

CRASH DATA RESEARCH CENTER
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CALSPAN ON-SITE ROLLOVER CRASH INVESTIGATION
SCI CASE NO: CA09018

VEHICLE: 2008 FORD TAURUS X
LOCATION: PENNSYLVANIA
CRASH DATE: JANUARY, 2009

Contract No. DTNH22-07-C-00043

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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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<p>16. Abstract</p> <p>This on-site investigation focused on the intersection collision and subsequent two-quarter turn rollover crash of a 2008 Ford Taurus X. A 1997 Saturn SL2 executing a left turn at the intersection was involved in the initial collision. The Ford Taurus X was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system, front seat-mounted side impact air bags, rollover sensing Inflatable Curtain (IC) air bags, front safety belt pretensioners and Electronic Stability Control (ESC). The manufacturer of the Ford certified that the vehicle was compliant with the advanced air bag portion of Federal Motor Vehicle Safety Standard No. 208. The front safety belt pretensioners actuated and the frontal air bags and IC air bags deployed as a result of the crash. The Ford was occupied by two restrained adults and two children restrained within Child Safety Seats (CSS) during the multiple event crash sequence. The four occupants were transported to a local hospital and treated for minor severity injuries.</p> <p>This crash was identified by the Crash Investigation Division (CID) of the National Highway Traffic Safety Administration during a weekly review of Police Crash Reports (PAR) submitted by the National Automotive Sampling System (NASS) General Estimates System (GES). Due to the Agency's interest in rollover crashes involving late model year vehicles, the PAR was forwarded to the Special Crash Investigations (SCI) team at Calspan on March 13, 2009. Calspan SCI established cooperation with the driver and the insurance carrier of the Ford and an on-site investigation was assigned March 16, 2009. The vehicle inspection, crash site inspection, child safety seat inspection and driver interview took place March 23, 2009. The Saturn was sold prior to SCI involvement and was not inspected.</p>			
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**CALSPAN ON-SITE ROLLOVER CRASH INVESTIGATION
SCI CASE NO: CA09018**

**VEHICLE: 2008 FORD TAURUS X
LOCATION: PENNSYLVANIA
CRASH DATE: JANUARY, 2009**

BACKGROUND

This on-site investigation focused on the intersection collision and subsequent two-quarter turn rollover crash of a 2008 Ford Taurus X. **Figure 1** is a front right oblique view of the Ford Taurus X. A 1997 Saturn SL2 executing a left turn at the intersection was involved in the initial collision. The Ford Taurus X was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system, front seat-mounted side impact air bags, rollover sensing Inflatable Curtain (IC) air bags, front safety belt pretensioners and Electronic Stability Control (ESC). The manufacturer of the Ford certified that the vehicle was compliant with the advanced air bag portion of Federal Motor Vehicle Safety Standard No. 208. The front safety belt pretensioners actuated and the frontal air bags and IC air bags deployed as a result of the crash. The Ford was occupied by two restrained adults and two children restrained within child safety seats during the multiple event crash sequence. The four occupants were transported to a local hospital and treated for minor severity injuries.



Figure 1: Front right oblique view of the Ford Taurus X.

This crash was identified by the Crash Investigation Division (CID) of the National Highway Traffic Safety Administration during a weekly review of Police Crash Reports (PAR) submitted by the National Automotive Sampling System (NASS) General Estimates System (GES). Due to the Agency's interest in rollover crashes involving late model year vehicles, the PAR was forwarded to the Special Crash Investigations (SCI) team at Calspan on March 13, 2009. Calspan SCI established cooperation with the driver and the insurance carrier of the Ford and an on-site investigation was assigned March 16, 2009. The vehicle inspection, crash site inspection, child safety seat inspection and driver interview took place March 23, 2009. The Saturn was sold prior to SCI involvement and was not inspected.

SUMMARY

VEHICLE DATA

2008 Ford Taurus X

The 2008 Ford Taurus X was a five-door station wagon that was manufactured in July 2007 and was identified by Vehicle Identification Number (VIN) 1FMDK05W68G (production number deleted). The odometer reading at the time of the SCI inspection was 31,567 km (19,615 miles). The Ford was powered by a 3.5-liter, transverse mounted six-cylinder engine linked to a six-

speed automatic transmission with All-Wheel Drive (AWD) and had the SEL trim package. The braking system consisted of power-assisted front and rear disc brakes with an Antilock Braking System (ABS) and electronic brake force distribution. The tires on the vehicle were Continental Conti Touring Contact, size P215/65R17, mounted on seven-spoke OEM alloy wheels. The tires were the proper size recommended by the vehicle manufacturer. The vehicle manufacturer recommended cold tire pressure was 228 kPa (35 PSI) for the front and rear. The specific tire data at the time of the SCI inspection was as follows:

Position	Measured Tire Pressure	Measured Tread Depth	Tire/Wheel Damage
Left Front	303 kPa (28 PSI)	4 mm (5/32 in)	Rim abrasions
Left Rear	186 kPa (27 PSI)	4 mm (5/32 in)	Rim abrasions
Right Front	179 kPa (26 PSI)	4 mm (5/32 in)	None
Right Rear	186 kPa (27 PSI)	4 mm (5/32 in)	None

The interior of the Ford was configured with leather upholstered seven-passenger seating. The front bucket seats were separated by a center console and equipped with height adjustable head restraints. The front left head restraint was adjusted to 4 cm (1.5 in) above the full-down position and the front right head restraint was adjusted to the full-down position. The second row consisted of a split bench seat with a forward folding back. Additionally, the Ford was equipped with a two-passenger third row split bench seat. The third row seat was folded in the stowed position at the time of the SCI inspection.

The Ford's safety systems consisted of a CAC frontal air bag system, front seat-mounted side impact air bags, rollover sensing IC air bags for the four outboard positions, front buckle mounted safety belt pretensioners, and the Lower Anchors and Tethers for CHildren (LATCH) system in the second row.

1997 Saturn SL2

The 1997 Saturn SL2 was identified by the VIN: 1G8ZK5277VZ (production number omitted). The four-door sedan was powered by a 1.9-liter, in-line four-cylinder engine, a four-speed automatic transmission, and was equipped with driver and front right passenger air bags. This vehicle was sold from an insurance salvage facility prior to the SCI investigation and was not inspected.

CRASH SITE

This multiple event crash occurred during the nighttime hours of January 2009. At the time of the crash, it was dark without overhead artificial street lighting. The asphalt road surface was dry. The crash occurred within a four-leg intersection of a five-lane north/south road and a three-lane east/west road in a suburban commercial setting. The travel lanes of the north/south road were configured with two lanes in either direction with opposing left turn only lanes. The intersection was controlled by overhead traffic signals. The traffic signal was on the green phase for the north/south direction at the time of the crash. The posted speed limit was 72 km/h (45 mph). **Figure 2** is a southbound view of the intersection. **Figure 3** is a northbound trajectory view of the Saturn.



Figure 2: Southbound view of the intersection.



Figure 3: Northbound trajectory view of the Saturn.

CRASH SEQUENCE

Pre-Crash

The Ford Taurus X was southbound on the outboard lane driven by a 49-year-old restrained male at a driver reported speed of 72 to 80 km/h (45 to 50 mph). The vehicle was occupied by a 37-year-old restrained female front right passenger, a 1-year-old female restrained within a forward facing Convertible Safety Seat (CSS) in the second row left position, and a 5-year-old male restrained in a backless Booster Safety Seat (BSS) in the second row right position. At the time of the crash, the family was returning to their home which was located approximately five minutes south of the crash site. They had been en-route for approximately 40 minutes. The driver reported that the children were asleep in their respective seats.

The Saturn was northbound in the left turn lane driven by a 46-year-old male. The Saturn driver entered the intersection and turned left across the path of the Ford immediately prior to the crash. The driver of the Ford steered his vehicle to the left in an unsuccessful avoidance maneuver. **Figure 11** at the end of this report is a schematic of the crash.

Crash

The center and right aspects of the Ford's frontal plane struck the right plane of the Saturn (Event 1). The directions of the impact force were in the 11 o'clock sector and 2 o'clock sector for the Ford and Saturn, respectively. The force of the impact caused the actuation of the front safety belt pretensioners and the deployment of frontal air bags in the Ford. The frontal air bags in the Saturn also deployed. The CDC Algorithm of the WINSMASH program was used to calculate the severity (delta V) of the crash. The total delta V of the Ford was 29.0 km/h (18.0 mph). The longitudinal and lateral delta V components were -27.3 km/h (-17.0 mph) and 9.9 km/h (6.2 mph), respectively. The Saturn's total delta V was 50.0 km/h (31.1 mph) with longitudinal and lateral components of -32.1 km/h (-19.9 mph) and -38.3 km/h (-23.8 mph).

The Saturn separated from the impact with a northwest trajectory and a clockwise (CW) rotation. The vehicle rotated approximately 135 degrees CW and came to rest off the road, facing east, in the northwest quadrant of the intersection. The Ford separated from the Saturn with a CW

rotation and southward trajectory. During the rotation, the left side tires folded under and the left wheel rims contacted the pavement, evidenced by circumferential rim abrasions. The rim-to-pavement contact tripped the Ford into a two-quarter turn left side leading rollover (Event 2). The rollover sensing system in the Ford deployed the IC air bags. The Ford rolled onto its roof and slid to rest in the outboard southbound lane approximately 18 m (60 ft) from the initial impact. The estimated roll distance from trip to final rest was 15 m (49 ft).

Post-Crash

The driver reported that, after regaining his faculties and realizing what had happened, he began to feel claustrophobic. He released his safety belt and exited the vehicle through the (disintegrated) left third row window opening. He then opened the left front door, crawled back into the vehicle to assist his wife and the children. He reported that his wife was initially unconscious. The driver indicated that both children remained in their respective seat positions and were still restrained. He released the safety belts for each child and passed them to unknown individuals that had responded to the crash site. He then assisted the front right passenger from her seat. By this time, the police and ambulance personnel had responded to the crash site. The occupants of the Ford were transported by ground ambulance to a local hospital. The driver and the children were examined and released. The front right passenger was hospitalized one day. The driver of the Saturn was not injured and did not require medical transport.

2008 FORD TAURUS X

Exterior Damage

The front plane of the Ford sustained moderate severity damage from the impact with the Saturn (Event 1). The direct contact damage was biased to the front right aspect of the vehicle beginning at the centerline and extended 79 cm (31.1 in) to the right bumper corner. The damage consisted of longitudinal deformation to the frontal structure. The maximum crush was located at C4, 51 cm (20.0 in) inboard of the right bumper beam corner and was 24 cm (9.4 in) in depth. The deformation from this impact was captured by documenting a crush profile across the 127 cm (50.0 in) wide bumper beam and was follows: C1 = 0 cm, C2 = 16 cm (6.3



Figure 4: Front view of the Ford.

in), C3 = 24 cm (9.4 in), C4 = 24 cm (9.4 in), C5 = 21 cm (8.3 in), C6 = 6 cm (2.4 in). In addition to the longitudinal crush, there was slight lateral displacement of the frame rails from the 11 o'clock direction of force. The left frame rail was displaced to the right 4 cm (1.7 in) and the right frame rail was displaced 7 cm (2.7 in) to the right. The Collision Deformation Classification (CDC) for this impact was 11-FZEW1.

The Ford rotated CW as it separated from the Saturn, tripped, and rolled over two-quarter turns onto its roof (Event 2). This event resulted in moderate damage to the left and top planes of the vehicle that consisted of abrasions and vertical crush to the right A-pillar, windshield header and front roof areas. The surface abrasions were noted on the side rails, roof, and the hood. The maximum vertical crush measured 11 cm (4.5 in) located at the junction of the right A-pillar and windshield header. The maximum lateral crush was located at the right A-pillar/header junction and was an estimated 3 cm (1 in). The CDC for this event was 00-TDDO2.



Figure 5: Ford roof deformation as a result of the rollover.

The right wheelbase dimension was reduced 6 cm (2.4 in). The left wheelbase dimension was unchanged. The left front wheel rim and left rear wheel rim were abraded about the circumference due to contact with the road surface. The rim-to-ground contact resulted in the rollover event.

The four doors and the rear hatch remained closed during the crash and were operational post-crash. The windshield fractured and had sagged during the passage of time between the date of the crash and the date of the SCI inspection. During the rollover event, the closed sunroof glazing contacted the ground and disintegrated. As the roof crushed, the tops of the front doors were compressed disintegrating the front door glazing. The left rear glazing also was disintegrated. The remainder of the side and rear glazing was intact.

1997 SATURN SL2

Exterior Damage

The damage assessment for the Saturn was derived from the single image that was provided by the Ford driver to the SCI investigator. Refer to **Figure 6**. The right side of the Saturn exhibited severe damage from the impact with the Ford. The damage was centralized within the passenger compartment area of the vehicle. The side panels of the Saturn were constructed of a composite material and had fractured. The composite panels over of the doors were fractured and separated from the vehicle. Severe crush was noted to the lower aspect of the right B-pillar and was estimated to be 51 cm (20 in). The right side door also exhibited lateral crush; however, the right front door appeared to have been pried open post-crash. The estimated CDC for this impact was 02-RDAW4.



Figure 6: Right oblique view of the Saturn supplied by the driver of the Ford.

2008 FORD TAURUS X SEL

Interior Damage

The Ford sustained moderate interior damage from occupant contact points and passenger compartment intrusion. Occupant contact points were present to the driver’s knee bolster and the right roof area. The driver’s knee bolster exhibited two 1 cm (0.5 in) wide scuff marks. These scuffs were located 11 cm (4.5 in) to the left and right of the steering column centerline. The roof contact was evidenced by a 17 cm x 23 cm (6.5 in x 9 in) scuffed area above the front right passenger seat. Scattered body fluid evidence was noted within the area. The passenger compartment intrusions are listed on the following table:

Position	Component	Magnitude	Direction
Row 1 Left	Windshield header	5 cm (2 in)	Vertical
Row 1 Left	Roof	5 cm (2 in)	Vertical
Row 1 Center	Windshield header	9 cm (3.5in)	Vertical
Row 1 Center	Roof	10 cm (4 in)	Vertical
Row 1 Right	Windshield header	9 cm (3.5 in)	Vertical
Row 1 Right	Roof	9 cm (3.5 in)	Vertical
Row 1 Right	A-pillar	11 cm (4.5 in)	Vertical

The driver seat was adjusted to a rear-track position that measured 4 cm (1.7 in) forward of full-rear. The total seat track travel measured 25 cm (10 in). The seat back was reclined 17 degrees aft of vertical. The horizontal distance from the seat back to the driver air bag module measured 62 cm (24.5 in). There was no deformation of the four-spoke steering wheel rim. There was no shear capsule displacement.

The front right seat was adjusted to the full-rear track position. The seat back was reclined 15 degrees aft of vertical. The horizontal distance from the seat back to the vertical face of the instrument panel measured 79 cm (31 in).

2008 FORD TAURUS X

Manual Restraint Systems

The manual restraint systems in the Ford consisted of three-point lap and shoulder belts in all seven seat positions. The driver’s restraint consisted of continuous loop webbing, an Emergency Locking Retractor (ELR), a sliding latch plate, a height adjustable D-ring, and a buckle mounted pretensioner. The frontal crash event actuated the driver’s pretensioner which compressed the buckle stalk 4 cm (1.8 in). The webbing was stowed on the retractor at initial inspection and the retractor was operational. Examination of the webbing revealed that a 46 cm (18 in) section of the belt exhibited signs of loading. The webbing was stiff from the occupant loading during the crash sequence. This webbing section began 31 cm (12 in) above the anchor and was located across the driver’s lap during the crash. Minor historical use abrasions were noted to the latch plate.

The front right safety belt was equipped with continuous loop webbing, a sliding latch plate, an adjustable D-ring, a buckle pretensioner, and a dual-mode retractor. The retractor was switchable from the ELR to Automatic Locking Retractor (ALR). The pretensioner actuated

during the crash and compressed the buckle stalk 4 cm (1.8 in). The webbing was in the stowed position at initial inspection; the retractor was operational. Historical use evidence was observed on the latch plate. No crash related evidence was observed on the webbing.

The second and third row belt systems consisted of continuous loop webbing, a sliding latch plate and switchable ELR/ALR. The second row left safety belt was used to restrain the 1-year-old female child passenger positioned in a forward facing CSS. In addition to the vehicle's belt system, the lower anchors were also used to install the safety seat to the vehicle (see *Child Safety Seat Data* section for further details). The safety belt was routed through the forward facing belt of the CSS. During the crash, the safety belt interacted with the CSS belt path resulting in creasing to the safety belt. The creasing spanned over a 50 cm (19.5 in) section of the webbing beginning 34 cm (13.5 in) above the floor anchor.

The second row rear right safety belt was used to restrain 5-year-old male passenger in a backless BSS. The webbing was stowed in the retractor at initial inspection. It was observed that the webbing was gathered in the latch plate hardware and was captured. The latch plate was captured 102 cm (40 in) above the floor anchor. Minor frictional abrasions were observed on the latch plate hardware. During the crash sequence, the child loaded the belt system which was evidence by creasing of the belt webbing. This creasing measured 28 cm (11 in) in length and began 102 cm (40 in) above the floor anchor.

2008 FORD TAURUS X SEL

Frontal Air Bag System

The Ford was equipped with a CAC frontal air bag system for the driver and front right passenger positions. A CAC vehicle is certified by the manufacturer to be compliant to the advanced air bag portion of Federal Motor Vehicle Safety Standard No. 208. The CAC system consisted of dual stage driver and passenger air bags, a front right occupant presence detection sensor, front seat track positioning sensors, safety belt buckle switch sensors and front retractor pretensioners. The CAC frontal air bag system deployed during the initial impact sequence of the crash. The air bag system was not supported by the Bosch Crash Data Retrieval tool.

The driver's air bag was concealed within the center hub of the steering wheel by two asymmetrical I-configuration cover flaps. The left flap was 13 cm (5 in) in height and 9 cm (3.5 in) in width. The right flap measured 13 cm (5 in) in height and 6 cm (2.5 in) in width. The air bag membrane measured 51 cm (20 in) in diameter in its deflated state and had a maximum rearward excursion of 20 cm (8 in). The air bag was vented by two 3 cm (1 in) diameter vent ports located at the 11 and 1 o'clock positions. The air bag was tethered by two straps located at the 12 and 6 o'clock positions. There were no occupant contacts to the driver's frontal air bag; however, dirt was present on the face of the air bag at the 10 to 11 o'clock positions.

The front right air bag was mounted within the top aspect of the right instrument panel. This air bag module contained a single cover flap that was 13 cm (5 in) in height and 27 cm (10.5 in) in width. The air bag measured 61 cm (24 in) in height and 46 cm (18 in) in width in its deflated state. It was vented by two ports located on the side panels. The rearward excursion of the air bag measured 51 cm (20 in). Sewn to the face of the bag were two 31 cm (12 in) wide band

tethers. The tethers were located 23 cm (9 in) and 43 cm (17 in) below the top surface of the bag, respectively. There were no observed occupant contact evidence or damage to the front right passenger air bag.

2008 FORD TAURUS X
Side Impact Air Bag System

The Ford was equipped with rollover sensing IC air bags that were mounted in the roof side rails and provided coverage to the six outboard seat positions. As a result of the rollover event, both IC air bags deployed from the respective roof side rails. **Figures 7 and 8** are interior images depicting the deployed curtain air bags.

The IC air bag measured 234 cm (92 in) in length and provided protection from the A- to C-pillars. The air bag was tethered at the A-pillar by a sail panel that measured 33 cm (13 in) in height and 25 cm (10 in) in width. This sail panel provided for longitudinal coverage over the forward aspect of the front glazing at the A-pillar junction.

At the front seating positions, the membrane measured 44 cm (17.5 in) in height and extended 6 cm (2.5 in) below the belt line. At the second row rear seating position; the membrane was 43 cm (17 in) in height and extended vertically to the belt line. The height of the air bag tapered at third row measuring 36 cm (14 in) and extended 1 cm (0.8 in) below the beltline. No damage or occupant contact points were observed on the IC air bags.



Figure 7: Deployed left curtain air bag.



Figure 8: Deployed right curtain air bag.

The front seat-mounted side air bags in the Ford did not deploy during the crash sequence.

CHILD SAFETY SEAT DATA

Cosco Alpha Omega 3-in-1

The 1-year-old female was restrained within the five-point harness system of a Cosco Alpha Omega 3-in-1 CSS (**Figure 9**). The seat's date of manufacture was 12/20/2003 and was identified by the Serial No. AO2C. The Model No. was 22-150-BNP. The Alpha Omega CSS was a convertible seat designed for a child weighting 2 to 36 kg (5 to 80 lb) and could be used in three modes. In the rear facing mode, the seat was designed for an infant 2 to 18 kg (5 to 40 lb) with a height of 48 to 109 cm (19 in to 43 in). In the forward facing mode, the CSS was designed to be used with the internal five-point harness with a child's weight rating of 10 to 18 kg (22 to 40 lb). The CSS could also be used as a booster seat for by a child 14 to 36 kg (30 to 80 lb) with a height up to 132 cm (52 in) by removing the internal harness and using the vehicle's safety belt system. The CSS had an adjustable base and was equipped with the Lower Anchors for Tethers and Children (LATCH) system.



Figure 9: Cosco Alpha Omega CSS.

The driver reported that he had installed the CSS in the vehicle at an unknown date prior to the crash. It was his habit to periodically check the installation and tighten it as necessary. He indicated that he had installed the seat with both the LATCH lower anchors strap and the vehicle's three-point safety belt. The tether strap was not in use. In order to install the seat, he routed the lower anchor strap through the forward facing belt path, attached the clips to the LATCH anchors, kneeled into the seat, and then tightened the strap. He then routed the vehicle's safety belt through the forward facing belt path, buckled the safety belt and tightened the webbing. He then extended the webbing from the retractor, switched the retractor to ALR mode and fed the excess webbing back into the retractor. He indicated the seat was tight with minimal side to side movement. He reported that he read the CSS manual and learned the installation techniques by experience. He was not aware of, or had ever heard of, Child Safety Seat Check Points.

At the time of the crash, the CSS was being used in the forward facing mode. The 14 kg (30 lb) reported-weight of the 1-year-old female was appropriate for this use. The driver indicated that he had checked the installation of the CSS on the evening of the crash. It was reported as tight with less than 3 cm (1 in) of movement at the belt path. The driver placed the child in the CSS and restrained her within the five-point harness. The driver reported that the straps were snug at the shoulder and that the harness retainer clip was at the mid-chest level.

The CSS was inspected at the driver's residence and had been disassembled prior to SCI involvement in the investigation. Reportedly, it had been disassembled by the family after the crash, as they looked for the serial and model numbers to give to their insurance company. The SCI examination of the CSS was unremarkable for damage. No stress marks were identified on the shell. Subtle abrasions were observed at the forward facing belt path from interaction with

the safety belts. The internal harness strap was twisted and roped in the left buckle clip. There were no indications of stress or damage to the internal harness. The buckle and harness retainer clip were operational.

Graco Turbo Booster

The 5-year-old male was restrained by the vehicle’s safety belt while seated on the Graco Turbo Booster BSS (**Figure 10**) in the second row right position. This seat was being used in the backless mode. The seat was identified by the Serial No. JJ040700506971; Model No. 8493BRG. The date of manufacture was 04/07/2004. The seat was designed for children 3 to 10 years of age. With the back installed, the seat was for use by a child weighting 14 to 45 kg (30 to 100 lb) with a height of 97 to 145 cm (38 to 57 in). In the backless mode, the seat was rated for a child 18 to 45 kg (40 to 100 lb) and 102 to 145 cm (40 to 57 in). The reported 23 kg (50 lb) weight and 117 cm (46 in) height of the child was appropriate for this booster seat in the backless mode.



Figure 10: Graco booster CSS.

The driver reported that he assisted the 5-year-old male into the seat on the evening of the crash and buckled the vehicle’s safety belt. The driver indicated that the lap portion of the webbing was across the child’s waist (under the BSS arm rests); the shoulder webbing was on his right shoulder. The switchable retractor was in the ELR mode.

Examination of the booster seat was unremarkable for crash related damage. A minor 3 cm (1 in) stress mark to the seat was observed on its left aspect forward of the belt path. This stress mark did not appear to be crash related due to its forward location.

DRIVER DEMOGRAPHICS

- Age/Sex: 49-year-old/Male
- Height: 188 cm (74 in)
- Weight: 118 kg (260 lb)
- Seat Position: Full-rear track position
- Restraint Use: Three-point lap and shoulder safety belt
- Usage Source: SCI vehicle inspection
- Medical Treatment: Transported by ground ambulance, examined and released

DRIVER INJURY

<i>Injury</i>	<i>Injury Severity (AIS 90/98 update)</i>	<i>Injury Source</i>
Complaint of neck, shoulder and chest pain, NFS	Not codeable under AIS rules	Crash force

Source: Emergency Room Records.

DRIVER KINEMATICS

The restrained driver was seated in a full-rear track position and was seated in an upright posture. He was operating the vehicle on the outboard southbound lane at a reported speed of 72 km/h to 80 km/h (45 mph to 50 mph). Immediately prior to the crash, the driver steered left in an unsuccessful avoidance maneuver.

At impact, the safety belt retractor locked, the pretensioner actuated, and the frontal air bags deployed. The pretensioner removed potential webbing slack and tightened the webbing about the driver. The driver initiated a forward trajectory in response to the 11 o'clock direction of the frontal impact. His lower extremities contacted the knee bolster evidenced by the identified scuff marks to the panel. The driver contacted and loaded the safety belt. His chest likely contacted the deployed driver air bag and he rode down the force of the impact.

As the vehicle tripped and began to roll over, the IC air bags deployed. The driver remained in contact with the safety belt and frontal air bag while moving to his right with respect to the vehicle. The vehicle rolled two-quarter turns onto its roof and slid to rest. The left IC air bag prevented the driver's potential contact to the left side structure. The driver remained within the front left interior and was suspended by the vehicle's locked safety belt at rest. He released the belt and was able to exit the vehicle under his own power.

FRONT RIGHT PASSENGER DEMOGRAPHICS

Age/Sex: 37-year-old/Female
Height: 163 cm (64 in)
Weight: 68 kg (150 lb)
Seat Position: Full-rear track position
Restraint Use: Three-point lap and shoulder safety belt
Usage Source: SCI vehicle inspection
Medical Treatment: Transported by ground ambulance and hospitalized one day.

FRONT RIGHT PASSENGER INJURY

<i>Injury</i>	<i>Injury Severity (AIS 90/98 update)</i>	<i>Injury Source</i>
Concussion	Not codeable from interview data under AIS rules	Intruding roof
Complaint of upper back pain. NFS	Not codeable under AIS rules	Crash force

Source: The above injuries were identified by driver interview. Medical records were requested multiple times; however no record of treatment was found for this patient.

FRONT RIGHT PASSENGER KINEMATICS

The 37-year-old restrained female was seated in an upright posture in a full-rear track position. At impact, the safety belt retractor locked, the pretensioner actuated and frontal air bags deployed. The passenger initiated a forward trajectory, loaded the safety belt system with her torso and began to ride down the force of the frontal impact. As the vehicle rotated CW and

began to rollover, the IC air bags deployed. The passenger remained in contact with the safety belt system. As the vehicle rolled inverted and impacted the ground, the roof crushed down toward the passenger. The passenger responded with a vertical trajectory and her head contacted the roof. This contact was evidenced by a scuffed area to the headliner/sunroof area above her seat. The driver reported that the passenger was unconscious for an unspecified time period immediately after the crash. The passenger came to rest suspended from the belt system and was assisted from the vehicle by the driver. She was transported to a local hospital and admitted for one day.

SECOND ROW LEFT PASSENGER DEMOGRAPHICS

Age/Sex: 1-year-old/Female
 Height: 79 cm (31 in)
 Weight: 14 kg (30 lb)
 Seat Position: Not adjustable
 Restraint Use: Five-point harness in a CSS (forward facing mode)
 Usage Source: SCI vehicle inspection, driver interview
 Medical Treatment: Transported by ground ambulance, examined and released.

SECOND ROW LEFT PASSENGER INJURY

<i>Injury</i>	<i>Injury Severity (AIS 90/98 update)</i>	<i>Injury Source</i>
No injury	N/A	N/A

Source: Emergency room records

SECOND ROW LEFT PASSENGER KINEMATICS

The 1-year-old female was restrained in a forward facing mode by the five-point harness of a convertible CSS. The driver reported that the passenger was asleep. At impact, safety belt retractor locked. The child (and CSS) responded to the 11 o'clock direction of the impact force by initiating a forward trajectory. The child loaded the internal CSS harness with her torso. In turn, the combined mass of the child and the CSS loaded the vehicle's safety belt and the lower anchors of the LATCH system. As the vehicle rotated, tripped and rollover, the child remained in contact with the harness and rode down the force of the rollover crash. She did not contact the IC air bag. The child came to rest restrained within the CSS and was removed from the CSS by the driver. The child was transported to a local hospital and examined. She was not injured.

SECOND ROW RIGHT PASSENGER DEMOGRAPHICS

Age/Sex: 5-year-old/Male
 Height: 117 cm (46 in)
 Weight: 23 kg (50 lb)
 Seat Position: Not adjustable
 Restraint Use: Three-point lap and shoulder safety belt in a BSS
 Usage Source: SCI vehicle inspection, driver interview
 Medical Treatment: Transported by ground ambulance, examined and released.

SECOND ROW RIGHT PASSENGER INJURY

<i>Injury</i>	<i>Injury Severity (AIS 90/98 update)</i>	<i>Injury Source</i>
Complaint of mild abdominal pain. NFS	Not codeable under AIS rules	Crash force

Source: Emergency room records

SECOND ROW RIGHT PASSENGER KINEMATICS

The 5-year-old male was seated on a backless BSS and restrained by the vehicle's safety belt. The driver reported that this passenger was asleep at the time of the crash. At impact, the safety belt retractor locked and the child initiated a forward trajectory. He loaded the belt system with his torso and began to ride down the crash. During the rollover sequence, the child remained in contact with the belt system and rode down the force of the rollover event. He came to rest in the CSS suspended by the safety belt. He was removed from the vehicle by the driver and transported to a local hospital. He complained of mild abdominal pain; however an objective injury was not identified.

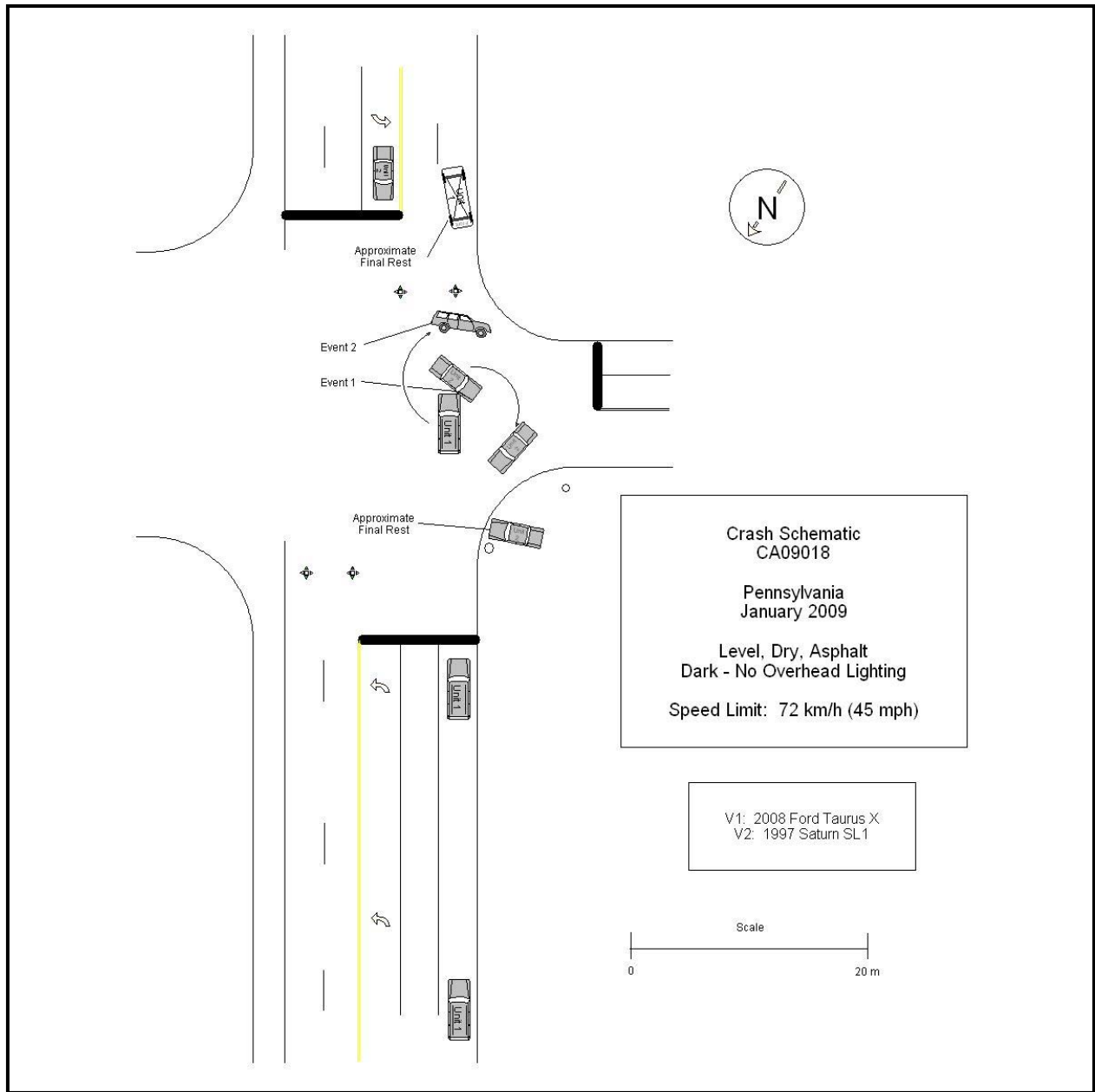


Figure 11: Crash schematic.