

CRASH DATA RESEARCH CENTER

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OFFICE OF DEFECTS INVESTIGATION

CALSPAN ON-SITE ROLLOVER CRASH INVESTIGATION

SCI CASE NO.: CA10021

VEHICLE: 1997 TOYOTA T100 PICKUP TRUCK

LOCATION: UTAH

CRASH DATE: MAY 2010

Contract No. DTNH22-07-C-00043

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 system.

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LOCATION: UTAH
CRASH DATE: MAY 2010**

BACKGROUND

This on-site investigation focused on the inspection of the steering and undercarriage components of a 1997 Toyota T100 extended cab pickup truck that was involved in a fatal rollover crash. The Toyota was driven by an unrestrained 23-year-old female and occupied by three children (ages 9-months, 3-years and 4-years of age) restrained in Child Restraint Systems (CRS) in the rear seat of the vehicle. The driver of the Toyota was traveling northbound on an interstate roadway when the vehicle drifted off the left shoulder onto the grass median. The center front plane area of the vehicle struck and overrode a delineator post. The driver initiated a clockwise (CW) steering maneuver in an attempt to regain the travel lanes. As the Toyota reentered the roadway, she counter steered left resulting in a CCW yaw across the travel lanes. The Toyota traveled onto the unprotected median and the right side tires tripped the vehicle into a six-quarter turn rollover event. The driver was extricated from the vehicle and was transported to a local hospital where she expired within one-hour of the crash. The three children remained in their respective CRSs throughout the rollover sequence and were transported to a local hospital for treatment and released. **Figure 1** is an overall view of the Toyota at final rest.



Figure 1: Overall view of the crash site and the final rest position of the Toyota. (Image obtained through an internet news site).

The Crash Investigation Division (CID) of the National Highway Traffic Safety Administration (NHTSA) provided notification of this May 2010 crash to the Calspan Special Crash Investigation's (SCI) team on June 2, 2010. Telephone contact was immediately initiated to the Investigating Police Agency. The investigating officer stated the vehicle had been released from police impound and that a law firm was seeking to gain possession of the Toyota. The SCI team contacted the law firm and established cooperation with the attorney to arrange an inspection of the Toyota. The inspection occurred on June 15, 2010, and involved a thorough inspection and documentation of the vehicle's undercarriage and steering components, tires and brakes, and the rollover damage. The CRSs had previously been removed from the vehicle and were not available for inspection.

SUMMARY

Crash Site

The crash occurred on a divided interstate roadway during daylight hours. The interstate consisted of two travel lanes in each direction, separated by an unprotected depressed grass median. At the time of the crash, the conditions were clear and dry. The driver was traveling in a northerly direction on the inboard lane in the posted 121 km/h (75 mph) speed zone. The travel speed was unknown. On her approach to the impending crash site, the driver was negotiating a right curve that transitioned to a straight segment of road. The travel lanes and adjacent shoulders were surfaced with concrete. Tactile rumble strips were cut into the outboard aspects of the shoulders. It should be noted that the rumble strips were not continuous with a significant spacing between the cut segments. There was a subtle negative grade of approximately two-percent in the northbound direction. A schematic of the crash is included, at the end of this report as **Figure 11**.



Figure 2: Rollover and roof crush to the Toyota. (Image supplied by an internet news site).

Vehicle Data

The 1997 Toyota T100 pickup truck was manufactured in July 1997 and was identified by Vehicle Identification Number (VIN): JT4UN22D9V0 (production number deleted). The Toyota was an extended cab, two-door truck built on a 310 cm (122.1 in) wheelbase and powered by a 3.4 liter, V-6 engine, linked to a 4-speed automatic transmission. The pickup truck was four-wheel drive with center tunnel-mounted transfer case shift lever. The Gross Vehicle Weight Rating was 2,722 kg (6,000 lbs) with a distribution of 1,315 kg (2,900 lbs) and 1,542 kg (3,400 lbs) front and rear, respectively. At the time of the SCI inspection, the odometer reading was 163,418 km (101,546 miles). The vehicle manufacturer recommended tire size was 235/75R15 with cold tire pressures of 193 kPa (28 PSI) for the front and 241 kPa (35 PSI) for the rear axle tires. The Toyota was equipped with oversize Michelin LTX tires, size LT265/75R16 that were mounted on OEM-style steel wheels. The specific tire data at the time of the SCI inspection was as follows:

Position	Tire Pressure	Tread Depth	Damage	Tire Identification Number
LF	262 kPa (38 PSI)	6 mm (7/32 in)	None	M34NR8DX3201
RF	48 kPa (7 PSI)	6 mm (7/32 in)	None	M34NR8DX3201
LR	269 kPa (39 PSI)	6 mm (7/32 in)	None	M34NB8DX3301
RR	276 kPa (40 PSI)	6 mm (7/32 in)	None	ED4NB8DX4802

The cargo bed of the Toyota was covered with an aftermarket aluminum cap that was held in place by four clamps at the corner locations. The cap separated from the truck during the rollover event. The bed of the Toyota contained a significant amount of personal items, as the

family was in the process of moving to a different state. These loose items separated from the bed of the truck during the rollover crash event.

The interior of the Toyota was configured for six-passenger seating. The front seat was a 60/40 split-bench seat with a fold-down center armrest. The driver (left) portion of the seat was wider than the right portion. The front outboard positions were equipped with adjustable head restraints. Both restraints were adjusted 2.5 cm (1 in) above the seat back at the time of the SCI inspection. The left head restraint was deformed by the intrusion of the roof with the right stalk fully compressed into the seat back. The rear seat was a three-passenger bench seat with a fixed back rest and rear-folding seat cushions. The cushions were split 60/40, right side wide.

The safety systems consisted of 3-point manual safety belts for the four outboard seating positions and lap belts for the center front and center rear positions. The Toyota was equipped with a frontal air bag for the driver position. The first generation air bag did not deploy in this crash. The Toyota was not equipped with a front right air bag system.

Recall Data/Vehicle History

This 1997 Toyota T100 pickup truck was the subject of a NHTSA recall campaign in 2005. The NHTSA Recall No. was 05V-389000 and involved the replacement of the steering relay rod.

The Toyota was purchased new on November 3, 1997. The original owner had the recall work performed by a Toyota dealership on June 6, 2006. He subsequently sold the vehicle to the husband of the driver involved in this crash during the 2008 calendar year.

Steering System

The Toyota's steering system (**Figure 3**) consisted of a recirculating ball system utilizing a cast iron steering box that was mounted to the left frame rail. A pitman arm connected to the left outboard aspect of the relay rod transferred steering inputs from the steering box to the relay rod (center link). An idler arm was mounted to the outboard end of the right frame rail. The inner tie rods were connected to the relay rod, inboard of the pitman arm and the idler arm. A hydraulic steering damper was connected to the inboard aspect of the left inner tie rod. The outer tie rods were mounted to the steering knuckle arms that were bolted to the spindle assemblies.

The undercarriage engine cover (skid plate/splash shield) was removed from the front undercarriage of the Toyota to facilitate a thorough inspection of the steering components. The SCI inspection of the steering system revealed that all linkage and associated components were intact and tight post-crash. There was no separation or looseness in the tie rods, pitman arm, idler arm or the relay rod. All rubber boots on the steering components were intact and free of damage (**Figure 4**).

There was slight deformation of the front suspension/steering system that resulted in a differential of the toe adjustment of the front tires. This damage was related to the rollover event and was not a pre-crash condition. With the steering wheel positioned in a near 12 o'clock position, the lateral distance between the outboard edges of the front tires at the forward position measured 172 cm (67.75 in) while the same measurement at the aft edge of the tires was 150 cm (59.25 in). The physical evidence at the crash site also indicated that the driver retained steering

of the vehicle as she applied rapid CW and CCW inputs in an attempt to regain control of the Toyota.

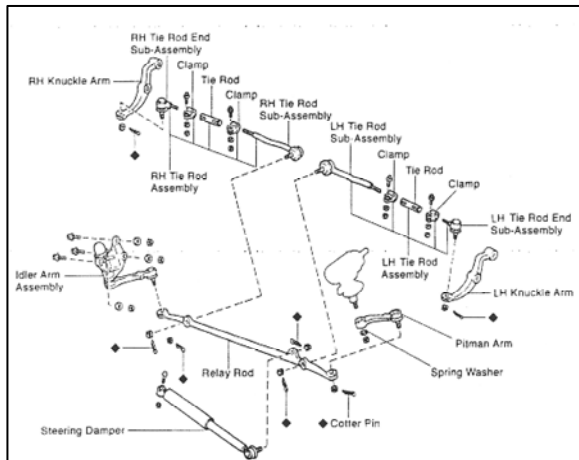


Figure 3: Mechanical illustration of the Toyota's steering system. Illustration supplied by ODI.



Figure 4: Overall view of the Toyota's steering linkage.

Crash Sequence ***Pre-Crash***

The driver was en-route to a destination in an adjacent state and was traveling in a northerly direction on the divided interstate in the 121 km/h (75 mph) speed zone. She was traveling with her three children who were restrained in CRS's secured in the rear seat of the Toyota. As the driver was exiting the right curve, the Toyota drifted to the left and departed the inboard shoulder of the grass median in a tracking attitude, **Figure 5**.

Crash

The center front plane of the Toyota impacted and overrode a steel delineator post that was located in the median, inboard of the edge of the shoulder. The delineator post crushed the front bumper to a depth of 16 cm (6.2 in). The 12 o'clock direction of force impact did not alter the trajectory of the Toyota.

The Toyota continued in a tracking mode for approximately 24 m (80 ft) as it entered the depressed grass median. The driver initiated a CW steering input in an attempt to regain the travel lanes. The steering input in combination of the slope of the median induced a CW yaw as the vehicle's center of gravity continued in a westerly direction.

The Toyota traveled approximately 98 m (320 ft) on the median prior to reentering the inboard shoulder. During this trajectory, the Toyota yawed approximately 15 degrees in a CW direction.

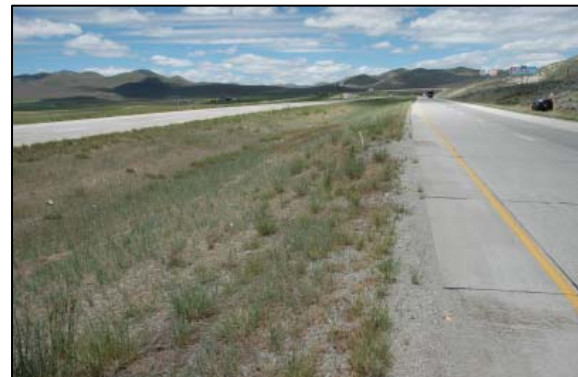


Figure 5: Northbound trajectory view of the Toyota in the area of the initial road departure.

As the driver redirected the vehicle onto the concrete surface of the shoulder, she counter steered to the left in an attempt to regain a tracking attitude to the Toyota. This steering maneuver redirected the Toyota from a CW to a CCW yaw across the travel lanes. The distance traveled across the paved surfaces involved a longitudinal distance of approximately 62 m (203 ft).

The Toyota subsequently departed the left inboard travel lane and shoulder in a CCW yaw (**Figure 6**). The Toyota had rotated approximately 35-40 degrees CCW as it reentered the median. The Toyota traveled approximately 15 m (50 ft) in a northerly direction in the median. The right side tires furrowed into the dirt surface and tripped the Toyota into a right side leading rollover. The initial contact involved the upper aspect of the right side of the vehicle's body. Contact evidence and crush damage was minimal. The Toyota continued to overturn and impacted the median surface with the left roof side rail area between the second and third-quarter turn. This contact resulted in the severe damage to the roof of the Toyota and separated the aluminum cap from the cargo bed.

The Toyota rolled an additional four-quarter turns to the right through the median before coming to rest on its roof with the front of the vehicle adjacent to the inboard shoulder of the southbound travel lanes. The Toyota completed six-quarter turns and rolled a distance of approximately 15 m (50 ft) from the trip point to final rest. **Figure 7** is a view of the Toyota's final rest location.



Figure 6: Northbound trajectory view of the yaw trajectory of the Toyota at the second left roadside departure.



Figure 7: Final rest position of the Toyota looking to the northwest. Image obtained through an Internet news site.

Post-Crash

Passing motorists used cellular telephones to call the 9-1-1 emergency response system to report the crash. Police, Emergency Medical Services (EMS) and the local fire department responded to the scene of the crash. The fire department and EMS arrived within 7 minutes of the notification. The children were removed from the vehicle as the EMS evaluated the condition of the driver and extricated her for medical transport. The driver was transported to a local hospital where she expired. The child passengers were transported to a local hospital where they were evaluated for possible injury and released. The Toyota sustained disabling damage and was towed from the scene.

Vehicle Damage

Exterior

The exterior of the Toyota sustained minor frontal damage that occurred from the initial delineator impact (Event 1) and severe damage that was associated with the rollover (Event 2).

The delineator post impact (**Figure 8**) was located right of the Toyota's frontal centerline and was diagonally oriented, representative of the negative slope of the median. The direct contact damage on the chrome bumper face was located 13–18 cm (5-7.25 in) right of center and 18–23 cm (7-9 in) right of center of the hood face. The yielding object impact produced crush resulting in deformation to the full width of the bumper. The combined induced and direct contact damage was 172 cm (67.75 in) and extended from bumper corner to bumper corner. Maximum crush was 16 cm (6.2 in), located 14 cm (5.5 in) right of the centerline. The residual crush profile at bumper level was as follows: C1 = 0 cm, C2 = 1 cm (0.25 in), C3 = 7 cm (2.6 in), C4 = 11 cm (4.5 in), C5 = 3 cm (1.2 in), C6 = 2 cm (0.6 in). The Collision Deformation Classification (CDC) for this impact event was 12FCEN1.



Figure 8: Left front oblique view of the Toyota.

The rollover (Event 2) produced contact damage to all of the vehicle's sheet metal components. Based on this contact evidence, the final rest position of the vehicle and the distance traveled from trip point to final rest, the Toyota completed six-quarter turns during the rollover event. The direct contact damage consisted of vertical and diagonally oriented abrasions to the left front fender, left front door, and the upper forward aspect of the left quarter panel with lateral crush of the sheet metal. The left upper A-pillar was abraded in a similar pattern and was crushed downward. The left C-pillar exhibited longitudinally oriented abrasions with lateral crush to the upper aspect of the pillar.

The right front fender was minimally contacted at the top forward aspect of the sheet metal. The right front door window frame had abrasions oriented laterally and longitudinally at the top aspect of the frame. The right front door skin was damaged. The sheet metal between the right B- and C-pillars was creased in a diagonal pattern from the beltline to the rub strip. The right quarter panel had minimal contact damage on the top surface near the back plane of the vehicle. There was minimal deformation to the right side of the vehicle.

The hood of the Toyota remained closed during the rollover and was jammed closed post-crash. The ground contact abrasion patterns were oriented laterally across the frontal area of the hood and diagonally at the front corner areas. The left side of the hood was crushed downward during the third-quarter turn in combination with the left front fender.

The greenhouse area of the Toyota sustained the majority of the damage from the rollover (**Figure 9**). The contact damage from the first and fifth-quarter turns was located at the right

upper C-pillar and the right roof side rail. The abrasion pattern to the roof was diagonally oriented front-to-back and left-to-right and involved the majority of the roof panel's surface. The third-quarter turn resulted in severe damage to the roof, the left side upper pillars, and the windshield header. The lateral right displacement of the left roof side rail and the vertical displacement of the windshield header buckled the roof over the driver's position. The maximum roof crush at this location was 57 cm (22.6 in). The maximum lateral roof crush measured 20 cm (7.75 in) and was located at the left roof side rail between the adjoining pillars.



Figure 9: Left view depicting the greenhouse deformation of the Toyota.

The left front door remained closed during the crash events and was pried open by the first responders during the extrication of the driver. The door would not re-latch at the time of the SCI investigation due to body distortion. The right front door remained closed during the crash and was opened by the first responders to aid in the extrication of the occupants. The door latch was released to open the door; however, the door would not re-latch due to body distortion.

Based on a review of the on-scene images, the tires remained inflated post-crash. The SCI inspection determined that there was no crash related damage to the tires. The OEM style steel wheels were not deformed by impact damage; however, ground debris consisting of gravel and grass were embedded in the outer beads of the right front, and both rear tires.

The laminated windshield was bonded to the Toyota and was fractured full height and width. The bond and laminate remained intact post-crash as evident in the on-scene image (**Figure 2 above**). At the time of the SCI inspection, the majority of the windshield glazing was sagged into the interior of the vehicle due to heat exposure of the plastic laminate. The left and right side glazing was disintegrated at the four outboard positions. The front door windows were closed pre-crash. This was determined by the position of the window tracks and fragments of tempered glass remaining in the window frames. The rear glazing panels were presumed to be closed pre-crash as these windows were wing-type with forward-mounted hinges. The backlight glazing was gasket-mounted and was disintegrated. The Toyota was not equipped with roof glazing.

The aftermarket aluminum cap was equipped with solar tint tempered glazing at the front, rear, and both sides. Although the cap separated from the Toyota during the rollover, all glazing panels remained intact. The front left corner of the aluminum cap was crushed to a depth consistent with the roof on the Toyota indicating the cap remained on the vehicle during the second to third-quarter turn. This contact probably separated the cap from the vehicle during this stage of the rollover. The CDC of the rollover event was 00TDDO5.

Interior

The interior of the Toyota sustained severe damage that was associated with intrusion of the roof structure. There were no discernable occupant contact points with the exception of body fluid on the driver’s seat and the rear left roof headliner. The speaker cover was fractured at the lower forward quadrant of the driver’s door; however, this did not appear to be occupant related.

The maximum intrusion occurred at the driver’s position and involved 57 cm (22.6 in) of vertical displacement of the roof. The roof was crushed by the rollover; however, the magnitude of intrusion was amplified by the buckling that resulted from lateral displacement of the left roof side rail and adjacent pillars, and the vertical displacement of the windshield header. The interior view of the driver’s position (**Figure 10**) documents a greater extent of crush, showing the headliner intruding beyond the level of the driver’s seat back. The headliner remained buckled post-crash; therefore this headliner intrusion of 60.3 cm (23.75 in) was not structural. The headliner also buckled and intruded into the rear center position, with a non-structural intrusion value of 43 cm (17 in). At both documented headliner locations, the headliner could be pushed up against the intruding roof. The interior intrusions are documented by position, component, magnitude and direction in the following table:



Figure 10: Right interior view across the front seat depicting the roof/headliner intrusion.

Position	Component	Magnitude	Direction
Front Left	Roof	57 cm (22.6 in)	Vertical
Front Left	*Headliner	60 cm (23.75 in)	Vertical
Front Left	Windshield header	47 cm (18.5 in)	Vertical
Front Left	Left upper A-pillar	42 cm (16.5 in)	Vertical
Front Left	Left upper B-pillar	29 cm (11.5 in)	Vertical
Front Left	Left roof side rail	20 cm (7.0 in)	Lateral
Front Center	Roof	38 cm (15.0 in)	Vertical
Front Center	Windshield header	31 cm (12.0 in)	Vertical
Front Right	Roof	30 cm (12.0 in)	Vertical
Front Right	Right A-pillar	15 cm (6.0 in)	Vertical
Front Right	Right roof side rail	10 cm (4.0 in)	Vertical
Rear Left	Roof	24 cm (9.25 in)	Vertical
Rear Left	Backlight header	16 cm (6.5 in)	Vertical
Rear Left	Left roof side rail	20 cm (7.75 in)	Lateral
Rear Center	Roof	15 cm (6.0 in)	Vertical
Rear Center	*Headliner	43 cm (17.0 in)	Vertical

Position	Component	Magnitude	Direction
Rear Right	Roof	10 cm (4.0 in)	Vertical

**Non-structural intrusions are not coded in EDS*

Brake System/Inspection

The 1997 Toyota T100 was equipped with power-assisted front disc/rear drum brakes. It is unknown if the vehicle was equipped with the optional anti-lock braking system. A scissors jack was used to lift the left side tires of the vehicle off the ground. The left tires and wheels were removed to inspect the brakes for evidence of wear and/or damage. The left front disc brake caliper was mounted aft of the axle position and utilized an opposing dual-piston design. There was no evidence of brake fluid leakage at the caliper. The disc brake pads indicated minimal wear and there was no evidence of heat build-up on the rotor or on the pads. The left front rotor was in good condition without scoring and appeared to be an uncut (resurfaced) rotor.

The rear drum brakes utilized a top-mounted hydraulic wheel cylinder and a cable activated parking brake system with a mechanical self-adjuster. The left rear drum was removed and was free of scoring and discoloration due to heat. The bonded brake linings were in like-new condition and were fully adhered to the shoes. There was no evidence of heat or performance issues associated with the left rear brake.

Safety Belt Systems

The Toyota was equipped with continuous loop 3-point lap and shoulder safety belts with sliding latch plates at the four outboard positions and center front and rear lap belts. The driver's belt system utilized an Emergency Locking Retractor (ELR). The D-ring was adjustable and was found in the full-down position at the time of the SCI inspection. The latch plate was free of loading evidence and there was no loading evidence on the belt webbing. An energy management loop was incorporated into the lower outboard aspect of the lap belt webbing, located 10–17 cm (4-6.5 in) above the floor anchor. The management loop was concealed within a vinyl sleeve and the stitching was not separated. At the time of the SCI inspection, the driver's belt webbing was slightly extended forward over the outboard edge of the front left seat back. It was not fully retracted against the B-pillar. Based on the lack of loading evidence to the driver's safety belt system and the observations of the first responders, it was determined that the driver was not restrained by the manual safety belt at the time of the crash.

The center front position utilized an adjustable lap belt with a cinching latch plate. This seat position was unoccupied; therefore the belt system was not in use.

The front right belt system utilized a switchable ELR/Automatic Locking Retractor (ALR). The adjustable D-ring was in the full-down position. This position was unoccupied at the time of the crash.

The rear left belt system utilized an ELR/ALR retractor with a fixed D-ring. The belt system was fully retracted against the C-pillar at the time of the SCI inspection. There was no loading evidence on the belt webbing or system hardware. This belt secured a CRS during the crash.

The rear center lap belt secured a CRS and did not yield evidence of loading to the belt webbing or the latch plate. The lap belt was found lying across the rear seat cushion of the Toyota at the time of the SCI inspection.

The rear right 3-point belt webbing was cut by the first responders to remove the CRS and the child passenger from the vehicle. The latch plate remained buckled into the buckle assembly. The belt webbing was cut in an irregular pattern indicating three separate cuts located 22–23 cm (8.5-9 in) above the outboard floor anchor. The remaining belt webbing either retracted onto the C-pillar mounted ELR/ALR retractor or was cut at a second location and removed from the vehicle. There was no loading evidence on the remaining belt webbing or latch plate.

Frontal Air Bag System

The Toyota was equipped with a 1st generation driver-only frontal air bag system. The air bag was concealed within the center hub of the steering wheel. In addition to the air bag module, the system consisted of a center front tunnel mounted air bag control module and two front mounted crash sensors. The frontal air bag system did not deploy. The air bag control module did not have Event Data Recording capabilities.

Occupant Demographics/Data

Driver

Age/Sex: 23-year-old female
 Height: 160 cm (63 in)
 Weight: 50 kg (110 lb)
 Seat Track Position: Mid-track
 Safety Belt Use: None
 Usage Source: Vehicle inspection, observations of the first responders
 Egress from Vehicle: Removed by the first responders
 Type of Medical Treatment: Transported by ambulance to a local hospital where she was pronounced deceased
 Glasgow Coma Score: 3 following extrication from vehicle and at arrival to hospital

Driver Injuries

Injury	Injury Severity (AIS 2005/Update 2008)	Injury Source
Laceration of the left scalp	Minor (110602.1,2)	Possible flying glass
Small laceration of the left arm	Minor (710602.1,2)	Possible flying glass

Source – Hospital Emergency Room Records

Driver Kinematics

The 23-year-old female driver of the Toyota was seated in the front left position of the Toyota with the seat track adjusted to a mid-track position with the leading edge of the seat cushion positioned (12.25 in) aft of the lower left A-pillar. The adjustable head restraint was set approximately 2.5 cm (1 in) above the seat back. At the time of the crash, she was not restrained by the manual safety belt system.

During the rollover event, the driver probably moved laterally left and right within the driver's space of the Toyota. She was captured by the roof intrusion that extended below the level of the driver's seat back. There were no discernable occupant contact points within the interior with the exception of possible body fluid on the driver's seat cushion. The driver sustained lacerations of the left scalp and the left arm from possible contact with flying glass. There were no abrasion patterns consistent with a partial ejection from the vehicle.

The Toyota came to rest on its roof. The driver came to rest within her seat position and was captured by the intruding roof. It was reported that she was pinned "awkwardly" within the vehicle prior to extrication by the first responders.

Medical Treatment

The fire department and Emergency Medical Service (EMS) arrived on scene approximately seven minutes of the call for assistance. The driver of the Toyota was evaluated in the vehicle. EMS personnel thought they detected a slight pulse and extricated the driver from the Toyota. The driver's Glasgow Coma Score (GCS) was 3 at the scene. Cardio Pulmonary Resuscitation (CPR) was initiated as the driver was prepared for emergency transport to a local hospital by ground ambulance. The EMS departed the scene 13 minutes following their time of arrival and continued the CPR activities during the transport. The ambulance arrived at the hospital approximately six minutes of scene departure. The driver arrived in full cardiac arrest with no pulse or respirations. There was no change in her GCS en route. The total time from crash notification to arrival at the hospital was approximately 28 minutes.

Initial treatment at the hospital was unsuccessful and the driver was pronounced deceased approximately 13 minutes after her arrival to the emergency department.

It was noted that the driver came to rest inverted in the Toyota with her head pinned awkwardly for an estimated time of approximately 20 minutes. Radiology of the chest indicated an increased density in the left mid-to-upper lung compatible with pulmonary contusion. This injury was not confirmed and therefore, was not coded using AIS 2005 rules. The medical staff indicated that due to the position of the driver at final rest within the vehicle, she may have sustained a fatal cervical spine injury or was possibly asphyxiated (positional asphyxiation). No autopsy was performed to confirm the cause of death.

Rear Left Child Passenger

Age/Sex:	4-year-old/Male
Height:	Unknown
Weight:	Unknown
Restraint Use:	Restrained in a forward-facing child safety seat
Egress from Vehicle:	Removed from the vehicle by the first responders
Type of Medical Treatment:	Transported to a local hospital for treatment of minor severity injuries

Rear Left Child Passenger Injuries

Injury	Injury Severity (AIS 2005/Update 2008)	Injury Source
Reported arm laceration	Minor (710602.1,9)	Possible flying glass

Source – Attorney

Rear Left Child Passenger Kinematics

The 4-year-old rear left child passenger of the Toyota was restrained in a forward-facing CRS. The CRS was removed from the vehicle prior to the assignment of this case; therefore the specific make and model are unknown. The CRS was secured to the vehicle by the manual 3-point lap and shoulder belt system. The child was secured to the CRS by the integral harness system.

During the rollover event, the child passenger was held secure in the CRS. The roof intruded over his position; however, the intrusion did not produce injury to the child passenger. He did sustain a reported laceration of his arm. There was no contact evidence within his position; therefore the laceration was attributed to possible flying glass. Body fluid was present on the headliner over the area of the rear left seating position. The combination of the CRS and the use of the safety belt system prevented the child from possible ejection and/or contact with interior components, thus protecting him from potential serious injury.

Rear Center Child Passenger

Age/Sex: 3-year-old/Female
Height: Unknown
Weight: Unknown
Restraint Use: Restrained in a forward-facing child safety seat
Egress from Vehicle: Removed from the vehicle by the first responders
Type of Medical Treatment: Transported to a local hospital where she was evaluated for possible injury and released

Rear Center Child Passenger Injuries

Injury	Injury Severity (AIS 2005)	Injury Source
Not injured	N/A	N/A

Source – Attorney and medical records

Rear Center Child Passenger Kinematics

The rear center child passenger was restrained in an unknown make and model convertible CRS that was installed in a forward-facing position. The CRS was secured to the vehicle by the manual lap belt system. The child was restrained in the CRS by the integral harness system.

The child passenger remained secure in the CRS during the rollover crash and was not injured. She was removed from the CRS by the first responders and was transported to a local hospital where she was evaluated for possible injury and released.

Rear Right Child Passenger

Age/Sex: 9-month-old/Male
Height: Unknown
Weight: Unknown
Restraint Use: Restrained in a rear-facing child safety seat
Egress from Vehicle: CRS and the child were removed from the vehicle by the first responders
Type of Medical Treatment: Transported to a local hospital where he was evaluated for possible injury and released

Rear Right Child Passenger Injuries

Injury	Injury Severity (AIS 2005)	Injury Source
Not injured	N/A	N/A

Source – Attorney and medical records

Rear Right Child Passenger Kinematics

The rear right child passenger was restrained in a rear-facing CRS that was secured to the vehicle by the manual 3-point lap and shoulder belt system. The child was restrained within the CRS by the integral harness system.

The child passenger remained secure in the CRS during the crash events and was not injured. She was removed from the vehicle by the first responders. The safety belt webbing was cut at the outboard aspect of the CRS and the child and CRS were removed as a unit from the Toyota. The child passenger was transported to a local hospital where he was evaluated for possible injury and released.

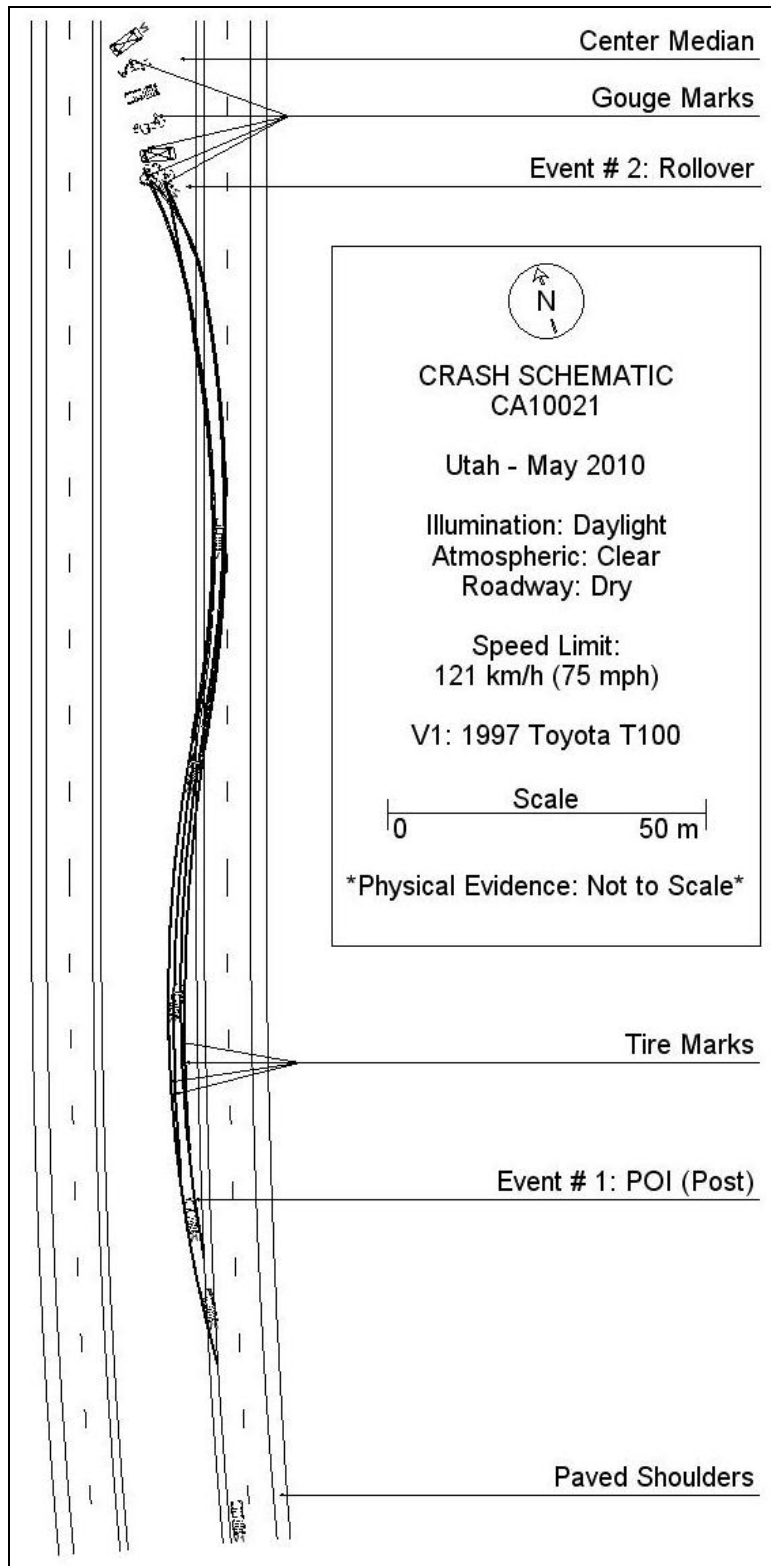


Figure 11: Crash schematic.