CRASH DATA RESEARCH CENTER

Calspan Corporation
Buffalo, NY 14225

CALSPAN ON-SITE CHILD SAFETY SEAT CRASH INVESTIGATION

NASS/SCI COMBO CASE NO: 2004-45-131K

VEHICLE: 1989 FORD AEROSTAR

LOCATION: TENNESSEE

CRASH DATE: JULY 2004

Contract No. DTNH22-01-C-17002

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
Washington, D.C. 20590

DISCLAIMER

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 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

1. Report No. 2004-45-131K	*2. Government Accession No.*	*3. Recipient's Catalog No.*	
4. Title and Subtitle Calspan Remote Child Safety Seat Crash Investigation Vehicle: 1989 Ford Aerostar Location: State of Tennessee		*5. Report Date*: May 2006 *6. Performing Organization Code*	
7. Author(s) Crash Data Research Center		*8. Performing Organization Report No.*	
9. Performing Organization Name and Address Crash Data Research Center Calspan Corporation P.O. Box 400 Buffalo, New York 14225		*10. Work Unit No.* C00410.0000.0224 *11. Contract or Grant No.* DTNH22-01-C-17002	
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Washington, D.C. 20590		*13. Type of Report and Period Covered* Technical Report Crash Date: July 2004 *14. Sponsoring Agency Code*	
15. Supplementary Note This remote investigation focused on the performance of two Child Safety Seats (CSS) that were in use in a 1989 Ford Aerostar minivan.			
16. Abstract This remote investigation focused on the performance of two Child Safety Seats (CSS) that were in use in a 1989 Ford Aerostar minivan. The Aerostar was involved in an intersection collision with a 1996 Ford Taurus. The impact resulted in the ejection of a 20-month-old male who was not restrained in a CSS that was installed in the center position of the second row short-bench seat. An unrestrained 23-year-old female driver, an unrestrained 29-year-old male front right passenger, and a 4-year-old female, who was restrained in a CSS installed in the second row left position, also occupied the Aerostar. The driver of the 1989 Ford Aerostar was traveling in an eastbound direction approaching a four-leg intersection. The driver initiated a left turn across the path of a 1996 Ford Taurus that was traveling through the intersection in a westbound direction. The front of the Taurus struck the right side aspect of the Aerostar resulting in moderate damage to both vehicles. The impact induced a rapid clockwise (CW) rotation of the Aerostar completely ejecting a 20-month-old male through the right side window, which was removed from the vehicle prior to the crash. The child reportedly came to rest on the roadway under the front aspect of the Aerostar. The child sustained fractures to his right arm and scapula, a contusion to his right lung, a bronchus laceration and soft-tissue injuries to the right side of his face, neck, head, and chest. He was transported by ambulance to a regional trauma center and admitted for treatment. The 23-year-old female driver of the Aerostar sustained a fractured and contused left wrist and a neck strain; she was transported, treated, and released from a local hospital. The 29-year-old male front right passenger sustained soft-tissue injuries to his scalp, right shoulder, and knees, but was not transported. The 4-year-old female seated in a CSS in the second row left position sustained soft-tissue injuries over her right clavicle, chest, and abdomen; she was transported to a local hospital, treated, and released.			
17. Key Words Forward facing Child Safety Seat. Ejection of child occupant.		*18. Distribution Statement* General Public	
19. Security Classif. (of this report) Unclassified	*20. Security Classif. (of this page)* Unclassified	*21. No. of Pages* 13	*22. Price*

TABLE OF CONTENTS

BACKGROUND **1**

SUMMARY **2**

VEHICLE DATA – 1989 FORD AEROSTAR 2
VEHICLE DATA – 1996 FORD TAURUS 2
CRASH SITE 2
CRASH SEQUENCE 3
PRE-CRASH 3
CRASH 3
POST-CRASH 4
VEHICLE DAMAGE 4
EXTERIOR DAMAGE – 1989 FORD AEROSTAR 4
INTERIOR DAMAGE – 1989 FORD AEROSTAR 5
EXTERIOR DAMAGE – 1996 FORD TAURUS 6
MANUAL RESTRAINTS – 1989 FORD AEROSTAR 7
CHILD SAFETY SEAT 7
CHILD SAFETY SEAT INSTALLATION – REAR LEFT POSITION 7
CHILD SAFETY SEAT INSTALLATION – REAR CENTER POSITION 8
OCCUPANT DEMOGRAPHICS 9
DRIVER 9
DRIVER INJURIES: 9
DRIVER KINEMATICS 9
FRONT RIGHT PASSENGER 9
FRONT RIGHT PASSENGER INJURIES 10
FRONT RIGHT PASSENGER KINEMATICS 10
REAR LEFT PASSENGER 10
REAR LEFT PASSENGER INJURIES 10
REAR LEFT PASSENGER KINEMATICS 10
REAR CENTER PASSENGER 11
REAR CENTER PASSENGER INJURIES 11
REAR CENTER PASSENGER KINEMATICS 11

FIGURE 14 – NASS SCENE SCHEMATIC **13**

CALSPAN REMOTE CHILD SAFETY SEAT INVESTIGATION
NASS/SCI COMBO CASE NO.: 04-45-131K
LOCATION: TENNESSEE
VEHICLE: 1989 FORD AEROSTAR
CRASH DATE: JULY 2004

BACKGROUND

This remote investigation focused on the performance of two Child Safety Seats (CSS) that were in use in a 1989 Ford Aerostar minivan (**Figure 1**). The Aerostar was involved in an intersection collision with a 1996 Ford Taurus. The impact resulted in the ejection of a 20-month-old male who was not restrained in a CSS that was installed in the center position of the second row short-bench seat. An unrestrained 23-year-old female driver, an unrestrained 29-year-old male front right passenger, and a 4-year-old female, who was restrained in a CSS installed in the second row left position, also occupied the Aerostar. The driver of the 1989 Ford Aerostar was traveling in an eastbound direction approaching a four-leg intersection. The driver initiated a left turn across the path of a 1996 Ford Taurus that was traveling through the intersection in a westbound direction. The front of the Taurus struck the right side aspect of the Aerostar resulting in moderate damage to both vehicles. The impact induced a rapid clockwise (CW) rotation of the Aerostar completely ejecting a 20-month-old male through the right side window, which was removed from the vehicle prior to the crash. The child reportedly came to rest on the roadway under the front aspect of the Aerostar. The child sustained fractures to his right arm and scapula, a contusion to his right lung, a bronchus laceration and soft-tissue injuries to the right side of his face, neck, head, and chest. He was transported by ambulance to a regional trauma center and admitted for treatment. The 23-year-old female driver of the Aerostar sustained a fractured and contused left wrist and a neck strain; she was transported, treated, and released from a local hospital. The 29-year-old male front right passenger sustained soft-tissue injuries to his scalp, right shoulder, and knees, but was not transported. The 4-year-old female seated in a CSS in the second row left position sustained soft-tissue injuries over her right clavicle, chest, and abdomen; she was transported to a local hospital, treated, and released.

Figure 1 - Damaged 1989 Ford Aerostar.

This crash was identified by the Crash Investigation Division of the National Highway Traffic Safety Administration (NHTSA). It was selected as CDS Case No: 04-45-131K. The NASS PSU performed the vehicle and scene inspections. Due to the ejection of the child and the presence of the multiple child safety seats, NHTSA assigned the tasks of case review and report preparation to the Calspan SCI team on June 21, 2004.

SUMMARY

Vehicle Data – 1989 Ford Aerostar

The 1989 Ford Aerostar was identified by the Vehicle Identification Number (VIN): 1FMCA11U3KZ (production number omitted). The vehicle's odometer read 104,802 km (65,121 miles) at the time of the NASS inspection. The Aerostar was configured with two front doors, a sliding door on the right side, and a rear tailgate. It was equipped with a 3.0-liter, 6-cylinder engine, a four speed automatic transmission, and tilt steering. The rear-wheel drive vehicle was also equipped with 36 cm (14") steel wheels and Triumph P215/70R14 tires. The manufacturer recommended tire pressure was 241 kPa (35 PSI). The specific tire information at the time of the NASS inspection was as follows:

Position	Measured Pressure	Measured Tread	Damage
LF	255 kPa (37 PSI)	6 mm (8/32")	None
LR	0 kPa	5 mm (6/32")	Tire cut/torn
RF	241 kPa (35 PSI)	6 mm (8/32")	None
RR	255 kPa (37 PSI)	4 mm (5/32")	None

The Ford Aerostar was configured with front bucket seats with integral head restraints. At the time of the NASS vehicle inspection, both front seats were adjusted to the rear most seat track position. The second row consisted of a two-position short bench seat with folding backs. In its original condition, the Aerostar was equipped with a removable third row bench seat with a folding seatback; however, the third row seats and restraints were removed from the vehicle prior to the crash and this space was used as a cargo area.

Vehicle Data – 1996 Ford Taurus

The 1996 Ford Taurus was identified by the VIN: 1FALP52U9TA (production number omitted). The vehicle's odometer read 329,984 km (205,042 miles) at the time of the NASS inspection. The four-door sedan was configured with a 3.0-liter, 6-cylinder engine, four-speed automatic transmission, and tilt steering. The front-wheel drive vehicle was equipped with 38 cm (15") steel wheels and Douglass Performance GT/H P205/65R15 tires. The specific tire information at the time of the NASS vehicle inspection was as follows:

Position	Measured Pressure	Measured Tread	Damage
LF	214 kPa (31 PSI)	8 mm (10/32")	None
LR	221 kPa (32 PSI)	8 mm (10/32")	None
RF	228 kPa (33 PSI)	8 mm (10/32")	None
RR	200 kPa (29 PSI)	7 mm (9/32")	None

Crash Site

This two-vehicle crash occurred in the northeast quadrant of a four-leg intersection. At the time of the crash, there were no adverse weather conditions and the asphalt roadway was dry. The intersection consisted of a five-lane east/west divided roadway traversing a four-lane north/south roadway. The east/west roadway was separated by a curbed grassy median. The north/south roadway crossed the intersection at an angle of approximately 20 degrees. Traffic flow through the intersection was controlled by overhead five-phase

traffic signals. Both roadways were straight and level and were bordered by concrete curbs. The roadside environment consisted of residential structures and natural growth. The eastbound lanes widened at the intersection to accommodate an outboard right turn lane and the curbed median width was reduced at the intersection to accommodate left turn lanes. The north/south roadway was configured with one travel lane in each direction, a center left turn lane, and an outboard right turn only lane. The posted speed limit was 72 km/h (45mph) for the east/west roadway. The NASS scene schematic is included as **Figure 14** at the end of this narrative report.

Crash Sequence

Pre-Crash

The 23-year-old driver of the 1989 Ford Aerostar was traveling eastbound (**Figure 2**) on the inboard left turn lane and was intending to turn left to travel northbound on the intersecting north/south roadway. The 23-year-old female driver of the 1996 Ford Taurus was traveling westbound (**Figure 3**) in the center lane and was intending to continue straight through the intersection. The traffic signal was green for east/west traffic; however, the left turn arrows cycled to red prior to the crash. As the driver of the Aerostar began to turn left against the red arrow, she detected the approaching Taurus and took evasive action by accelerating. The driver of the Taurus stated that she applied her brakes resulting in four-wheel lock-up and steered to the right in an attempt to avoid the Aerostar. The NASS investigation revealed that the Taurus left a tire mark of 1 meter (3.3') in length on the westbound roadway.

Figure 2 - Eastbound approach of the 1989 Ford Aerostar.

Figure 3 - Westbound approach of the 1996 Ford Taurus.

Crash

The right side passenger area of the Aerostar was impacted by the full frontal plane of the Taurus. The directions of force for the Aerostar and the Taurus were 2 o'clock and 11 o'clock, respectively. The damage algorithm of the WinSMASH program computed a total delta-V of 16 km/h (9.9 mph) for the Aerostar and 22 km/h (13.7 mph) for the Taurus based on their respective crush profiles. The specific longitudinal and lateral delta-V was –8 km/h (-5 mph) and –14 km/h (-8.7 mph) for the Aerostar and –21 km/h (-13.1 mph) and 8 km/h (5 mph) for the Taurus. The impact reportedly induced a rapid clockwise (CW) rotation (approximately 110 degrees) by the Aerostar and it came to rest 9 meters (29.5') from the impact facing southbound in the northwest quadrant of the

intersection. The 20-month-old male passenger seated in a CSS in the second row center position was fully ejected from the vehicle through the open second row right window. The Taurus rotated approximately 10 degrees in a clockwise direction and came to rest near the point of impact facing northwest. **Figure 4** illustrates the vehicles at final rest.

Post-Crash

Rescue personnel arrived on the scene and assisted the driver, front right, and rear left occupants from the Aerostar. The 20-month old child came to rest on the roadway under the front of the Aerostar approximately 9 meters (29.5') from the point of impact. The 20-month-old child sustained AIS-3 level injuries and was transported to a local hospital by ambulance and admitted for 21 days. The three remaining occupants of the Aerostar sustained minor-to-moderate severity injuries. The driver and rear left passenger were transported to a local hospital by ambulance for treatment. The driver of the Taurus was not injured. Both vehicles were towed from the scene of the crash to a police impound lot where they were inspected by the NASS researcher.

Figure 4 - Overall view of post-crash scene.

Vehicle Damage

Exterior Damage – 1989 Ford Aerostar

The 1989 Ford Aerostar (**Figure 5**) sustained moderate right side damage as a result of the impact with the 1996 Ford Taurus. The NASS vehicle inspection revealed that the direct contact damage began 30 cm (11.8") forward of the right rear axle and measured 230 cm (90.1") in length. The maximum crush was reportedly 145 cm (57.1") forward of the right rear axle and measured 43 cm (16.9") in depth. The NASS investigation revealed that the combined direct and induced damage was the same as the direct contact damage 230 cm (90.1"). It appears that the induced damage has been slightly understated as there is sheet metal buckling along the rear right quarter panel; although, this discrepancy is not sufficient enough to alter the delta-V. Previous damage was present along the rear bumper unassociated with these crash events. The SCI revised Collision Deformation Classification (CDC) for the impact with the Taurus was 02-RPEW-3.* Six equidistant crush measurements were documented at the mid-door level and were as follows: C1 = 3 (1.2"), C2 = 26 cm (10.2"), C3 = 40 cm (15.7"), C4 = 40 cm (15.7"), C5 = 30 cm (11.8"), C6 = 1 cm (2.5").

Figure 5 - 1989 Ford Aerostar crush profile.

**The CDC was SCI revised and differs from the NASS case.*

Interior Damage – 1989 Ford Aerostar

The 1989 Ford Aerostar sustained moderate interior damage as a result of lateral passenger compartment intrusion emanating from the right side. The vehicle's worn condition probably masked a small amount of physical contact evidence; however, the NASS vehicle inspection successfully identified a number of intrusions and probable contact points.

The right rear door panel and right side B-pillar intruded laterally reaching a peak of 14 cm (5.5") at the forward aspect of the right rear door. The front right passenger seat cushion and seatback was shifted to the left 4 cm (1.6") due to the buckling of the floor pan. The floor pan was displaced vertically in the area of the front right and second row right positions.

The left and center instrument panel revealed faint scuffmarks attributable to knee contacts from the unbelted driver, and the center console transmission shifter was deformed from the loading by the driver's right upper leg and hip as she traveled laterally responding to the 2 o'clock direction of force. The driver's left wrist contacted and fractured the windshield near the center point of the vehicle before the driver's kinematical movement subsided (**Figure 6**). The upper right instrument panel above the glove compartment exhibited heavy compression marks attributable to the loading of the unbelted front right passenger's knees (**Figure 7**). The right side interior door surface was fractured on the forward aspect at the beltline from interaction with the front right passenger's shoulder.

Figure 6 - Crack on windshield from driver's wrist.

Figure 7 - Damage right instrument panel from right front passenger.

The right rear and backlight glazing were removed from the vehicle prior to the impact with the 1996 Ford Taurus. The unbelted 20-month-old male passenger, who was not restrained in the center position of the second row short-bench seat, was fully ejected through the right side window opening (**Figure 8**). As this occupant exited the vehicle, it was possible that he contacted the window frame (**Figure 9**). Evidence in the form of deformed sheet metal on the lower left aspect of the frame is present, but this correlation could not be confirmed from the NASS case.

Figure 8 - Ejection point of right center passenger.

Figure 9 - Possible contact point from ejected passenger.

The restrained 4-year-old child remained seated within the CSS and sustained minor injuries through contact with the internal components of the CSS.

The passenger compartment intrusions were documented by the NASS investigator and are specified below by their magnitude:

Position	Intruded Component	Magnitude	Direction
Second row right	Door panel interior	14 cm (5.5”)	Lateral
Second row right	B-pillar	8 cm (3.2”)	Lateral
Front center	Right seat cushion	4 cm (1.6”)	Lateral
Front center	Right seatback	3 cm (1.2”)	Lateral
Front right	Floor pan	3 cm (1.2”)	Vertical
Second row right	Floor pan	3 cm (1.2”)	Vertical

Exterior Damage – 1996 Ford Taurus

The 1996 Ford Taurus (**Figure 10**) sustained moderate frontal damage as a result of the impact with the 1989 Ford Aerostar. The NASS vehicle inspection revealed that the direct contact damage began 44 cm (17.3”) left of the vehicle’s centerline and extended 124 cm (48.8”) across the front bumper to the right front corner. The maximum crush was recorded at the right front corner and measured 11 cm (4.3”) in depth. The combined direct and induced damage was reportedly across the entire frontal plane and measured 160 cm (63”) in length. The CDC for the impact with the Aerostar was 11-FDEW-1. Six equidistant crush measurements were documented at the bumper level and were as follows: C1 = 0 cm, C2 = 0 cm, C3 = 0 cm, C4 = 2 cm (0.8”), C5 = 5 cm (2”), C6 = 11 cm (4.3”).

Figure 10 - 1996 Ford Taurus damage profile.

The Taurus sustained damage on the right front fender as a result of direct contact with the Aerostar. The length of the direct contact damage on the fender was not reported within the NASS case. The side damage resulted from the continuous contact with the Aerostar as it rotated around the front end of the Taurus in route to final rest.

Manual Restraints – 1989 Ford Aerostar

The 1989 Ford Aerostar was equipped with manual 3-point lap and shoulder belts for the front seat positions. The front seat belts were configured with continuous loop webbing, a sliding latch plate, and an Emergency Locking Retractor (ELR). Neither the driver nor front right passenger utilized the belts. They were found in the stowed position at the time of the NASS inspection.

The second row was configured with 2-point lap belts for the rear left and center positions of the short-bench seat. Both belts were used to install the two child safety seats. Both rear lap belts were in poor condition with the fraying of stitching of the Emergency Management Loop (EML) system, and the cupping and rippling of the belt webbing, indicative of age and overuse.

The third row contained three seating positions at the time of manufacture. The third row was removed from the vehicle prior to the crash. Present in the cargo bay at the time of the NASS inspection was a tire, buckets, and a multitude of refuse.

Child Safety Seat

Child Safety Seat Installation – Rear Left Position

A Century Breverra Classic forward-facing CSS was installed in the rear left position of the Aerostar (**Figure 11**). The Model Number was 4865JTW01 and the Date of Manufacture was 12/11/2001. The CSS was intended for forward facing only, but could also be utilized as a high-back belt positioning booster seat. The CSS was configured with a 5-point integrated harness and a two-piece locking retainer clip. The CSS was designed for children weighing between 14 kg (30 lb) and 18 kg (40 lb). The 4-year-old female child was within the manufacturer's weight range for this CSS.

Figure 11 - CSS occupied by rear left passenger.

The owner was unsure whether the CSS had ever been in a crash prior to this, which is indicative of the CSS being obtained used. The CSS was secured in the vehicle with the 2-point lap belt, which was fastened through the belt path on the lower back aspect of the CSS. The 2-point belt held the CSS in place but was not tensioned to keep the CSS free of lateral movement. The integrated 5-point harness was routed through the bottom set of slots.

The 4-year-old child was placed in the CSS and the owner stated that the retainer clip was positioned between the child's armpits and belly button. The owner reported that the CSS was used daily and was originally installed by a friend. Following the crash the owner reported that the CSS was slightly tilted to the right. Based on the available information, the lap belt was not taut through the belt path.

Child Safety Seat Installation – Rear Center Position

A Century Breverra Classic forward-facing CSS was installed in the rear center position of the Aerostar (**Figure 12**). The Model Number was 44865FRN and the Date of Manufacture was 07/15/2004. The CSS was intended for forward facing use only, but could also be used as a high-back booster seat. The CSS was configured with a 5-point integrated harness and a two-piece locking retainer clip. The CSS was designed for children weighing between 14 kg (30 lb) and 18 kg (40 lb). The 20-month-old male child was under the manufacturer's weight range for this CSS by 3 kg (7 lb).

Figure 12 - CSS for rear center passenger.

The CSS was secured in the vehicle with the 2-point lap belt routed through the belt path on the lower back aspect of the CSS. The integrated harness straps were fastened through the bottom set of slots.

The 20-month-old child was placed in the CSS, but was not restrained by the integrated 5-point harness. The mother of the child claimed that the child might have undone the straps prior to the crash; however, this is unlikely due to the age of the child and worn condition of the CSS. The owner was unsure whether the CSS had ever been in a crash prior to this, which is indicative of the CSS being obtained used by the owner. The CSS was removed by police following the crash and was impounded.

Figure 13 is an illustration of the CSS installation prior to police removal.

Figure 13 – CSS placement inside vehicle post crash.

Occupant Demographics

Driver

Age/Sex:	23-year-old/Female
Height:	170 cm (67”)
Weight:	138 kg (304 lb)
Seat Track Position:	Full rear
Safety Belt Use:	None used
Usage Source:	Vehicle inspection
Eyewear:	None
Type of Medical Treatment:	Transported by ambulance and released

Driver Injuries:

Injury	Injury Severity (AIS-90/Update 98)	Injury Source
Wrist fracture+	Moderate (731800.2,2)	Windshield
Wrist contusion+	Minor (790402.1,2)	Windshield
C-Spine strain	Minor (640278,1,6)	Impact forces

**Source: Interview*

+The sources for these injuries were SCI revised and differ from the NASS case

Driver Kinematics

The 23-year-old female driver of the 1989 Ford Aerostar was seated in an upright posture and was not restrained by the available lap and shoulder belt. At impact with the 1996 Ford Taurus, the driver initiated a slightly forward and lateral trajectory to the right responding to the 2 o’clock direction of force. Her knees contacted and faintly scuffed the lower left and center instrument panel causing no injury. This is supported by identifiable faint scuffmarks present on the left and center instrument panel. The driver’s right upper leg and hip loaded and slightly deformed the transmission shifter mounted in the center console. As the driver was being displaced to the right, she probably attempted to brace herself with her arms. As she approached the windshield, her left wrist was contused and fractured, evidenced by a starburst crack emanating from the interior. After maximum engagement, the Aerostar rotated rapidly in a clockwise direction resulting in a cervical spine strain to the driver. The driver exited the vehicle with some assistance and was transported to a hospital by ambulance where she was treated for her injuries and released.

Front Right Passenger

Age/Sex:	29-year-old/Male
Height:	173 cm (68”)
Weight:	86 kg (190 lb)
Seat Track Position:	Full rear
Safety Belt Use:	None used
Usage Source:	Vehicle inspection
Eyewear:	None
Type of Medical Treatment:	No treatment

Front Right Passenger Injuries

Injury	Injury Severity (AIS-90/Update 98)	Injury Source
Scalp contusion+	Minor (190402.1,5)	Right A-pillar
Bilateral knee contusions+	Minor (890402.1,3)	Right instrument panel
Contusion to right shoulder+	Minor (790402.1,1)	Right door panel

**Source: Interview.*
+The sources for these injuries were SCI revised and differ from the NASS case

Front Right Passenger Kinematics

The 29-year-old front right passenger of the 1989 Ford Aerostar was seated in an upright posture and was not restrained by the available lap and shoulder belt. At impact with the 1996 Ford Taurus, this passenger initiated a slightly forward and lateral trajectory to the right responding the 2 o'clock direction of force. The passenger sustained soft-tissue injuries to his knees as he loaded the right instrument panel above the glove compartment door, evidenced by a deep compression on the plastic covering. The passenger continued in his lateral trajectory to the right and contacted the forward aspect of the right front door panel along the baseline with his right shoulder. A fractured plastic panel and correlative soft-tissue injury support this contact. As the driver loaded the door panel his head contacted the A-pillar resulting in a scalp contusion to the anterior aspect of his head. The front right passenger exited the vehicle under his own power and later declined medical treatment.

Rear Left Passenger

Age/Sex:	4-year-old/Female
Height:	Unknown
Weight:	17 kg (37 lb)
Seat Track Position:	Not adjustable
Safety Belt Use:	Forward-facing CSS with a 5-point harness, installed with a manual 2-point lap belt.
Usage Source:	Vehicle inspection
Eyewear:	None
Type of Medical Treatment:	Transported by ambulance and released

Rear Left Passenger Injuries

Injury	Injury Severity (AIS-90/Update 98)	Injury Source
Right clavicle contusion	Minor (790402.1,1)	Harness
Chest skin contusion+	Minor (490402.1,4)	Harness retainer clip
Abdomen contusion	Minor (590402.1,1)	Integrated 5-point harness

**Source: Emergency room records.*
+The source for this injury was SCI revised and differs from the NASS case

Rear Left Passenger Kinematics

The 4-year old female rear left passenger was seated in an upright posture in the forward-facing CSS. The CSS was installed using a 2-point lap belt in the left rear position of the

Areostar. The 5-point integrated harness restrained the child within the CSS. The harness retainer clip was reportedly positioned between the child's armpit and belly-button level. At impact with the 1996 Ford Taurus, the child initiated a slightly forward and lateral trajectory to the right. As the child loaded the 5-point harness and right side of the CSS she sustained soft-tissue injuries over her right clavicle, to her central chest, and to the right aspect of her abdomen. Responding to the right side impact and the resultant CW rotation, the loosely installed seat pitched to the right and was found slightly tilted following the crash. The CSS and its components were in poor condition making the task of locating corroborative loading evidence difficult. However, the harness webbing contained severe rippling and the individual straps were cupped due to poor maintenance and age. The 4-year-old rear left passenger was removed from the vehicle by rescue personnel and was later transported to a hospital for treatment and released.

Rear Center Passenger

Age/Sex:	20-month-old/Male
Height:	Unknown
Weight:	10 kg (22 lb)
Seat Track Position:	Not adjustable
Safety Belt Use:	Placed in an installed forward-facing CSS, but not restrained by the internal harness system
Usage Source:	CSS and vehicle inspection
Eyewear:	None
Type of Medical Treatment:	Transported by ambulance and admitted for 21days

Rear Center Passenger Injuries

Injury	Injury Severity (AIS-90/Update 98)	Injury Source
Right lung contusion	Serious (441406.3.1)	Ground
Bronchus distal laceration	Moderate (440204.2,4)	Ground
Humerus fracture	Moderate (752602.2,1)	Ground
Scapula fracture	Moderate (753000.2,1)	Ground
Abrasion on right eyebrow	Minor (290202.1,1)	Ground
Forehead abrasion	Minor (290202.1,7)	Ground
Forehead laceration 1.5 cm (0.6") in length	Minor (290602.1,7)	Ground
Abrasion on chest	Minor (490202.1,1)	Ground
Abrasion on neck	Minor (390202.1,1)	Ground

**Source: Medical records.*

Rear Center Passenger Kinematics

The 20-month-old male rear left passenger was seated in an upright posture in the forward-facing CSS. The CSS was installed using a 2-point lap belt in the rear position of the Areostar. The child was seated on top of the harness straps and was unrestrained within the CSS. At impact with the 1996 Ford Taurus, the child initiated a slightly forward and lateral trajectory to the right. After the initial impact, the Aerostar rotated

rapidly in a CW direction approximately 110 degrees, and through this rotation, the child was fully ejected from the vehicle through the right rear window opening. The right rear glazing was removed from the vehicle prior to this crash and was not replaced. As this occupant exited the vehicle it is possible that he contacted the window frame. Evidence in the form of deformed sheet metal on the lower left aspect of the window frame is present, but this could not be confirmed from the NASS case. The child suffered a right lung contusion, a laceration to the distal bronchus, and a fractured right humerus at the mid-shaft, a fractured right scapula, and soft-tissue injuries to the right side of the neck, chest, forehead, and eyebrow. All of the child's injuries were confined to his right side and were in all probability caused by striking the asphalt roadway. The child came to rest under the front end of the Aerostar at final rest, approximately 9 meters (29.5') from the impact. The child was transported to a hospital be ambulance where he was admitted for 21 days.

Figure 14 – NASS Scene Schematic