driver's belt webbing was scuffed and there were webbing fibers on the driver's D-ring. There was blood found on a section of the second row left seat belt webbing that may have crossed this occupant's chest. A 28 cm (11.0 in) section of the second row right seat belt webbing was scuffed, beginning approximately 14 cm (5.5 in) below the stop button, and extending upward.

The second row left seat back fabric was scuffed from contact with the lower back section of the child safety seat.

The left side doors and rear liftgate remained closed and operational. The right front door was jammed shut due to damage. The right rear door's sliding and locking mechanisms were damaged during the crash. The door was pushed rearward, resulting in integrity loss. The opening into the second row right seating area measured approximately 114 cm (44.9 in) in width by 108 cm (42.5 in) in height.

There was additional integrity loss to all three right side window glazing areas. The windshield was cracked, but remained in place.

The right front seat was deformed due to lateral intrusion of the right front door panel and right B-pillar. The second row right seat was deformed from contact with the front end of the Ford F350. There was scratching to the lower right corner of the seat cushion which may have resulted from contact with the Ford's bumper. The third row seats were damaged from contact with the intruded second row right seat.

There were multiple longitudinal, lateral and vertical intrusions into the passenger compartment seating areas. The specific passenger compartment intrusions were documented as follows:

Row/Position	Intruded Component	Magnitude of Intrusion	Direction
3rd row right	Second row right seat	65 cm (25.6 in)	Longitudinal
3rd row right	D-pillar	46 cm (19.3 in)	Lateral
1st row right	B-pillar	36 cm (14.2 in)	Lateral
1st row right	Window frame	34 cm (13.4 in)	Lateral
1st row left	Knee bolster cover	32 cm (12.6 in)	Vertical
1st row right	Door panel	31 cm (12.2 in)	Lateral
2nd row right	Roof side rail	19 cm (7.5 in)	Lateral
2nd row right	C-pillar	18 cm (7.1 in)	Lateral
1st row right	Glove compartment door	9 cm (3.5 in)	Longitudinal
1st row right	Roof side rail	8 cm (3.1 in)	Lateral
1st row right	Windshield header	6 cm (2.4 in)	Vertical
3rd row right	Roof side rail	6 cm (2.4 in)	Lateral
2nd row right	Roof	4 cm (1.6 in)	Vertical
3rd row middle	A-pillar	3 cm (1.2 in)	Vertical
3rd row middle	D-pillar	3 cm (1.2 in)	Lateral
3rd row middle	Instrument panel	3 cm (1.2 in)	Longitudinal

Manual Restraints - 2005 Dodge Grand Caravan

The Dodge was configured with 3-point manual lap and shoulder belts for all six of the outboard seating positions. The third row middle seating position was equipped with a manual lap belt.

The first row seat belts were equipped with retractor pretensioners. There were no indications that either pretensioner actuated during the crash. The first row right seat belt was locked in the stowed

position due to B-pillar damage.

The driver's seat belt anchorage adjustment was set to the full up position; the front right anchorage was set to the middle position. Both second row seating positions were equipped with seat belt anchorage adjustments that were set to the full down positions. The third row seat belts were not equipped with anchorage adjustments.

The first row seat belts were configured with sliding latch plates and emergency locking retractors (ELR). The second and third row outboard seat belts were configured with lightweight locking/cinching latch plates and emergency locking retractors. The third row center seat belt had a locking latch plate and no retractor.

The second row left and right seat belts were used to secure the two child safety seats (**Figures 10-11**). According to investigating officers, both child safety seats were properly secured at the time of the crash. The lower portion of the second row left seat belt was found routed through the seat back adjustment lever. The belt showed signs of damage indicating that the belt webbing had been routed this way at the time of the crash.

Figure 10. Second row left seat belt found routed through seat back adjustment lever

Figure 11. Second row right safety belt and child seat

Supplemental Restraints - 2005 Dodge Grand Caravan

The 2005 Dodge Grand Caravan was equipped with advanced occupant protection systems (AOPS), including multi-stage Certified Advanced 208-Compliant (CAC) driver and front right passenger air bags. A CAC vehicle is certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208. In a CAC vehicle, the front air bags deploy depending the severity of the crash, the location of each occupant's seat track position and whether or not there is a right front passenger present. In certain conditions the passenger sensing system will turn off the right front air bag.

Figure 12. Deployed driver front air bag

Additionally, this vehicle included a driver inflatable knee bolster. This vehicle was not equipped with side air bags or side curtain air bags.

Figure 13. Deployed driver inflatable knee bolster

The driver's front air bag was mounted within the steering wheel hub. The single semi-circular air bag module cover flap was 6 cm (2.4 in) wide along the two upper horizontal edges and 3 cm (1.2 in) high along the upper vertical flap edges. The cover flap measured 20 cm (7.9 in) in width at its widest point and 12 cm (4.7 in) in height at the highest point.

The deployed air bag was circular in shape and measured 65 cm (25.6 in) in diameter in its deflated state (**Figure 12**). The maximum excursion of the deflated front air bag measured 26 cm (10.2 in) from the module face. The air bag had one internal tether. There were two vent ports located on the back of the bag at the 11 and 1 o'clock positions. There was no damage to the air bag or the air bag module cover flaps. There was dirt found on the lower right quadrant on the front of the air bag face and on the upper and lower areas on the back of the bag. Some of the scene debris had been placed in the driver's seating area and dried mud was found on the steering wheel and left front door panel. The mud and dirt were likely transferred during post-crash activities.

Figure 14. Inflatable knee bolster top tether attachment points

The driver's inflatable knee bolster was mounted below the steering column. As it inflated, the bolster knocked the plastic cover 32.0 cm (12.6 in) into the driver's lower leg area (**Figure 13**) . The air bag was rectangular in shape and measured 48.0 cm (18.9 in) wide by 36.0 cm (14.2 in) high. The top of the knee bolster was attached to the base of the steering column by two tether straps (**Figure 14**) and the bottom of the bolster was attached to the lower left instrument panel plastic cover by two tether straps. There was no damage or sign of occupant contact to the inflatable knee bolster.

The front right passenger air was located in the mid instrument panel. There was no occupant seated in this position; do to the seat being unoccupied, the air bag was suppressed and did not deploy during the crash.

Child Safety Seats

Britax Starriser Comfy Belt Positioning Booster Seat

A forward facing Britax Starriser Comfy belt positioning booster seat was positioned in the Caravan's second row left seating position (**Figure 15**). The model number was E900336 and the date of manufacture was March 17, 2006. The seat was configured with a height adjustable seat back and a padded head rest. On the outer right section of the headrest, there was a small section of damaged foam that measured 3 cm (1.2 in) wide by 1 cm (0.4 in) high. The seat back on the booster seat was found to be bent slightly to the right, but there were no visible cracks or stress marks found anywhere on the seat.

Figure 15. Britax booster seat in second row left seat

The manufacturer recommended that this seat be used only with children whose height is between 109 - 135 cm (43 - 53 in); there were no weight restrictions posted on the seat. The 5-year-old female using this child seat measured 114 cm (45 in) in height and weighed 20 kg (45 lb). She was of an appropriate height and weight for the booster seat. One of the seat's warning labels stated that a child is over the maximum height for the seat when the top of the child's ears are above the top of the fully raised headrest. A second label stated to "use only this vehicle's lap and shoulder belt system when restraining the child in this seat." There were visible friction marks found on the left side of the child seat, in the area of the route path of the lap belt.

The base of the seat measured 34 cm (13.4 in) wide by 37 cm (14.6 in) deep from front to back. The seat back measured 41 cm (16.1 in) at its widest point, and was set to a height of 71 cm (28.0 in) from the base of the seat. The seat was configured with removable padding for both the sections of the booster seat (**Figure 16**). There was a blood stain found on the padding of the seat cushion (**Figure 17**). There was dirt found on multiple areas of padding, which likely was transferred post-crash. At the time of the vehicle inspection, this booster seat was found on the floorboard area behind the right front seat, facing upright.

Figure 16. Seat back structure (padding removed)

The second row left seating position was equipped with a 3-point manual lap and shoulder belt with a lightweight locking/cinching latch plate and an emergency locking retractor. The anchorage adjustment was set to the full down position. At the time of the vehicle inspection, the lower portion of this occupant's seat belt was found routed through the seat back adjustment lever. There was damage to this section of webbing that indicated the belt may have been routed this way at the time of the crash.

Figure 17. Britax booster seat showing seat back angle and blood on seat padding

The seat belt webbing did not show any signs of occupant loading. There were no scuffs or friction marks present that would have indicated that the shoulder belt had been routed through the child seat's belt positioning device. A bloodstain was found on the shoulder portion of the seat belt webbing.

At the time of the inspection, the second row left seat head restraint was adjusted to the full down position. The fabric on the second row left seat back near the seat bight was scuffed from contact with the lower back section of the booster seat. This occupant's seating position was equipped with the lower anchors and tether points that are part of this vehicle's Lower Anchors and Tethers for Children (LATCH) system, but this Britax belt positioning booster seat was not configured with LATCH hardware.

Cosco Dorel Juvenile Group Booster Seat

A forward facing Cosco/Dorel High Rise booster seat was positioned in the Caravan's second row right seating position. The model number was 22-297-WAL and the date of manufacture was July 8, 2003. The seat was configured as a backless booster seat with a fabric covered seat cushion.

At the time of the vehicle inspection, this booster seat was found on the second row right seat bottom, with the back end partially wedged between the damaged seat back and seat bottom, and the front end tilted upward (**Figure 18**). According to the police report, an off-duty paramedic found the 4-year-old occupant pinned upside down. She reportedly was still in her car seat, which was entangled within the vehicle's damaged components.

There were two small tears to the seat cushion fabric that appeared to be related to this crash. The right side of the child seat was broken into several pieces (**Figure 19**). Pieces of the damaged child seat were found on the floorboard in the area of the displaced second row right seat.

The manufacturer recommended that this seat be used only with children whose weight is between 14 and 45 kg (30 and 100 lbs) and whose height is less than 132 cm (52 in), as long as the midpoint of the child's head is not above the vehicle's seat back. The booster seat's warning label stated to use only the vehicle's lap and shoulder belt system when restraining the child in the booster seat. The 4-year-old female using this booster seat measured 109 cm (43 in) in height and weighed 21 kg (46 lb). She was of an appropriate height and weight for the booster seat.

Figure 18. Cosco Dorel booster seat as found in the vehicle

Figure 19. Cosco Dorel booster seat, showing damage

The second row right seating position was equipped with a 3-point manual lap and shoulder belt with a lightweight locking/cinching latch plate and an emergency locking retractor. The anchorage adjustment was set to the full down position. The seat belt was found buckled; the belt webbing was damaged. A 28 cm (11.0 in) section of the second row right seat belt webbing was scuffed, beginning approximately 14 cm (5.5 in) below the stop button, and extending upward.

At the time of the inspection, the top of the second row right seat head restraint was adjusted to 10 cm (3.9 in) above the top of the seat back cushion. This occupant's seating position was equipped with the lower anchors and tether points that are part of this vehicle's LATCH system; however, this booster seat was not configured with LATCH hardware.

Vehicle Data - 2004 Ford F350 Super Duty Crew Pickup

The 2004 Ford F350 Super Duty crew pickup was identified by the Vehicle Identification Number (VIN): 1FTSW31P94Exxxxxx (**Figure 20**).

The Ford was towing a horse trailer that contained two horses. An investigating police officer estimated the weight of the trailer to be approximately 4534 kg (10,000 lbs). The weight of the horses is not known.

Figure 20. 2004 Ford F350, partially torn down at repair facility

The Ford F350 Super Duty crew cab pickup was a 4-wheel drive, 4-door pickup with seating for six. The vehicle was equipped with a 6.0 liter, 8-cylinder engine, a 4- speed automatic transmission, 4-wheel anti-lock brakes and a tilt steering wheel. The vehicle mileage at the time of the inspection was 113,402 km (70,465 miles).

The Ford F350 was configured with BF Goodrich Rugged Trail T/A LT265/75R16 tires on the front and rear axles. The vehicle manufacturer's recommended cold tire pressure was 379 kPa (55 psi) for the front and 552 kPa (80 psi) for the rear. The specific tire information was as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	331 kPa (48 psi)	6 mm (7/32 in)	No	None
LR	331 kPa (48 psi)	6 mm (7/32 in)	No	None
RR	331 kPa (48 psi)	5 mm (6/32 in)	No	None
RF	345 kPa (50 psi)	6 mm (7/32 in)	Yes	None

The seating in the 2004 Ford F350 was configured with a front row vinyl covered 40/20/40 split bench seat with separate back cushions. The second row was configured as a vinyl covered 60/40 bench seat with separate back cushions.

The two front row outboard seating positions were equipped with integral head restraints that were not damaged. The second row outboard seating positions were equipped with adjustable head

restraints that were not damaged. The front and second row center seats were not equipped with head restraints. The front row seats were adjusted to between the center and fully rearward track positions. The second row seat tracks were not adjustable.

Vehicle Damage - 2004 Ford F350 Super Duty Crew Pickup

Exterior Damage

The Ford F350 sustained moderate front end damage as a result of the impact with the Dodge Grand Caravan (**Figure 21**). The front end of the Ford had been partially dismantled by a repair facility prior to the inspection. The damaged front bumper, grille and right front quarter panel were found inside the truck's cargo bed. A front end crush profile could not be obtained. The vehicle sustained 141 cm (55.5 in) of direct damage beginning 58 cm (22.8 in) left of the vehicle's pre-crash center point, extending along the front bumper to the right. The maximum longitudinal crush for this impact measured 18 cm (7.1 in) and was located 8 cm (3.1 in) left of the vehicle's pre-crash center point. The right front tire was damaged and restricted. The CDC for the Ford's damage was 12FDEW1.

Figure 21. 2004 Ford F350, front view

There was 98 cm (38.6 in) of direct damage to the Ford's right front and rear doors that began 222 cm (87.4 in) forward of the right rear axle, and extended forward up the right side. This direct damage was likely due to contact with the Dodge's right rear door during the initial impact.

Figure 22. Left rear intra-unit contact damage

The Ford F350 sustained left side damage as a result of intra-unit contact with the horse trailer, which jack-knifed during the crash (**Figure 22**). The direct damage from this event began 81 cm (31.9 in) aft of the left rear axle, extending forward 15 cm (5.9 in). The maximum lateral crush for this impact measured 20 cm (7.9 in) and was located 76 cm (29.9 in) aft of the left rear axle. The CDC for the intra-unit contact was 08LBEN2.

2004 Ford F350 Event Data Recorder Discussion

The Ford's Event Data Recorder (EDR) was downloaded by the SCI investigator and the Vetronix report is included as Attachment 2 at the end of this narrative report.

The 2004 Ford F350 was equipped with an advanced occupant protection system. The system consisted of the Restraint Control Module (RCM), a driver's air bag, a front right passenger's air bag, and front seat belt pretensioners. The vehicle was equipped with a Passenger Air Bag Switch and it was found in the ON/Automatic position at the time of the vehicle inspection. The RCM records only longitudinal acceleration/deceleration of the vehicle. The primary function of the RCM is to control the deployment of the air bags and pretensioners. The RCM recorded a single deployment event. Both frontal air bags deployed and both front row outboard seat belt pretensioners actuated.

The Vetronix report indicated the following:

- The passenger air bag switch position during event was Activated.
- The frontal and pretensioner fire time was 42.25 milliseconds.
- The longitudinal cumulative Delta V was 16.56 km/h (10.29 mph) at 116 milliseconds.

Occupant Demographics - 2005 Dodge Grand Caravan

	Driver	**Second Row Left Seat Occupant**
Age/Sex:	39/Female	5/Female
Seated Position:	Between the middle and forward most track position	Rearward most track position
Seat Type:	Bucket	Van/box mounted
Height:	179 cm (67 in)	114 cm (45 in)
Weight:	70 kg (154 lb)	20 kg (45 lb)
Alcohol/Drug Involvement:	None	None
Body Posture:	Upright, normal	Upright, normal
Hand Position:	Both hands on steering wheel	Hands at sides
Foot Position:	Right foot on brake, left foot on floor	Feet not touching floor
Restraint Usage:	3-point manual lap and shoulder belt used	3-point manual lap and shoulder belt used with booster safety seat
Air bag:	Steering wheel mounted, deployed; knee air bag, deployed	None available

	Second Row Right Seat Occupant
Age/Sex:	4/Female
Seated Position:	Unknown due to damage
Seat Type:	Van/box mounted
Height:	109 cm (43 in)
Weight:	21 kg (46 lb)
Alcohol/Drug Involvement:	None
Body Posture:	Upright, normal
Hand Position:	Hands at sides
Foot Position:	Feet not touching floor
Restraint Usage:	3-point manual lap and shoulder belt used with booster safety seat
Air bag:	None available

Occupant Kinematics - 2005 Dodge Grand Caravan

Driver Kinematics

The 39-year-old female driver was seated in an upright posture and was restrained by the available 3-point manual lap and shoulder safety belt (**Figure 23**). The safety belt anchorage adjustment was set to the full up position. The seat was adjusted to between the middle and forward most track position. The driver's seat back angle was positioned 16 degrees from vertical and the seat bottom angle was 16 degrees from horizontal.

Figure 23. Driver's seat belt, frayed webbing fibers on D-ring

The Dodge entered an area of roadway that had patches of ice, and the driver lost control of the vehicle. The Dodge rotated counterclockwise, crossed the center lane and traveled into the northbound lane. The driver of the Ford braked but could not avoid the impact with the Dodge. The front end of the Ford contacted the right side of the Dodge, resulting in the deployment of the Dodge driver's front air bag and knee air bag.

At impact, the Dodge driver initiated a forward and slightly right trajectory in response to the 2 o'clock direction of force. She loaded the lap and shoulder belt with her chest and abdomen. She sustained contusions to her left shoulder, left breast, and abdomen from the seat belt webbing. Her right hip sustained a contusion from contact with the seat belt buckle. Her left lower leg sustained a contusion from contact with the knee bolster.

The Dodge was redirected rearward from the force of the impact and rotated counterclockwise while still engaged with the Ford F350. During the rotation, this driver was displaced rearward and to the right. She sustained cervical and thoracic disk injuries and cervical ligament strain as a result of impact forces. The Caravan rotated approximately 270 degrees before it departed the east side of the roadway. The vehicle traveled down the sloped grassy shoulder and came to rest in a field, facing west. The driver sought medical treatment later.

Second Row Left Seat Occupant Kinematics

The 5-year-old female seated in the second row left position was seated in the forward facing BSS. The child was sitting in an upright posture and was restrained by the available 3-point manual lap and shoulder belt. At the time of the inspection, the booster seat was found on the floorboard area behind the right front seat, facing upright. The lower portion of this occupant's safety belt was found routed through the seat back adjustment lever. There was damage to this section of webbing that indicated the belt may have been routed this way at the time of the crash.

This occupant's seat track was adjusted to the fully rearward track position. The seat back angle was positioned 7 degrees from vertical and the seat bottom angle was 11 degrees from horizontal. The seat belt anchorage adjustment was set to the full down position.

As the front of the Ford F350 struck the right side of the Caravan, this passenger initiated a forward and slightly right trajectory. She sustained a contusion to the left shoulder as a result of contact with the seat belt webbing. She sustained a contused left lung as a result of indirect contact when she loaded the seat belt.

The Dodge moved rearward from the force of the impact and rotated counterclockwise while still engaged with the Ford F350. During the rotation, this occupant was displaced rearward and to the right. The driver indicated there were loose toys in passenger compartment. The 5-year-old sustained a fracture to the right cheek and a contusion to the right eye. The driver indicated these injuries may have resulted from contact with airborne toys. The child sustained superficial lacerations to the face as a result of contact with flying glass. The Caravan rotated approximately 270 degrees before it departed the east side of the roadway. The vehicle traveled down the sloped grassy shoulder and came to rest in a field, facing west. The child was transported by ambulance to a local hospital where she was admitted for one day.

Second Row Right Seat Occupant Kinematics

The 4-year-old female seated in the second row right position was seated in the forward facing BSS. The child was sitting in an upright posture and restrained by the available 3-point manual lap and shoulder belt. This occupant's pre-crash seat track position and seat back/seat cushion angles

could not be determined due to damage. The seat belt anchorage adjustment was set to the full down position.

As the front of the Ford F350 struck the right side of the Caravan, this occupant initiated a forward and slightly right trajectory. The right rear door was pushed rearward and the Ford F350's right front bumper corner intruded into the Dodge Caravan's passenger compartment. She sustained a contusion to the lower abdomen as a result of loading the seat belt. She sustained a contused lung while loading the seat belt, a right facial fracture when her face contacted the right door panel, and a lower leg fracture (the source for this injury is not known). This occupant's seat was torn from its anchorage and pushed rearward, into the third row seating area. She sustained minor lacerations to the left side of her face, right neck and right shoulder as a result of contact from flying glass. The right side of the BSS was heavily damaged; pieces of the child seat were found on the floor in the area surrounding the seat. The seat belt was found with the latch plate still wedged in the buckle and the belt webbing was damaged in two areas.

The child was found pinned upside down, still in her car seat, that was still attached to the main seat and was tangled in the vehicle's damaged body. According to the police report, this occupant was removed from the vehicle by a passing motorist, who was an off-duty paramedic. The child was transported by air ambulance to an area hospital. She was hospitalized for approximately eight weeks.

Occupant Injuries - 2005 Dodge Grand Caravan

Driver

Injury	OIC Code	Injury Mechanism	Confidence Level
Contusion, left lower leg	890402.1,2	Left lower IP	Certain
Contusion, left shoulder	790402.1,2	Seat belt webbing	Certain
Contusion, left breast	490402.1,2	Seat belt webbing	Certain
Contusion, abdomen	590402.1,8	Seat belt webbing	Certain
Contusion, right hip	590402.1,1	Seat belt buckle	Certain
Disc injury NFS, cervical	650200.2,6	Impact forces	Probable
Disc injury NFS, thoracic	650400.2,7	Impact forces	Probable
Ligament injury NFS, (cervical strain)	640278.1,6	Impact forces	Probable

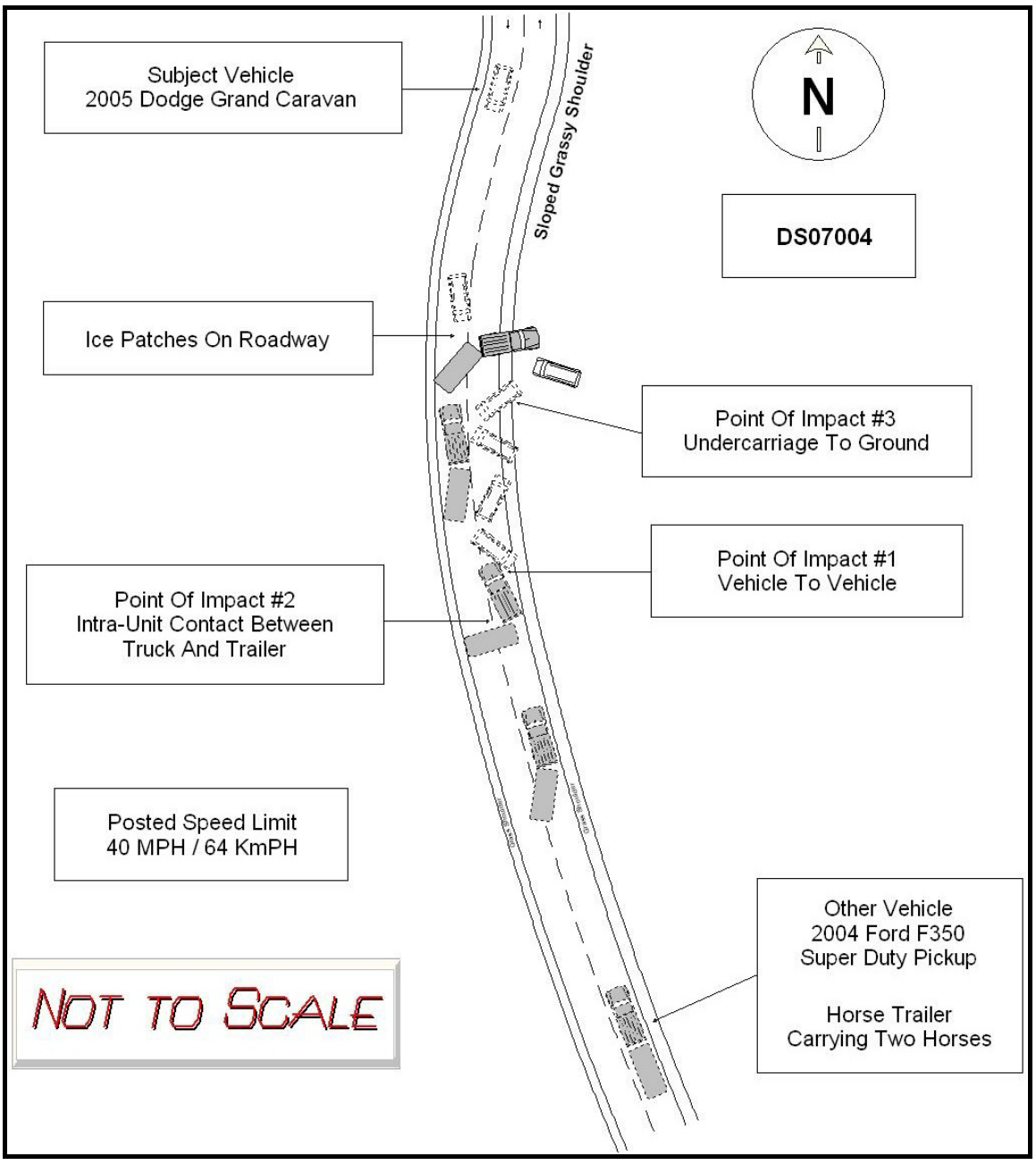
Second Row Left Occupant

Injury	OIC Code	Injury Mechanism	Confidence Level
Fracture, right cheek	250400.1,1	Loose object, toy	Probable
Contusion, right eye (orbit)	297402.1,1	Loose object, toy	Probable
Contusion, left shoulder	790402.1,2	Seat belt webbing	Probable
Contusion, left lung	441402.3,2	Seat belt webbing	Probable
Laceration, minor, left face	290602.1,2	Flying glass	Probable

Second Row Right Occupant

Injury	OIC Code	Injury Mechanism	Confidence Level
Fracture, right face NFS	250400.1,1	Side door, panel	Probable
Fracture, lower leg NFS	852002.2,9	Unknown	Unknown
Contusion, lung NFS	441402.3,9	Seat belt webbing	Probable
Multiple lacerations, minor, left face	290602.1,1	Flying glass	Probable
Multiple lacerations, minor, right neck	390602.1,1	Flying glass	Probable
Multiple lacerations, minor, right shoulder	790602.1,1	Flying glass	Probable
Contusion, lower abdomen	590402.1,8	Seat belt webbing	Probable

Attachment 1. Scene Diagram



Attachment 2. 2004 Ford F350 EDR Report

CDR File Information

Vehicle Identification Number	1FTSW31P94E******
Investigator	
Case Number	
Investigation Date	
Crash Date	
Filename	07004 V2.CDR
Saved on	Friday, February 16 2007 at 03:40:20 PM
Collected with CDR version	Crash Data Retrieval Tool 2.800
Reported with CDR version	Crash Data Retrieval Tool 2.900
Event(s) recovered	Deployment

Module Information

The retrieval of this data has been authorized by the vehicle's owner, or other legal authority such as a subpoena or search warrant, as indicated by the CDR tool user on Friday, February 16 2007 at 03:40:20 PM .

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

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

Important

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

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

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

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

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

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

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

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

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

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

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

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

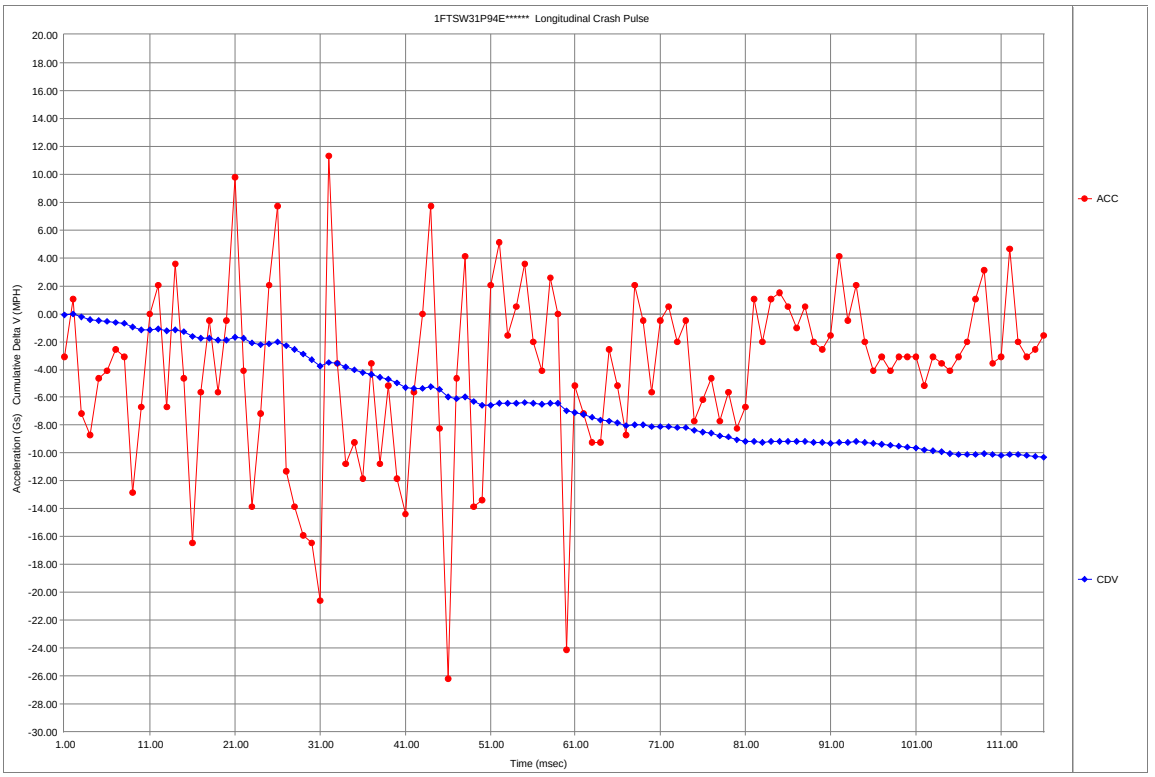
5. Vertical acceleration/decelerations are not recorded. Vehicle spin about a point not centered on the Restraints Control Module sensor may add or subtract from bulk vehicle motion.

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

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

System Status At Deployment

Diagnostic codes active when event occurred	0
Passenger Airbag Switch Position During Event	Activated
Time From Side Safing Decision to Left (Driver) Side Bag Deployment (msec)	Not Deployed
Frontal and Pretensioner Fire time (ms)	42.25


1FTSW31P94E****** Longitudinal Crash Pulse
Acceleration (Gs) Cumulative Delta V (MPH)
Time (msec)
ACC
CDV

Crash Pulse Data

Milliseconds	Long. Acceleration (Gs)	Long. Cumulative Delta V (MPH)
1	-3.08	-0.07
2	1.03	-0.05
3	-7.20	-0.20
4	-8.74	-0.39
5	-4.63	-0.50
6	-4.11	-0.59
7	-2.57	-0.64
8	-3.08	-0.71
9	-12.85	-0.99
10	-6.68	-1.14
11	0.00	-1.14
12	2.06	-1.09
13	-6.68	-1.24
14	3.60	-1.16
15	-4.63	-1.26
16	-16.45	-1.63
17	-5.65	-1.75
18	-0.51	-1.76
19	-5.65	-1.88
20	-0.51	-1.90
21	9.77	-1.68
22	-4.11	-1.77
23	-13.88	-2.08
24	-7.20	-2.23
25	2.06	-2.19
26	7.71	-2.02
27	-11.31	-2.27
28	-13.88	-2.57
29	-15.93	-2.92
30	-16.45	-3.28
31	-20.56	-3.74
32	11.31	-3.49
33	-3.60	-3.57
34	-10.79	-3.80
35	-9.25	-4.01
36	-11.82	-4.27
37	-3.60	-4.34
38	-10.79	-4.58
39	-5.14	-4.69
40	-11.82	-4.95
41	-14.39	-5.27
42	-5.65	-5.39
43	0.00	-5.39
44	7.71	-5.22
45	-8.22	-5.41
46	-26.21	-5.98
47	-4.63	-6.08
48	4.11	-5.99
49	-13.88	-6.30
50	-13.36	-6.59
51	2.06	-6.55
52	5.14	-6.43

Milliseconds	Long. Acceleration (Gs)	Long. Cumulative Delta V (MPH)
53	-1.54	-6.47
54	0.51	-6.45
55	3.60	-6.38
56	-2.06	-6.42
57	-4.11	-6.51
58	2.57	-6.45
59	0.00	-6.45
60	-24.16	-6.99
61	-5.14	-7.10
62	-7.20	-7.26
63	-9.25	-7.46
64	-9.25	-7.66
65	-2.57	-7.72
66	-5.14	-7.83
67	-8.74	-8.02
68	2.06	-7.98
69	-0.51	-7.99
70	-5.65	-8.11
71	-0.51	-8.13
72	0.51	-8.11
73	-2.06	-8.16
74	-0.51	-8.17
75	-7.71	-8.34
76	-6.17	-8.47
77	-4.63	-8.58
78	-7.71	-8.75
79	-5.65	-8.87
80	-8.22	-9.05
81	-6.68	-9.20
82	1.03	-9.17
83	-2.06	-9.22
84	1.03	-9.20
85	1.54	-9.16
86	0.51	-9.15
87	-1.03	-9.17
88	0.51	-9.16
89	-2.06	-9.21
90	-2.57	-9.26
91	-1.54	-9.30
92	4.11	-9.21
93	-0.51	-9.22
94	2.06	-9.17
95	-2.06	-9.22
96	-4.11	-9.31
97	-3.08	-9.38
98	-4.11	-9.47
99	-3.08	-9.54
100	-3.08	-9.60
101	-3.08	-9.67
102	-5.14	-9.78
103	-3.08	-9.85
104	-3.60	-9.93
105	-4.11	-10.02
106	-3.08	-10.09
107	-2.06	-10.13

Milliseconds	Long. Acceleration (Gs)	Long. Cumulative Delta V (MPH)
108	1.03	-10.11
109	3.08	-10.04
110	-3.60	-10.12
111	-3.08	-10.19
112	4.63	-10.09
113	-2.06	-10.13
114	-3.08	-10.20
115	-2.57	-10.26
116	-1.54	-10.29

Hexadecimal Data

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0800:  A6 42 40 5F 14 A2 58 2D 0D 23 0F 2D 38 4C C8 FF
0810:  10 FF EC 13 3C 78 F1 9E 08 A2 F9 EF 19 99 52 49
0820:  2D 03 B3 43 1E 0A F5 0A A1 5E 03 0E 1D 1E 00 25
0830:  3C 3C 80 28 05 28 B3 07 28 18 20 0B 03 84 B7 09
0840:  04 05 0B 05 AD 42 14 06 5E 00 64 00 B4 0B B8 03
0850:  E8 09 60 11 30 05 78 09 60 11 94 00 78 00 B8 0E
0860:  74 11 94 03 20 00 08 00 0F 00 12 03 20 05 78 75
0870:  30 00 FE 00 C8 01 B7 07 D0 03 20 00 C8 04 45 01
0880:  DC 00 0A 00 DC 00 91 02 EE 01 1E 40 40 01 FA 3C
0890:  32 27 46 1E 82 1B 23 C8 96 23 02 18 31 03 FF 0A
08A0:  14 FF 50 41 60 CC 43 FF FF FF FF FF FF FF FF 0B
08B0:  FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
08C0:  04 FF FF FF FF FF 57 09 63 33 43 33 41 02 00 03
08D0:  00 FF 78 32 FE 00 32 FF 00 32 FF 00 02 F6 80 FF
08E0:  08 FF 77 21 F6 80 23 F6 80 09 F7 80 0A F7 80 FF
08F0:  05 07 00 00 0A 00 04 FF FF FF FF FF FF FF 00 00
0900:  06 31 43 35 26 40 FF FF FF 02 26 AA AA FF FF AA
0910:  AA 90 08 76 26 FF FF 25 40 44 98 47 83 72 FF 02
0920:  98 A0 90 8D 95 96 99 98 85 91 9E A2 91 A5 95 7E
0930:  93 9D 93 9D B1 96 83 90 A2 AD 88 83 7F 7E 76 B4
0940:  97 89 8C 87 97 89 94 87 82 93 9E AD 8E 6B 95 A6
0950:  83 84 A2 A8 9B 9F A5 9A 96 A3 9E 6F 94 90 8C 8C
0960:  99 94 8D A2 9D 93 9D 9F 9A 9D 8F 92 95 8F 93 8E
0970:  91 A0 9A A0 A1 9F 9C 9F 9A 99 9B A6 9D A2 9A 96
0980:  98 96 98 98 98 94 98 97 96 98 9A A0 A4 97 98 A7
0990:  9A 98 99 9B 9E 07 00 00 10 9D 00 7B 00 00 00 00
09A0:  00 00 01 02 00 00 00 20 00 A9 00 8F 00 00 00 04
09B0:  00 73 00 51 00 A9 00 C8 02 D6 00 00 00 00 00 00
09C0:  00 00 A9 FF 01 FF FF 07 C7 00 FF FF FF FF FF FF
09D0:  FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
09E0:  FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
09F0:  FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
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