TRANSPORTATION SCIENCES
CRASH DATA RESEARCH CENTER

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VERIDIAN ON-SITE CHILD SAFETY SEAT CRASH INVESTIGATION SCI TECHNICAL SUMMARY REPORT

VERIDIAN CASE NO. CA01-024

VEHICLE - 1996 CHEVROLET BLAZER

LOCATION - STATE OF NEW YORK

CRASH DATE - APRIL 2001

Contract No. DTNH22-94-D-07058

Prepared for:

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

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

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16. *Abstract* This on-site investigation focused on a two-vehicle intersection crash that involved a 1996 Chevrolet Blazer (subject vehicle) and a 1997 Ford Explorer. The front of the Explorer struck the right side of the Blazer and caused the Blazer to trip-over onto its roof). The Chevrolet Blazer was driven by a 26-year-old male who was restrained by the 3-point manual lap and shoulder belt. The 3-year-old female passenger, who incurred minor injuries, was positioned in the right rear seat of the Chevrolet Blazer in a shield booster seat. The Ford Explorer was occupied by a 41-year-old female driver and a 39-year-old female front right passenger. Both occupants of the Explorer were restrained. Impact resulted in severe damage to the Blazer and moderate damage to the Explorer. The impact caused the deployment of the frontal air bag system in the Ford Explorer. The driver of the Blazer initiated a lateral trajectory to the right and loaded the center console. The use of the 3-point manual lap and shoulder belt prevented additional movement throughout the vehicle. He sustained minor hand abrasions, arm abrasions, and a posterior right upper arm contusion. He was transported by ambulance to a regional trauma center where he was treated and released. The 3-year-old child passenger initiated a lateral trajectory and jackknifed over the right side aspect of the shield booster and struck her head on intruding components. She sustained abrasions and contusions on her right hand and a minor abrasion over her right eye. She was transported by ambulance to a regional children's hospital where she was admitted and was released the following day. Both occupants of the Explorer initiated forward trajectories and loaded the manual restraints and deployed frontal air bags. The driver had a police-reported complaint of back pain, and the front right passenger sustained police-reported facial bleeding. Both were transported by ambulance to a local hospital. Their admission status was not reported.			
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BACKGROUND

This on-site investigation focused on a two-vehicle intersection crash that involved a 1996 Chevrolet Blazer (subject vehicle) and a 1997 Ford Explorer. The front of the Explorer struck the right side of the Blazer and caused the Blazer to trip-over onto its roof **(Figure 1)**. The Chevrolet Blazer was driven by a 26-year-old male who was restrained by the 3-point manual lap and shoulder belt. The 3-year-old female passenger, who incurred minor injuries, was positioned in the right rear seat of the Chevrolet Blazer in a shield booster seat. The Ford Explorer was occupied by a 41-year-old female driver and a 39-year-old female front right passenger. Both occupants of the Explorer were restrained. Impact resulted in severe damage to the Blazer and moderate damage to the Explorer. The impact caused the deployment of the frontal air bag system in the Ford Explorer. The driver of the Blazer initiated a lateral trajectory to the right and loaded the center console. The use of the 3-point manual lap and shoulder belt prevented additional movement throughout the vehicle. He sustained minor hand abrasions, arm abrasions, and a posterior right upper arm contusion. He was transported by ambulance to a regional trauma center where he was treated and released. The 3-year-old child passenger initiated a lateral trajectory and jackknifed over the right side aspect of the shield booster and struck her head on intruding components. She sustained abrasions and contusions on her right hand and a minor abrasion over her right eye. She was transported by ambulance to a regional children's hospital where she was admitted and was released the following day. Both occupants of the Explorer initiated forward trajectories and loaded the manual restraints and deployed frontal air bags. The driver had a police-reported complaint of back pain, and the front right passenger sustained police-reported facial bleeding. Both were transported by ambulance to a local hospital. Their admission status was not reported.

Figure 1. 1996 Chevrolet Blazer

The Veridian SCI team identified this crash from the local television news in April 2001. The notification was forwarded to NHTSA and an on-site effort was assigned to the Veridian SCI team on Monday, April 2, 2001. The on-site inspections of both vehicles were completed on April 5, 2001, and an interview with the driver of the Chevrolet Blazer was obtained on April 12, 2001.

Crash Site

This crash occurred at a 3-leg intersection in the daylight hours of April 2001. The 3-leg intersection consisted of a two-lane east/west local roadway that intersected a four-lane north/south state roadway. At the time of the crash, it was cloudy with no adverse weather conditions as the asphalt road surface was dry. Both roadways were straight and had level grades. The north/south roadway consisted of two 3.3 m (10.8') wide travel lanes in each direction separated by a double-yellow centerline. The north/south roadway was bordered by 1.3 m (4.3') wide asphalt shoulders outboard of the fog lines. The east/west roadway consisted of one 3.3 m (10.8') wide travel lane in each direction separated by a double-yellow centerline. The east/west roadway was bordered by dirt shoulders outboard of the fog lines. The roadside environment consisted of grassy areas and commercial properties. A guard rail was present on the southwest corner of the intersection that followed the curvature of the corner. Traffic control consisted of 3-phase traffic signals for northbound, southbound, and eastbound traffic approaching the intersection. At the time of the crash, the traffic signal was reported to be functioning properly. Painted stop lines were also present in each leg of the intersection.

Figure 2. Approach #1 for the Chevrolet Blazer

Pre-Crash

The 26-year-old male driver of the 1996 Chevrolet Blazer was stopped south of the intersection in the inboard northbound lane behind an uninvolved vehicle **(Figure 2)**. Both vehicles were waiting for southbound traffic to clear so they could make a left turn onto the east/west roadway. At the time he came to a stop, the traffic signal was still in the green phase for north/south traffic. According to the driver of the Blazer, he thought the traffic signal had cycled from green to red for north/south traffic, and the vehicle in front of the Blazer initiated the left turn in an attempt to clear the intersection **(Figure 3)**. He noted that a vehicle to his right in the outboard northbound lane had stopped for the traffic signal. The driver of the Blazer followed the other vehicle in an attempt to clear the intersection. The driver of the Blazer noted that there was no cellular telephone present and that the radio was not on at the time of the crash.

Figure 3. Approach #2 for the Chevrolet Blazer

Figure 4. Approach for the 1997 Ford Explorer

The 41-year-old female driver of the 1997 Ford Explorer was operating the vehicle southbound in the inboard lane on approach to the 3-leg intersection **(Figure 4)**. She detected the uninvolved vehicle initiating a left turn across her path in the intersection. She steered to the right and traveled toward the outboard lane and entered the intersection. As the uninvolved vehicle cleared the intersection, the driver of the Explorer failed to detect the Blazer turning left behind the uninvolved vehicle. The driver of the

Blazer said he was halfway through the turn when he detected the Explorer approaching in the intersection. The Explorer was equipped with four-wheel anti-lock brakes and there were no skid marks in the Explorer's trajectory indicative of pre-crash braking.

Crash

The front of the Ford Explorer impacted the right side of the Chevrolet Blazer. Impact resulted in moderate damage to both vehicles. The directions of force for the Blazer and Explorer were in the 2 o'clock and 11 o'clock sectors, respectively. The damage algorithm of the WinSMASH program computed a total velocity change of 35.5 km/h (22.1 mph) for the Chevrolet Blazer based on the documented crush profile. The longitudinal and latitudinal components were -12.1 km/h (-7.5 mph) and -33.4 km/h (-20.7 mph), respectively. The barrier equivalent speed was calculated to be 48.9 km/h (30.4 mph) for the Blazer. The damage algorithm of the WinSMASH program computed a total velocity change of 40.8 km/h (25.4 mph) for the Ford Explorer based on the documented crush profile. The longitudinal and latitudinal components were -38.3 km/h (-23.8 mph) and 14.0 km/h (8.7 mph), respectively. The barrier equivalent speed was calculated to be 22.4 km/h (13.9 mph) for the Explorer. The impact induced deceleration was sufficient to deploy the frontal air bag system in the Explorer. The forward momentum of the Explorer caused it to redirect the Blazer in a lateral direction to the left with a slight clockwise (CW) rotation. A lateral tire mark from the left rear wheel of the Blazer which measured 1.1 m (3.6') in length was documented in the southwest corner of the intersection. A gouge mark that measured 1.0 m (3.3') was present in the center of the tire mark. As the tire provided additional resistance, the lateral movement was slowed which induced a trip-over onto the Blazer's roof. The Blazer slid laterally to final rest on its roof in the southwest shoulder against the guardrail **(Figure 5)**. Paint transfers were noted on the guardrail from the right rear side aspect of the Blazer. The Ford Explorer came to rest in the southwest corner of the intersection facing southwest with the frontal plane against the left side of the overturned Blazer.

Figure 5. Final rest position for the Chevrolet Blazer

Post-Crash

The driver of the Blazer came to rest upside down in the vehicle suspended from the lap and shoulder belt. He stated that he did not remember how he exited the vehicle. He was not sure if he had lost consciousness, but believes that if he did, it was only for a minute. He walked around to the right side of the Blazer to assist his 3-year-old daughter who was unconscious and suspended upside down from the integrated lap belt in the shield booster seat. He walked back to the left side and entered the Blazer through the left front door window opening. He crawled into the rear seat area to remove the 3-year-old from the vehicle. The driver stated that he had difficulty in removing her from the child safety seat because her right leg was pinned between the rear seat and the intruded right side of the vehicle. He estimated that it took approximately three minutes to remove her from the seat, and he passed her through the backlight opening to a passer-by who stopped to assist. The child safety seat was not removed from the vehicle. The driver then exited the Blazer through the backlight opening. The driver was transported by ambulance to a regional

trauma center and treated and released. The 3-year-old female was transported by ambulance to a regional children's hospital and admitted overnight. It was not known how the occupants of the Ford Explorer exited the vehicle. Both occupants were transported by ambulance to a local hospital. Their admission status was not reported.

VEHICLE DATA -*1996 Chevrolet Blazer*

The 1996 Chevrolet Blazer was identified by the Vehicle Identification Number (VIN): 1GNCT18W2TK (production sequence omitted). The vehicle was a two-door, ½ Ton series, 4 x 4, sport utility vehicle (SUV) and was equipped with a 4.3 liter, V6 engine. The full-size spare tire was positioned on an exterior arm attached to the rear right corner and a trailer hitch was centered below the rear bumper. The Blazer was also equipped with automatic transmission, cruise control, power windows and power door locks. The odometer read 110,428 km (68,619 miles) at the time of the vehicle inspection. The backlight and fixed windows on the sides of the Blazer were equipped with factory-tinted glazing. The Blazer was also equipped with P235/70 R15 Kelly Safari ARW tires The Blazer had a tilt steering column which was adjusted between the center and full-down positions. The knee bolster was a rigid plastic type.

The front seating positions were configured with bucket seats with folding backs and integral head restraints. The rear seat was configured with a two-person split bench seat with folding backs. The front seating positions were equipped with 3-point manual lap and shoulder belts with sliding latch plates. The front right lap and shoulder belt was equipped with a switchable retractor. The left front lap and shoulder belt showed signs of loading and was operational. The front right lap and shoulder belt was found restricted in its stowed position. Both latch plates were abraded which indicated frequent usage. The upper D-ring adjustments were fixed, and there were no indications of failure. Both rear seating positions were equipped with 3-point manual lap and shoulder belts with switchable retractors and sliding latch plates. The left latch plate had indications of frequent usage and the switchable retractor was fully operational. Instructions were noted on the webbing regarding proper use of the switchable retractor when installing a child safety seat. The right latch plate indicated occasional usage. The right rear lap and shoulder belt had been routed through the belt path of the shield booster seat, and showed signs of loading. The switchable retractor seemed to be in the automatic locking (ALR) mode, however the locking mechanism did not function properly post-crash.

VEHICLE DAMAGE

Exterior Damage - *1996 Chevrolet Blazer*

The 1996 Chevrolet Blazer sustained severe right side damage as a result of the impact with the Ford Explorer **(Figure 6)**. The direct contact damage was concentrated at the passenger compartment area rearward of the right A-pillar and began 51.0 cm (20.0") aft of the front axle and extended 205.0 cm (80.7") rearward along the right side plane. The combined direct and induced damage began 32.0 cm (12.6") aft of the front axle and extended 278.0 cm (109.4") rearward along the right side. The maximum crush was located at the B-pillar, 28.0 cm (11.0") to the right of C3 and measured 63.0 cm (24.8"). The vertical location of the direct contact damage from the bumper of the Explorer was located at the mid-door level. There was no direct damage above the belt line. The right sill was crushed inward above the right frame rail and longitudinal paint transfers were noted on the right front door and right quarter panel. The right front door was crushed inward and rearward however, there were no latch or hinge failures. Induced buckling was present in each window frame and the entire right side of the Blazer. Slight separation was noted between the rear bumper and the right side panel. The Collision Deformation Classification (CDC) for this event was 02-RZEW-04. Six crush measurements spaced 55.6 cm (21.9") apart were taken at the mid-door level and were as follows: C1 = 0.0 cm, C2 = 20.0 cm (7.9"), C3 = 55.0 cm (21.7"), C4 = 61.0 cm (24.0"), C5 = 39 cm (15.4"), C6 = 0.0 cm. The window frame located between the right C-pillar and D-pillar was displaced and distorted from contact with the guardrail. The CDC for the guardrail impact was 03-RZHW-3.

Figure 6. Right side damage to Chevrolet Blazer

Figure 7. Trip-over damage to the Chevrolet Blazer

Both side mirrors and the rear backlight hatch were separated from the vehicle. Heavy lateral abrasions were noted on the left side rails and top aspect of the left side plane. The hood also sustained lateral abrasions on the front aspect. The roof was crushed from the trip-over and the windshield header was crushed downward approximately 30.5 cm (12.0") at the front right area **(Figure 7)**. The CDC for the trip-over event was 00-TDDO-05. The plastic roof rack was separated from the vehicle, and laterally oriented abrasions were noted on the roof.

Interior Damage - *1996 Chevrolet Blazer*

Interior damage to the 1996 Chevrolet Blazer was severe and attributed to compartment intrusion and occupant contact **(Figures 8 and 9)**. Integrity was lost through all side window glazing, backlight glazing, and the windshield. All side glazing and backlight glazing was disintegrated from impact forces. The windshield glazing was cracked and holed from impact forces. The driver's 3-point lap and shoulder belt had 10.0 cm (3.9") of fraying on the edges and had signs of loading on the lower aspect of the shoulder webbing and the right aspect of the lap webbing. Abrasions were noted on the D-ring anchor, and two small puncture marks were identified on the upper portion of the shoulder webbing below the D-ring anchor. The left front door interior surface and arm rest were scuffed and abraded from driver contact, probably when he rebounded to the left. The top aspect of the center console was displaced to the right from driver loading during the initial impact. Scuff marks were noted on the right interior side panel aft of the B-pillar from contact with the child safety seat. The retractor guide for the rear right lap and shoulder belt was fractured from loading. The retractor was found to be locked during the vehicle inspection prior to the removal of the child safety seat. After the buckle was disengaged, the retractor made a grinding sound as the webbing retracted, which indicated that it was in the automatic locking mode. After the webbing retracted, the investigator spooled out the entire length of the webbing to examine the operation of the retractor. The retractor did not switch into the ALR mode, however, the grinding sound was still present and resistance in the retractor was felt as the webbing was pulled out and retracted. Based on the inspection of the belt system, it appears the ratchet mechanism in the retractor was no longer operable, which indicates possible retractor damage. This was due to the exterior deformation and intrusion of the right C-pillar. Abrasions were noted on the plastic cover of the sliding latch plate from the webbing and the webbing showed signs of loading and exhibited a plastic transfer from the child safety seat. Multiple intrusions were documented and are listed in the following table.

Figure 8. Interior damage to Chevrolet Blazer

Figure 9. View from backlight of interior damage to the Chevrolet Blazer

Location of Intrusion	Intruded Component	Intrusion	Direction
Front left	Windshield header	16.0 cm (6.3")	Vertical
Front left	Roof	13.0 cm (5.1")	Vertical
Front left	Left roof side rail	7.0 cm (2.8")	Vertical
Front left	Right front seat	15.0 cm (5.9")	Lateral

Location of Intrusion	Intruded Component	Intrusion	Direction
Front center	Windshield header	23.0 cm (9.1")	Vertical
Front center	Roof	26.0 cm (10.2")	Vertical
Front right	Right A-pillar	13.0 cm (5.1")	Lateral
Front right	Right door panel	27.0 cm (10.6")	Lateral
Front right	Roof	32.0 cm (12.6")	Lateral
Front right	Windshield header	28.0 cm (11.0")	Vertical
Front right	Right window frame	23.0 cm (9.1")	Lateral
Front right	Right B-pillar	41.0 cm (16.1")	Lateral
Front right	Right side panel forward of the A-pillar	10.0 cm (3.9")	Lateral
Front right	Right sill	33.0 cm (13.0")	Lateral
Rear left	Left C-pillar	16.0 cm (6.3")	Lateral
Rear left	Left roof side rail	17.0 cm (6.7")	Lateral
Rear left	Roof	3.0 cm (1.2")	Vertical
Rear right	Right C-pillar	20.0 cm (7.9")	Lateral
Rear right	Right side panel aft of B-pillar	37.0 cm (14.6")	Lateral
Rear right	Right window frame	31.0 cm (12.2")	Lateral
Rear right	Right sill	26.0 cm (10.2")	Lateral
Rear right	After-market stereo speaker	8.0 cm (3.1")	Longitudinal
Rear cargo area	Right D-pillar	8.0 cm (3.1")	Lateral
Rear cargo area	Backlight header	10.0 cm (3.9")	Vertical

VEHICLE DATA - *1997 Ford Explorer*

Figure 10. Child safety seat in the Ford Explorer

The 1997 Ford Explorer was identified by the Vehicle Identification Number (VIN): 1FMDU24E4VU (production sequence omitted). The vehicle was a 2-door, 4 x 4, sport utility vehicle with the Sport trim package. It was equipped with a 4.0 liter, V-6 engine and 4-speed automatic transmission with overdrive. The odometer read 194,879 km (76,724 miles) at the time of the vehicle inspection. All side windows and the backlight were equipped with factory-tinted glazing. The Explorer had P255/70 R16 Kelly Safari AIR tires. The Explorer was also equipped with cruise control, power windows, power door locks and power seat adjustment for the driver's seat. The tilt steering column was adjusted between the center and full-up positions. The knee bolster was a rigid plastic type. The seating was configured with bucket seats with folding backs and integral head restraints for both front positions. Both front seat backs were adjusted to an upright position at the time of the vehicle inspection. At the time of the vehicle inspection, an aftermarket heating pad was positioned against the driver's seat back and plugged into the accessory outlet. The rear seat was configured with a two-person split bench seat with folding backs and adjustable head restraints. The front seating positions were equipped with 3-point manual lap and shoulder belts with sliding latch plates. The front right lap and shoulder belt was equipped with a switchable retractor. Both front lap and shoulder belts showed signs of loading and were operational. Both latch plates were abraded, which indicated frequent usage. The upper anchorage adjustments were both in the full-up position, and there were no indications of failure. Both rear seating positions were equipped with 3-point manual lap and shoulder belts with switchable retractors and sliding latch plates. Both latch plates indicated frequent usage. The rear left 3-point manual lap and shoulder belt was in its stowed position and had one twist in the webbing between the retractor and the upper D-ring anchor, and two additional twists between the upper D-ring anchor and lower anchor point. The rear right 3-point manual lap and shoulder belt was routed through the forward facing belt path of a convertible child safety seat that was installed in the rear right position **(Figure 10)**. The child safety seat had 10.0 cm (3.9") of lateral movement at the belt path. The lap and shoulder belt webbing had one twist in it between the retractor and upper D-ring anchor and was crimped as the shoulder belt webbing passed through the latch plate.

VEHICLE DAMAGE

Exterior Damage - *1997 Ford Explorer*

Figure 11. Frontal damage to the Ford Explorer

The 1997 Ford Explorer sustained moderate damage as result of the impact with the Chevrolet Blazer **(Figure 11)**. The direct contact damage began at the left bumper corner and extended 146.0 cm (57.5") to the right bumper corner. The combined direct and induced damage involved the entire frontal plane and measured the same as the direct damage. The maximum crush was located at C6 at the right bumper corner and measured 27.1 cm (10.7"). The direct damage extended vertically from the bottom edge of the front bumper to the leading edge of the hood. Paint transfers from the Blazer were noted on the bumper, grille area, and leading edge of the hood. Both headlights were displaced. The front bumper was crushed rearward and shifted slightly to the right. The right aspect of the front bumper was crushed against the right front wheel, causing the wheel to be restricted. The hood was displaced slightly to the right and was buckled at the designated fold points. Both front fenders were crushed rearward and buckled outward. The Collision Deformation Classification (CDC) for this event was 11-FDEW-2. Six crush measurements were documented at the level of the front bumper and were as follows: C1 = 17.1 cm (6.7"), C2 = 10.8 cm (4.3"), C3 = 11.5 cm (4.5"), C4 = 12.5 cm (4.9"), C5 = 14.8 cm (5.8"), C6 = 27.1 cm (10.7").

Interior Damage - *1997 Ford Explorer*

Interior damage to the 1997 Ford Explorer was minor and attributed to occupant contact. There were no measurable intrusions. The rear view mirror was cracked on the left side and separated from the windshield, and may have been contacted by the right hand of the driver. A scuff mark was noted on the knee bolster to the right of the steering column from the driver's right knee.

CHILD SAFETY SEAT *(1996 Chevrolet Blazer)*

Figure 12. Gerry "Double Guard" shield booster seat

The child safety seat that was installed in the Chevrolet Blazer was a Gerry "Double Guard" shield booster **(Figure 12)**. The model number was 675 and the manufacture date was May 4, 1994. The driver of the Blazer did not have access to an owner's manual, as the seat had been given to him from a family member who purchased the seat new approximately 8 years ago. A copy of the owner's manual was obtained from NHTSA, and provided the basis for evaluating the use of this child safety seat.

There were no NHTSA safety recalls associated with this booster seat. The safety seat was equipped with a rigid plastic shield hinged at the left aspect. A integrated lap belt was fixed to the inboard lower left area and extended across to a retractor that was located in the lower right aspect of the plastic shield. This was designed to fit snugly over the child's lap and provide the primary restraint. The lower right aspect of the plastic shield was also equipped with an integrated buckle which fit onto a stationary latch plate that secured the shield to the base of the seat. The owner's manual indicates that this shield booster seat was designed to be used with the shield and secured with the vehicle's manual lap/lap and shoulder belts **(Figure 13)** or without the shield and used as a belt positioning booster with the vehicle's lap and shoulder belts. The owner's manual also illustrates the necessity of using a locking clip when securing the booster seat with 3-point lap and shoulder belts that have sliding latch plates. The owner's manual stated that the seat was designed for use only by children who weigh between 13.6 kg (30.0 lb) and 27.2 kg (60.0 lb) and are between 83.8 cm (33.0") and 129.5 cm (51.0") in height.

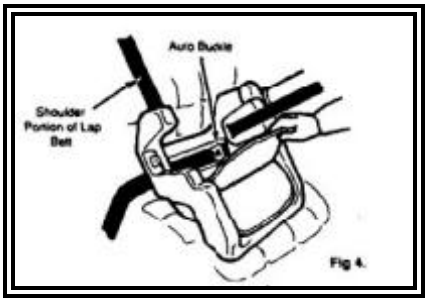

Figure 13. Illustration of proper belt path from owner's manual

Based on the vehicle inspection and driver interview, the booster seat was used with the shield and installed with the Blazer's 3-point lap and shoulder belts routed through the belt path on the rear aspect of the seat **(Figure 14)**. The driver stated that a family member had installed the seat earlier in the day prior to the crash, and engaged the switchable retractor to secure the seat. He also indicated that he had never been to a Child Safety Seat Checkpoint and did not read the owner's manual for this seat. He said that this booster seat was usually installed in a different vehicle, and was regularly switched between vehicles. Abrasions on the shield latch plate indicated frequent usage.

Figure 14. Post-crash views of seat installed in the Blazer

The seat was installed in the rear right position in the Blazer. During the vehicle inspection, the 3-point lap and shoulder belt was properly routed through the belt path and the switchable retractor was in the automatic locking retractor mode. Due to the use of the switchable retractor, a locking clip was not necessary. There were no misuses associated with the installation of the booster seat. According to the child safety seat owner's manual, the child was within the recommended height and weight guidelines associated with this shield booster seat at the date of manufacture. However, based on the September 1996 changes to the FMVSS 213 standard, current models of shield booster are not recommended for children over 18.1 kg (40.0 lb).

CHILD SAFETY SEAT DAMAGE

Damage to the Gerry "Double Guard"booster seat was minor, which was attributed to compartment intrusion and occupant contact. The integrated lap belt showed signs of occupant loading from the impact forces and the child being suspended upside down by the belt after the Blazer tipped onto its roof. Scuff marks were noted on the right outer aspect of the booster seat from contact with the intruded right interior side panel aft of the B-pillar **(Figures 15 and 16)**. Abrasions were noted on the outboard aspects of the vehicle belt path from the lap and shoulder belt as the booster seat loaded the vehicle's lap and shoulder belt. The rigid plastic bottom aspect of the child safety seat was scuffed from the lateral travel on the rear seat cushion.

Figure 15. Scuff marks on shield booster seat

Figure 16. Scuff marks on interior trim panel from shield booster seat

FRONTAL AIR BAG SYSTEM - ***1997 Ford Explorer***

The 1997 Ford Explorer was equipped with frontal air bags for the driver and front right passenger positions **(Figure 17)**. The air bags had deployed as a result of the frontal impact with the 1996 Chevrolet Blazer. The driver's air bag was housed in the center of the steering wheel with asymmetrical H-configuration module cover flaps. The top flap measured 24.2 cm (9.5") in width across the top, 17.7 cm (7.0") in width across the bottom, and measured 6.4 cm (2.5") in height. The bottom flap measured 17.7 cm (7.0") in width and 4.2 cm (1.7") in height. The air bag was circular in shape and measured 58.0 cm (22.8") in diameter. The driver's air bag was vented by two circular ports that measured 1.2 cm (0.5") in diameter and were located 7.0 cm (2.8") from the outer edge at the 11 and 1 o'clock positions. The air bag was tethered by two internal straps. There was no identifiable contact evidence or damage to the air bag surface or module cover flaps.

Figure 17. Frontal air bags in Ford Explorer

The front right passenger's air bag deployed from the right mid-instrument panel area with a single cover flap design. The cover flap was rectangular in shape and hinged at the top aspect. The cover flap measured 36.7 cm (14.4") in width and 17.5 cm (6.9") in height. The front right passenger's air bag measured 81.0 cm (31.9") in width and 60.2 cm (23.7") in height. It was vented by two circular ports that measured 5.5 cm (2.2") in diameter and were located 9.5 cm (3.7") inboard of the side seams at the 10 and 2 o'clock positions. An unknown transfer, possibly a dark colored beverage, was noted on the lower right corner of the air bag. There was no identifiable contact evidence or damage to the air bag surface or module cover flaps.

OCCUPANT DEMOGRAPHICS - *1996 Chevrolet Blazer*

Driver

Age/Sex:	24-year-old male
Height:	168.0 cm (66.0")
Weight:	81.6 kg (180.0 lb)
Seat Track Position:	Mid-position
Manual Restraint Use:	3-point lap and shoulder belt
Usage Source:	Vehicle inspection driver, police report
Eyewear:	None
Type of Medical Treatment:	Transported by ambulance to a regional trauma center where he was treated and released

Driver Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanisms
Right arm abrasions	Minor (790202.1,1)	Center console
Left arm abrasions	Minor (790202.1,2)	Left front interior door panel
Right wrist abrasions	Minor (790202.1,1)	Center console
Left wrist abrasions	Minor (790202.1,2)	Left front interior door panel
Posterior right upper arm contusion	Minor (790402.1,1)	Front right seat back

*Injury source: Hospital records/discharge summary

Driver Kinematics

The 24-year-old male driver stated that he was seated in an upright posture with the seat back slightly reclined and seat track adjusted to the mid-track position. He was restrained by the 3-point manual lap and shoulder belt. At impact, he initiated a lateral trajectory to the right and loaded the manual restraint and center console which resulted in right arm and wrist abrasions. He also struck the front right seat back that intruded laterally to the left, which resulted in a posterior right upper arm contusion. He rebounded to the left and struck the interior door panel and arm rest as evidenced by scuff marks. He sustained left hand and wrist abrasions from the interior door contact. As the vehicle tripped over, he was redirected laterally to the right and loaded the manual restraint which prevented additional movement throughout the vehicle. As the vehicle came to rest, he was suspended upside down by the seat belt. The driver stated he did not remember how he exited the vehicle. He re-entered the vehicle to remove the 3-year-old female passenger and exited the vehicle a second time through the backlight. He was transported by ambulance to a regional trauma center where he was treated and released.

Rear Right Child Passenger (In Child Safety Seat)

Age/Sex:	3-year-old female
Height:	106.7 cm (42.0")
Weight:	18.1 kg (40 lb)
Seat Track Position:	Fixed
Manual Restraint Use:	Gerry "Double Guard" shield booster
Usage Source:	Police report, driver, vehicle inspection
Eyewear:	None
Type of Medical Treatment:	Transported by ambulance to a regional children's hospital and admitted overnight for observation

Rear Right Child Passenger Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanisms
1.0 cm (0.5") abrasion over right eye	Minor (290202.1,1)	Right C-pillar
Right hand abrasions	Minor (890202.1,1)	Right side panel aft of the B-pillar
Right hand contusions	Minor (890402.1,1)	Right side panel aft of the B-pillar

*Injury source: Discharge summary/hospital records

Rear Right Child Kinematics

The 3-year-old female child was presumed to be seated in an upright posture and was positioned in the Gerry "Double Guard" shield booster seat in the rear right position. The seat was installed in the Blazer according to the manufacturer's owner manual. At impact, the child initiated a lateral trajectory to the right and loaded the rigid plastic right side aspect of the shield booster seat. She most likely struck her head on the intruding right C-pillar which resulted in a 1.0 cm (0.5") abrasion over the right eye. She struck her right arm on the intruding right interior side panel which resulted in right hand contusions and abrasions. According to the driver, the child's right leg was compressed between the right interior side panel and the right seat cushion. She rebounded to the left and loaded the rigid plastic left aspect of the booster seat. As the Blazer tripped over, she became suspended upside down by the integrated lap belt of the shield booster seat. She was removed from the shield booster seat and from the vehicle by the driver. He stated that he had difficulty freeing her leg from between the seat cushion and intruded components, and that it took approximately two to three minutes to remove her from the Blazer. The Emergency Room report identified a possible brief loss of consciousness, but it could not be confirmed. She was transported by ambulance to a regional children's hospital and admitted overnight for treatment and observation.

Occupant Kinematics - *1997 Ford Explorer*

Both occupants of the Explorer initiated forward trajectories and loaded the manual restraints and deployed frontal air bags. The driver had a police-reported complaint of back pain, and the front right passenger sustained police-reported facial bleeding. Both were transported by ambulance to a local hospital however. Their admission status was not reported.

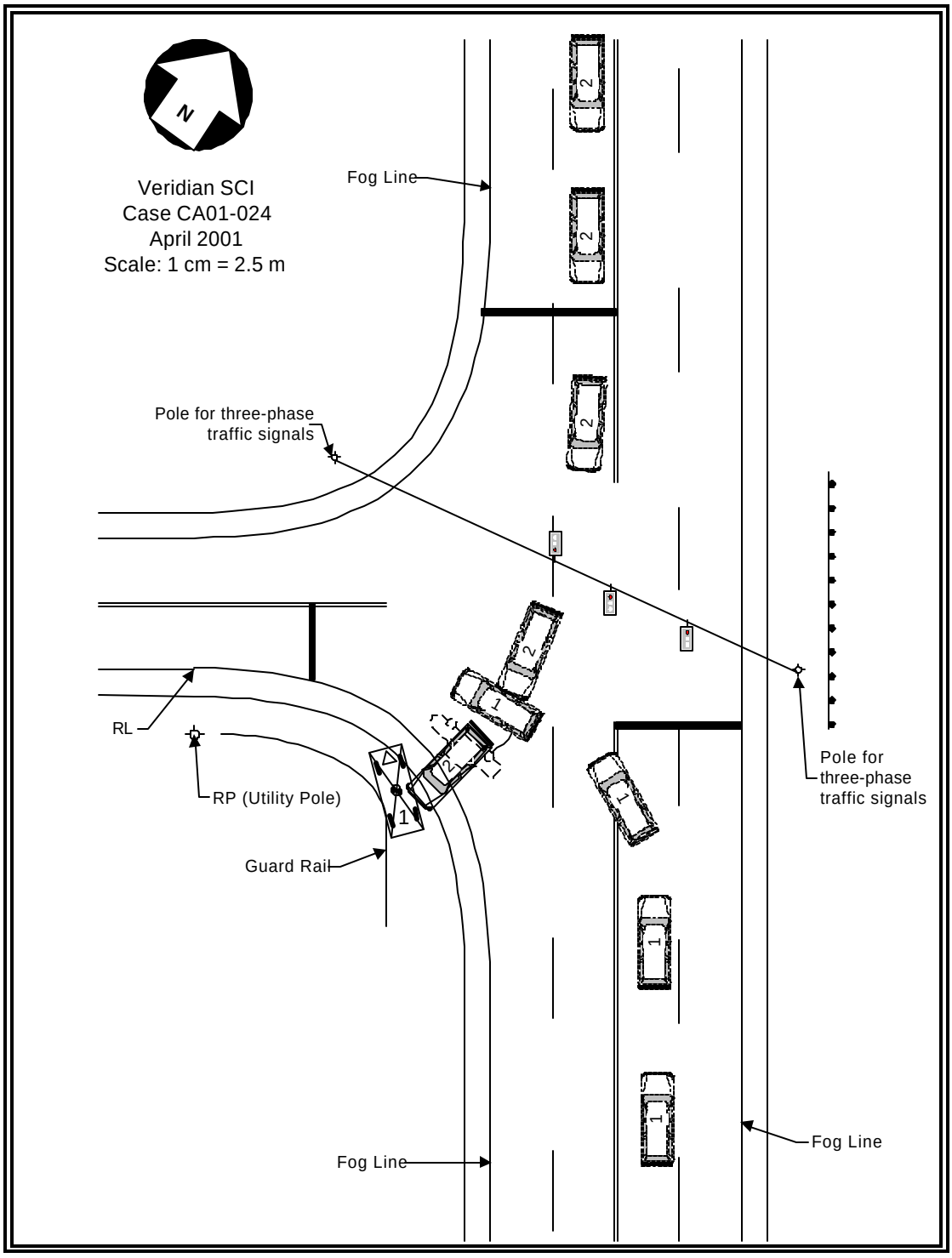

Figure 18. Scene schematic