

INDIANA UNIVERSITY

TRANSPORTATION RESEARCH CENTER

School of Public and Environmental Affairs

501 South Morton Street Suite 105

Bloomington, Indiana 47403-2452

(812) 855-3908 Fax: (812) 855-3537

ON-SITE CHILD SAFETY SEAT INVESTIGATION

CASE NUMBER - IN09022

LOCATION - INDIANA

VEHICLE - 2009 KIA SPECTRA EX

CRASH DATE - July 2009

Submitted:

December 17, 2009



Contract Number: DTNH22-07-C-00044

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
National Center for Statistics and Analysis
Washington, D.C. 20590-0003

DISCLAIMERS

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no responsibility for the contents or use thereof.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

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. <i>Report No.</i> IN09022		2. <i>Government Accession No.</i>		3. <i>Recipient's Catalog No.</i>	
4. <i>Title and Subtitle</i> On-Site Child Safety Seat Investigation Vehicle - 2009 Kia Spectra EX Location - Indiana		5. <i>Report Date:</i> December 17, 2009		6. <i>Performing Organization Code</i>	
		7. <i>Author(s)</i> Special Crash Investigations Team #2		8. <i>Performing Organization Report No.</i>	
9. <i>Performing Organization Name and Address</i> Transportation Research Center Indiana University 501 South Madison Street, Suite 105 Bloomington, Indiana 47403-2452		10. <i>Work Unit No. (TRAIS)</i>		11. <i>Contract or Grant No.</i> DTNH22-07-C-00044	
		12. <i>Sponsoring Agency Name and Address</i> U.S. Department of Transportation (NVS-411) National Highway Traffic Safety Administration National Center for Statistics and Analysis Washington, D.C. 20590-0003		13. <i>Type of Report and Period Covered</i> Technical Report Crash Date: July 2008	
		14. <i>Sponsoring Agency Code</i>			
15. <i>Supplementary Notes</i> On-site Child Safety Seat (CSS) investigation involving a 2009 Kia Spectra EX.					
16. <i>Abstract</i> This report covers an on-site CSS investigation that involved a 2009 Kia Spectra that was involved in a crash with a 2000 Peterbilt tractor semi-trailer. This investigation focused on the Kia's second row left passenger (16-month-old, male) and the Safety 1st All-in-One convertible CSS in which he was seated. The Kia was occupied by a restrained 31-year-old female driver, the 16-month-old second row left passenger, and a 3-year-old male second row right passenger who was also seated in a CSS. Both child seats were in the forward-facing position. The Kia's driver was traveling south in the left turn lane approaching a four leg intersection with a state highway and intended to turn left. The Peterbilt was traveling southwest and the driver intended to continue southwest through the intersection. The front plane of the Peterbilt impacted the left side plane of the Kia. The Kia's direction of force was within the 9 o'clock sector and the impact force was sufficient to trigger deployment the driver's seat-mounted side impact air bag and the left side impact inflatable curtain air bag. Both vehicles remained engaged as they traveled southwest to final rest on the median. The driver of the Kia was transported by air ambulance to a trauma center, while both second row passengers were transported by ground ambulance to a local hospital. The driver of the Kia sustained severe injuries and was hospitalized for 10 days. Both second row passengers sustained minor injuries and were hospitalized for one day. The Safety 1st CSS sustained minor damage.					
17. <i>Key Words</i> Child Safety Seat Child Injury			18. <i>Distribution Statement</i> General Public		
19. <i>Security Classif. (of this report)</i> Unclassified		20. <i>Security Classif. (of this page)</i> Unclassified		21. <i>No. of Pages</i> 14	22. <i>Price</i>

TABLE OF CONTENTS

IN09022

Page No.

BACKGROUND 1

CRASH CIRCUMSTANCES 1

CASE VEHICLE: 2009 KIA SPECTRA EX 3

 CASE VEHICLE DAMAGE 3

 AUTOMATIC RESTRAINT SYSTEM 5

 MANUAL RESTRAINT SYSTEM 6

 CHILD SAFETY SEAT 7

 CASE VEHICLE DRIVER KINEMATICS 8

 CASE VEHICLE DRIVER INJURIES 9

 CASE VEHICLE SECOND ROW LEFT PASSENGER KINEMATICS 11

 CASE VEHICLE SECOND ROW LEFT PASSENGER INJURIES 11

 CASE VEHICLE SECOND ROW RIGHT PASSENGER KINEMATICS 12

 CASE VEHICLE SECOND ROW RIGHT PASSENGER INJURIES 12

OTHER VEHICLE: 2000 PETERBILT 6X4 TRACTOR SEMI-TRAILER 13

CRASH DIAGRAM 14

This on-site investigation focused on the second row left passenger (16-month-old, male) of a 2009 Kia Spectra and the Safety 1st All-in-One convertible Child Safety Seat (CSS) in which he was seated. This crash was brought to the attention of the National Highway Traffic Safety Administration on July 13, 2009 by this contractor. This investigation was assigned on July 16, 2009. The crash involved the Kia (**Figure 1**) and a 2000 Peterbilt 6x4 truck-tractor hauling a 2009 Transcraft flat-bed semi-trailer. The crash occurred in July 2009, at 1048 hours in Indiana and was investigated by the Indiana State Police. The Kia and the crash scene were inspected on July 16 and 17, 2009. The driver's husband (a non-occupant) was interviewed on July 23, 2009. The Peterbilt was not inspected since it had been driven out of state. This report is based on the police crash report, crash scene and Kia inspections, an interview with the driver's husband, discussions with the investigating police officer, occupant kinematic principles, and evaluation of the evidence.



Figure 1: The damaged 2009 Kia Spectra EX

CRASH CIRCUMSTANCES

Crash Environment: The roadway that the Kia was traveling on was a 3-lane, undivided city street, traversing in a north-south direction, and formed a 4-leg intersection with a state highway. The Kia's roadway had one through lane in each direction and a left turn lane. The through lanes were approximately 4.7 m (15.4 ft) in width, while the left turn lane was 3.2 m (10.5 ft) in width. The roadway pavement markings consisted of solid white edge lines, a solid white left turn lane line, white left turn arrow, a solid white stop bar, and a double-yellow center line. The roadway that the Peterbilt was traveling on was a 6-lane, divided state highway, traversing in an northeast and southwest direction. The southwest roadway had 2 through lanes, a right turn lane, and a left turn lane. The right turn lane was 4.2 m (13.8 ft) in width, while the remaining lanes were approximately 3.6 m (11.8 ft) in width. Roadway pavement markings consisted of solid white edge lines, solid white turn lane lines, white left and right turn arrows, and broken white through lane lines. The posted speed limit for the Kia was 48 km/h (30 mph) and 88 km/h (55 mph) for the Peterbilt. The intersection was controlled by 3-phase traffic signals. At the time of the crash the light condition was daylight and the atmospheric condition was cloudy. The roadway pavement was dry bituminous for the Kia and dry concrete for the Peterbilt. The grade was level for both vehicles. The site of the crash was urban and the traffic density at the time of the crash was moderate. The Crash Diagram can be seen on page 14 of this report.

Pre-Crash: The Kia was occupied by a restrained 31-year-old female driver, a 16-month-old male second row left passenger, and a 3-year-old male second row right passenger. Both second row passengers were restrained in child seats that were in the forward-facing position. The Kia's driver was traveling south in the left turn lane (**Figure 2**) and intended to turn left onto the state highway. It is not known if the Kia's driver took any actions to avoid the crash. The Peterbilt

was occupied by a 53-year-old male driver who was traveling southwest in the outside through lane and was negotiating a right curve as he approached the intersection (**Figure 3**). The driver intended to continue southwest through the intersection. The Peterbilt's driver initiated a left steering maneuver and applied hard braking in an attempt to avoid the crash. The police crash report indicated that the left rear tires of the trailer left skid marks on the roadway 39 m (128 ft) in length, which continued to the final rest position of the Peterbilt.

Crash: The two vehicles entered the intersection and the front plane of the Peterbilt impacted the left side plane (**Figure 4**) of the Kia. The Kia's direction of force was within the 9 o'clock sector and the impact force was sufficient to trigger deployment the driver's seat-mounted side impact air bag and the left side impact inflatable curtain (IC) air bag. Both vehicles remained engaged as they traveled approximately 26 m (85.3 ft) southwest to their final rest positions. The Kia came to final rest on the median heading northeast. The Peterbilt came to final rest with the tractor on the median heading southwest and the semi-trailer on the inside southwest lane.

Post-Crash: The police were notified of the crash at 1051 hours and arrived on scene at 1053 hours. Emergency rescue personnel mechanically removed the left side doors of the Kia and extricated the driver from the vehicle. The second row passengers were removed from the vehicle through the right rear door. The Kia's driver was transported by air ambulance to a trauma center while both second row passengers were transported by ground ambulance to a local hospital. The driver of the Peterbilt was not injured and not transported to a hospital. Both vehicles were towed from the scene due to damage.



Figure 2: Approach of the Kia to the intersection in the left turn lane; arrow shows approach of the Peterbilt



Figure 3: Approach of the Peterbilt to the intersection; arrow shows approach of the Kia

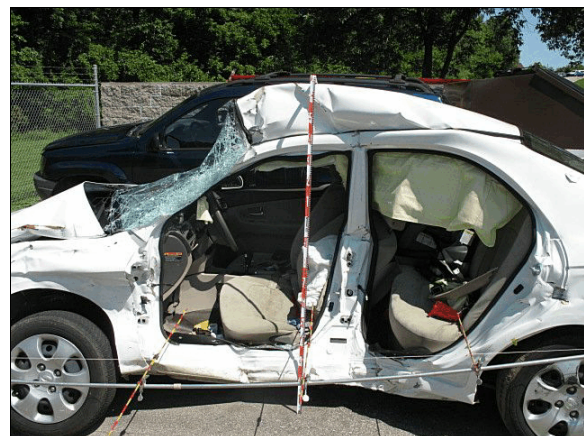


Figure 4: Damage to the left side plane of the Kia from the impact with the Peterbilt; left side doors had been removed by rescue and were discarded

The 2009 Kia Spectra EX was a front-wheel drive, 4-door sedan (VIN: KNAFE221495-----) equipped with a 2.0-liter, 4-cylinder engine, automatic transmission, and 4-wheel anti-lock brakes. The front row was equipped with bucket seats, adjustable head restraints, lap-and-shoulder safety belts, driver and front passenger frontal air bags, front seat-mounted side impact air bags, and side impact IC air bags that provided protection for the front and second rows. The second row was equipped with a bench seat with folding backs, lap-and-shoulder safety belts, adjustable head restraints, and Lower Anchors and Tethers for Children (LATCH) in the outboard seating positions. The vehicle specified wheelbase was 261 cm (102.8 in).



Figure 5: Front left view of Kia's left side crush profile



Figure 6: Top view of the Kia's left side crush profile

CASE VEHICLE DAMAGE

Exterior Damage: The impact with the Peterbilt involved the left side plane of the Kia. The left fender and both left side doors were directly damaged. The direct damage began 26 cm (10.2 in) forward of the left rear axle and extended forward 244 cm (96.1 in). The Kia's left side doors had been removed by rescue personnel and discarded. It was necessary to estimate the crush profile at C₂, C₃, and C₄ based on the remaining damaged components and experience documenting similar impacts. The crush values at C₂, C₃, and C₄ were represented against the left side door openings using a string line and the measurements rods (Figures 5 and 6). The crush measurements were taken at the mid-door level and the maximum residual crush was 67 cm (23.2 in) occurring at C₃. The induced damage involved the left fender, hood, roof, left quarter panel, trunk lid, and right side plane. The table below shows the left side crush profile.

Units	Event	Direct Damage		Field L	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	Direct	Field L
		Width CDC	Max Crush								±D	±D
cm	1	244	67	328	0	21	67	52	25	0	33	30
in		96.1	26.4	129.1	0.0	8.3	26.4	20.5	9.8	0.0	13.0	11.8

Damage Classification: The Collision Deformation Classification was **09-LYAW-5 (270 degrees)**. The WinSMASH program could not be used to calculate the Kia's Delta V because an impact with a heavy truck is out of scope for program. The Damage Algorithm of WinSMASH

was used to calculate a Barrier Equivalent Speed (BES). The calculated BES was 68 km/h (42.3 mph).

The manufacturer’s recommended tire size was P195/60R15. The Kia was equipped with the recommended size tires. The vehicle’s tire data are shown in the table below.

Tire	Measured Pressure		Vehicle Manufacturer’s Recommended Cold Tire Pressure		Tread Depth		Damage	Restricted	Deflated
	kPa	psi	kPa	psi	milli-meters	32 nd of an inch			
LF	221	32	207	30	4	5	None	No	No
LR	234	34	207	30	5	6	None	No	No
RR	Flat	Flat	207	30	4	5	None	No	Yes
RF	221	32	207	30	4	5	None	No	No

Vehicle Interior: The inspection of the Kia’s interior revealed evidence of several possible occupant contacts. The emergency brake lever was displaced to the right, possibly from contact by the driver’s right hip. Two possible occupant contact scuffs were present on the left IC air bag adjacent to the left front seat. The bottom of the steering wheel rim was bent, probably due to contact by the driver’s thighs. There was no discernable evidence of occupant contact in the second row.

The left front and left rear doors were jammed shut and the right side doors remained closed and operational. The pre-crash status of the left front and left rear window glazing could not be determined. The remaining window glazings were either closed or fixed. While the left front and left rear doors were not present, the glazing for these windows would have probably disintegrated due to impact. The windshield was in place and cracked from impact forces. The remaining window glazings were not damaged.

The vehicle’s passenger compartment sustained 21 intrusions due to the left side plane impact. The most severe intrusions into the driver’s space involved the lower rear quadrant of the left front door, left B-pillar, left A-pillar, and the left roof side rail (**Figure 7**). The extent of the left front door’s lateral intrusion was estimated to be approximately 45 cm (17.7 in), while the left B-pillar, A-pillar, and left roof side rail intruded laterally 45 cm, (17.7 in), 31 cm (12.2 in), and 26 cm (10.2 in), respectively. The most severe



Figure 7: Left A-pillar and roof side rail intrusion into the driver’s occupant space

intrusions into the second row left passenger's space involved the forward lower quadrant of the left rear door, left B-pillar, and left roof side rail. The left rear door was estimated to have intruded laterally 44 cm (17.3 in), while the left B-pillar and left roof side rail intruded laterally 44 cm (17.3 in) and 24 cm (9.4 in), respectively.

AUTOMATIC RESTRAINT SYSTEM

The Kia was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system that consisted of dual stage driver and front right passenger air bags, driver seat position sensor, safety belt usage sensors, retractor mounted pretensioners for the driver and front passenger, and a front passenger pattern recognition sensor. Neither of the frontal air bags deployed in this crash. The manufacturer has certified that the vehicle is compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208.

The side impact air bag system consisted of front seat-mounted side impact air bags and roof side rail-mounted side impact IC air bags. Based on the Holmatro Rescuer's Guide to Vehicle Safety Systems, the vehicle's side impact sensors were located within the lower B- and C-pillars. The IC air bag inflators were located within the C-pillars.

The left IC air bag was located along the left roof side rail (**Figures 8 and 9**) inside the headliner and extended from the A-pillar to the C-pillar. The IC air bag was designed with inflation chambers adjacent to the driver and second row left seat positions. There were no external vent ports. The deployed IC air bag was 170 cm (66.9 in) in width, 34 cm (13.4 inches) in height, and extended approximately 9 cm (3.5 in) below the beltline. It was attached at the A-pillar by a 4 cm (1.6 in) cloth tether. There was no visible tether at the C-pillar. There was no gap between the front of the IC air bag and the A-pillar. The fold creases on the air bag indicated that it had been folded accordion fashion within the headliner. Inspection of the deployed air bag revealed that an approximate 70 x 25 cm (27.6 x 9.8 in) section adjacent to the left front seat had been cut out of the air bag, probably during extrication of the driver. There was no evidence of crash related damage on the inside surface of the air bag. A hole and a tear were located on the lower outside surface of the IC air bag (**Figure 10**) located 33 cm (13 in) and 50 cm (19.7 in) rearward of the front of IC air bag. This damage was probably the result of contact by the front of the Peterbilt.



Figure 8: Front portion of the Kia's left IC air bag

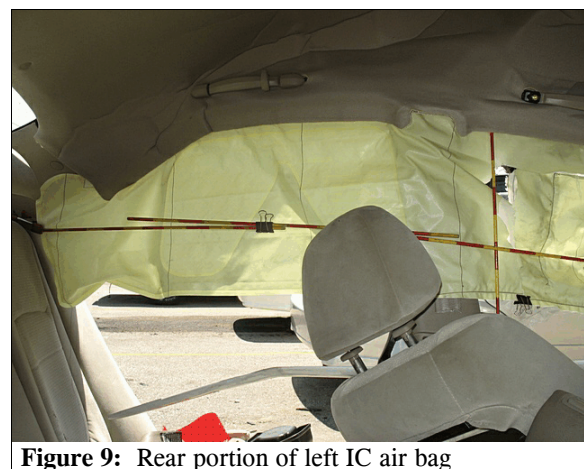


Figure 9: Rear portion of left IC air bag

Two possible occupant contact scuffs were located adjacent to the left front seat position 30 cm (11.8 in) rear of the front of IC air bag and 15 cm (5.9 in) and 25 cm (9.8 in) below the top of the air bag. There was no discernable occupant contact evidence on the air bag adjacent to the second row left seat position (**Figure 11**).

The driver's seat-mounted side impact air bag was located in the outboard side of the seat back and deployed through a tear-seam. The deployed air bag (**Figure 12**) was 22 cm (8.7 in) in width and 56 cm (22 in) in height and was designed with one vent port located on the front edge. There was a single circular tether where both sides of the air bag were sewn together located 20 cm (7.9 in) below the top of the air bag. A line of stitching located 20 cm (7.9) above the bottom of the air bag extended across the width of the air bag. There was no discernable evidence of occupant contact on the air bag. A small area of damage was present on its outboard surface. The damage consisted of small holes and was probably the result of contact by flying glass fragments from the disintegrated left front window. The area of damage was located 10 cm (3.9 in) from the top of the air bag.

MANUAL RESTRAINT SYSTEM

The Kia was equipped with lap-and-shoulder safety belts for the front and second row seating positions. The driver's safety belt consisted of continuous loop belt webbing, an Emergency Locking Retractor (ELR), sliding latch plate, and an adjustable upper anchor that was in the full-up position. The front right safety belt consisted of continuous loop belt webbing, a switchable ELR/Automatic Locking Retractor (ALR), sliding latch plate, and adjustable upper anchor that was located in the full-up position. The seat belts were also equipped with retractor-mounted pretensioners. The status of the driver's pretensioner could not be determined due to the damage to the B-pillar. The front right pretensioner did not actuate during the crash. The second row safety belts were similar to the front passenger, but had fixed upper anchors and were not equipped with pretensioners.

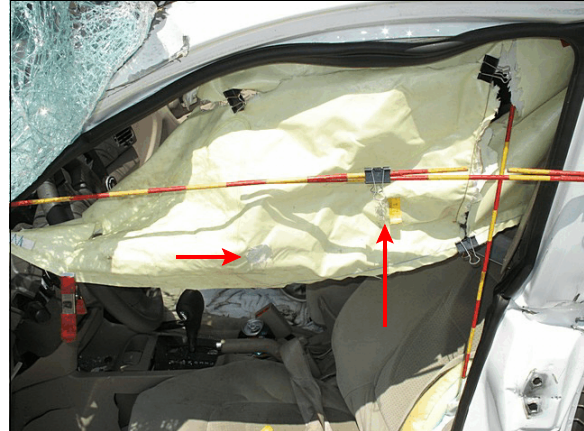


Figure 10: Arrows show a hole and tear in the IC air bag, probably due to contact by the front grille of the Peterbilt



Figure 11: Rear portion of left side curtain air bag



Figure 12: The left front seat back-mounted side impact air bag

The inspection of the driver's safety belt assembly revealed that the latch plate was in the buckle and the belt webbing had been cut. The length of the remaining belt webbing was consistent with usage by the driver at the time of the crash.

The inspection of the second row left safety belt assembly revealed that the belt webbing had been cut in two places. The latch plate was in the buckle and the cut piece of belt webbing was in the latch plate belt guide. The CSS's top tether strap had been cut and the tether clip was latched to the vehicle's upper tether anchor (**Figure 13**). Based on this evidence and the SCI interview with the driver's husband, the second row left passenger's CSS was secured in the vehicle by the tether strap and the vehicle's lap-and-shoulder belt, which was routed through the forward-facing belt path on the back of the CSS. The interviewee reported that the seat belt retractor was switched to ALR mode to secure the CSS in the vehicle and the passenger was restrained by the 5-point harness. The CSS's lower LATCH straps were not used.



Figure 13: The second row left CSS tether clip was found latched to the upper tether anchor

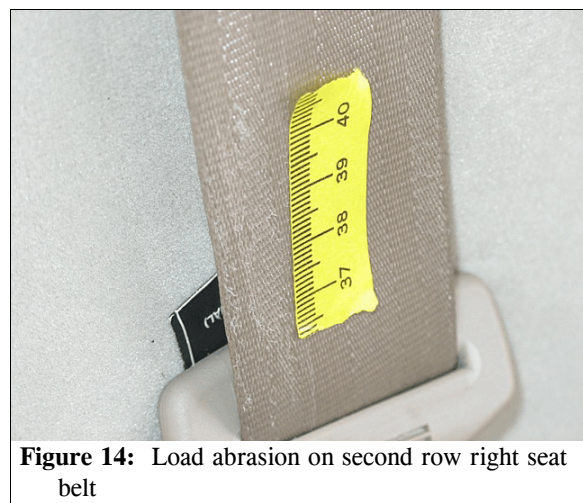


Figure 14: Load abrasion on second row right seat belt

The inspection of the second row right safety belt assembly revealed a load abrasion 5 cm (2 in) in length on the belt webbing (**Figure 14**). The abrasion was located 13 cm (5.1 in) above the seat cushion with the safety belt in the retracted position. Based on this evidence and the SCI interview with the driver's husband, the second row right passenger's CSS was secured in the vehicle by the lap-and-shoulder belt. The safety belt retractor was switched to ALR mode to secure the CSS in the vehicle and the passenger was restrained by the 5-point harness. The interviewee did not know if the CSS was equipped with a LATCH system.

CHILD SAFETY SEAT

The Kia's second row left passenger [16-month-old, male; 81 cm (32 in) and 13 kg (29 lbs)] was seated in a Safety 1st All-in-One convertible CSS (**Figure 15**). It was located in the second row of the vehicle at the time of the inspection. The CSS was manufactured on March 19, 2007 and the model number was 22-152-BVL. The CSS was equipped with a LATCH system and a 5-point harness. There was no harness retainer clip present at the time of the inspection. Based on the SCI interview, a harness retainer clip was in use at the time of the crash, but its position on the child is not known. The CSS was used in the forward facing position. When used in this

position, the CSS was designed for children over 1 year old who weigh between 10 and 18 kg (22 and 40 lbs) and were between 86 and 109 cm (34 and 43 in) in height.

The CSS was constructed of a one-piece plastic shell with a non-detachable base and had a 1 cm (0.4 in) thick padded fabric cover and a reclining seat back. The seat back was adjusted to the upright position. The CSS was equipped with a sliding harness strap adjustment with 5 settings. The harness straps were adjusted to the lowest position (**Figure 16**).

Inspection of the CSS revealed a few stress marks on the left side and front left corner of the shell from contacting the left rear door during the crash. The plastic belt guides for the harness straps were also detached. The top tether strap had been cut (**Figure 16**) and the tether clip was found latched to the vehicle's upper tether anchor (**Figure 13**). There were no discernable occupant contact marks on the CSS.

The second row right passenger [3-year-old, male; 97 cm (38 in) and 15 kg (33 lbs)] was seated in an unknown make and model forward facing CSS. The CSS was not with the vehicle at the time of the inspection and could not be located. Based on interview data, the child seat's harness straps were routed through top belt paths. The interviewee did not know if the CSS was equipped with a harness retainer clip. The vehicle's lap-and-shoulder safety belt was routed through the forward facing belt path to secure the CSS in the vehicle.

CASE VEHICLE DRIVER KINEMATICS

The driver [31-year-old, female; 165 cm (65 in) and 61 kg (135 lbs)] was seated in an unknown posture. At the time of the vehicle inspection, the seat track was adjusted to between the middle and rear positions. The tilt positions of the seat back



Figure 15: The second row left CSS: Safety 1st All-in-One



Figure 16: Harness strap adjustments; arrow shows cut tether strap

and steering column could not be determined due to the damage they sustained. The driver was wearing glasses at the time of the crash.

The left side impact on the Kia displaced the driver left, opposite the 9 o'clock direction of force. She loaded through the seat-mounted side impact air bag and the left side of her torso loaded the intruding door. She sustained a grade IV laceration of the spleen, fracture of the left sacral ala, and fractures of the superior and inferior aspects of the left pubic ramus from contacting the rear lower quadrant of the left front door arm rest. The driver's head loaded through the IC air bag and probably contacted the grille of the Peterbilt, which caused a fracture of the left occipital condyle. She was displaced to the right by the intruding door and her right thorax probably contacted the gear shift lever and center console causing a pneumothorax in the right pleural cavity and minimally displaced fractures of the right transverse processes of L₂ and L₃. The driver also sustained multiple contusions and abrasions. Rescue personnel mechanically removed the left front and left rear doors and extricated the driver through the left front door opening.

CASE VEHICLE DRIVER INJURIES

The driver was transported by air ambulance to a trauma center. She was hospitalized for seven days. Following her release, the driver acquired an infection and was hospitalized an additional three days. The table below shows the driver's injuries and injury sources.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
	Nonanatomic brain injury with loss of consciousness of unknown duration, confusion at scene, asking repetitive questions, amnesia to event, GCS = 14	Not coded	Exterior of other motor vehicle: grille	Probable	Hospitalization records
1	Laceration, grade IV, spleen with extravascation of contrast, and embolization of spleen	severe 544226.4,2	Left front hardware/armrest, rear lower quadrant	Certain	Hospitalization records
2	Pneumothorax, tiny, right pleural cavity	serious 442202.3,1	Floor-mounted transmission selector lever	Possible	Hospitalization records
3	Fracture, impacted, left sacral ala with mild comminution–non-operative ¹	serious 852604.3,2	Left front hardware/armrest, rear lower quadrant	Certain	Hospitalization records

¹ The orthopedist who evaluated this patient indicated that there was no anterior/posterior compression or vertical shear to the patient's pelvis, and the pelvic lesions were because of lateral compression.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
4	Fracture, oblique, nondisplaced, left occipital condyle--no surgical intervention	serious 150202.3,8	Exterior of other motor vehicle: grille	Probable	Hospitalization records
5 6	Fracture left superior pubic ramus at root of acetabulum ¹ and nondisplaced fracture left inferior pubic ramus near ischial tuberosity ¹	moderate 852600.2,5 852600.2,2	Left front hardware/armrest, rear lower quadrant	Certain	Hospitalization records
7 8	Fracture, minimally displaced, right transverse processes L ₂ -L ₃	moderate 650620.2,8 650620.2,8	Interior, center console first row ²	Probable	Hospitalization records
9	Laceration, small, to tongue, not further specified	minor 243402.1,8	Air bag, driver's side inflatable curtain	Probable	Emergency room records
10	Abrasions, mild, on face, not further specified	minor 290202.1,0	Air bag, driver's side inflatable curtain	Probable	Hospitalization records
11	Abrasions, several, on abdomen, not further specified	minor 590202.1,0	Noncontact injury: flying glass, left front glazing	Possible	Hospitalization records
12	Abrasions, multiple, over left upper extremity with multiple radiodense foreign bodies scattered along arm	minor 790202.1,2	Noncontact injury: flying glass, left front glazing	Certain	Emergency room records
13	Contusion (bruise) medial right proximal forearm	minor 790402.1.1	Floor-mounted transmission selector lever	Probable	Emergency room records
14	Contusions (bruising) with swelling left arm at shoulder and head of ulna	minor 790402.1,2	Left front door panel, rear upper quadrant	Certain	Emergency room records
15	Contusions (bruises) medially over both femurs	minor 890402.1,3	Occupant's left and right medial thighs	Probable	Emergency room records
16	Contusions (bruises) posterior lateral upper and lower right leg	minor 890402.1,1	Interior, center console first row	Probable	Emergency room records
17	Contusion over left anterior shin, not further specified	minor 890402.1,2	Left front door panel, forward lower quadrant	Certain	Emergency room records

² These lesions occurred as the driver's torso was redirected rightward after impacting the interior surface of the left front door.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
18	Contusion over right anterior shin, not further specified	890402.1,1	Center lower instrument panel	Probable	Emergency room records

CASE VEHICLE SECOND ROW LEFT PASSENGER KINEMATICS

The second row left passenger [16-month-old, male; 81 cm (32 in) and 13 kg, (29 lbs)] was seated in the CSS in an unknown posture.

The Kia's left side impact with the Peterbilt displaced the second row left passenger to the left opposite the 9 o'clock direction of force. The intruding left rear door loaded the CSS and displaced it to the right. The left side of the passenger's face contacted the shell of the CSS, which caused an abrasion and contusion. The harness latch and buckle assembly contacted the medial left thigh causing a contusion on the thigh. The passenger also sustained abrasions over the left eye and left and right lower extremities from flying glass fragments from the disintegrated left rear window glazing. The passenger remained restrained in the CSS throughout the crash. The CSS was entrapped in the vehicle by the intruded left rear door. Rescue personnel removed the passenger from the CSS and removed him from the vehicle through the right rear door.

CASE VEHICLE SECOND ROW LEFT PASSENGER INJURIES

The second row left passenger was transported to a hospital by ambulance. He was treated in the emergency room and hospitalized for one day. The table below shows the passenger's injuries and injury sources.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Abrasion, small, over left eye	minor 290202.1,7	Noncontact injury: flying glass, left rear glazing	Probable	Hospitalization records
2	Abrasion, superficial, large, left cheek	minor 290202.1,2	Child safety seat shell	Probable	Hospitalization records
3	Contusion (hematoma), large, left side of face	minor 290402.1,2	Child safety seat shell	Probable	Hospitalization records
4	Abrasions, scattered, left and right lower extremities, including over left knee area	minor 890202.1,3	Noncontact injury: flying glass, left rear glazing	Probable	Hospitalization records
5	Contusion (bruise) medial left thigh near groin area	minor 890402.1,2	Child safety seat's harness latch and buckle assembly	Probable	Emergency room records

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
6	Contusion (bruise), 2 cm (0.8 in), lateral left lower leg below left knee	minor 890402.1,2	Left rear door panel, forward upper quadrant	Probable	Hospitalization records

CASE VEHICLE SECOND ROW RIGHT PASSENGER KINEMATICS

The second row right passenger [3-year-old, male; 97 cm and 15 kg (38 in, 33 lbs)] was seated in the CSS in an unknown posture.

The Kia's left side impact with the Peterbilt displaced the second row right passenger to the left within the CSS opposite the 9 o'clock direction of force. Flying glass fragments caused abrasions on the left face and forehead. The passenger also sustained a contusion on the right side of the forehead, probably due to contact with the shell of the CSS. The passenger remained restrained in the CSS throughout the crash. Rescue personnel removed the passenger from the vehicle through the right rear door while still in the CSS.

CASE VEHICLE SECOND ROW RIGHT PASSENGER INJURIES

The second row right passenger was transported by ambulance to a hospital. He was treated in the emergency room and hospitalized for one day. The table below shows the passenger's injuries and injury sources.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Abrasions, small, left face, not further specified	minor 290202.1,7	Noncontact injury: flying glass, unknown source	Possible	Hospitalization records
2	Abrasion left forehead, not further specified	minor 290202.1,2	Noncontact injury: flying glass, unknown source	Possible	Hospitalization records
3	Contusion (bruising) on right side of forehead	minor 290402.1,7	Child safety seat shell	Probable	Emergency room records

OTHER VEHICLE

IN09022

The 2000 Peterbilt 379 was a 4-wheel drive, 6x4, conventional cab, truck-tractor (VIN: 1XP5DB9X8YD-----) hauling a 2009 Transcraft (VIN: unknown) flat-bed semi-trailer.

Other Vehicle's Driver: According to the police crash report, the Peterbilt's driver (53-year-old, male) was restrained by the lap-and-shoulder belt. He sustained no police-reported injuries and was not transported to a hospital.

