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OFFICE OF DEFECTS INVESTIGATION
CALSPAN ON-SITE POTENTIAL UNINTENDED ACCELERATION CRASH INVESTIGATION

SCI CASE NO.: CA10014

VEHICLE: 2007 TOYOTA CAMRY

LOCATION: VIRGINIA

CRASH DATE: MARCH, 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 systems.

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16. Abstract This on-site investigation focused on the alleged Unintended Acceleration (UA) of a 2007 Toyota Camry which was involved in a roadside departure/fixed object crash. The Toyota was driven by a 37-year-old female and was occupied by two 11-year-old female second-row passengers. None of the vehicle's occupants were restrained by the manual safety belt systems. The driver was operating the vehicle northbound on a straight segment of 2-lane state road in a rural setting. At the time of the crash, it was dark (not lighted) and there were no adverse weather conditions. For unknown reasons, the vehicle drifted over the center line, departed the left side of the road and impacted a tree line with its frontal and left side planes. The force of the crash resulted in the deployment of the driver's Certified Advanced 208-Compliant (CAC) frontal air bag, driver knee bolster air bag, driver seat-mounted side impact air bag and the left side impact Inflatable Curtain (IC) air bag. The manufacturer of the Toyota has certified that this vehicle was compliant to the advanced air bag requirements of Federal Motor Vehicle Safety Standard No. 208. The driver sustained fatal blunt force injuries and was pronounced deceased at the scene. The second-row passengers were both transported by ground ambulance to a hospital with police-reported incapacitating injuries.			
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TABLE OF CONTENTS

OFFICE OF DEFECTS INVESTIGATION
CALSPAN ON-SITE POTENTIAL UNINTENDED ACCELERATION
CRASH INVESTIGATION
SCI CASE NO.: CA10014
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BACKGROUND

This on-site investigation focused on the alleged Unintended Acceleration (UA) of a 2007 Toyota Camry, **Figure 1**, which was involved in a roadside departure/fixed object crash. The Toyota was driven by a 37-year-old female and was occupied by two 11-year-old female second-row passengers. None of the vehicle's occupants were restrained by the manual safety belt systems. The driver was operating the vehicle northbound on a straight segment of 2-lane state road in a rural setting. At the time of the crash, it was dark (not lighted) and there were no adverse weather conditions. For unknown reasons, the vehicle drifted over the center line, departed the left side of the road and impacted a tree line with its frontal and left side planes. The force of the crash resulted in the deployment of the driver's Certified Advanced 208-Compliant (CAC) frontal air bag, driver knee bolster air bag, driver seat-mounted side impact air bag and the left side impact Inflatable Curtain (IC) air bag. The manufacturer of the Toyota certified that the vehicle was compliant to the advanced air bag requirements of Federal Motor Vehicle Safety Standard No. 208. The driver sustained blunt force trauma to the head, chest and abdomen and was pronounced deceased 6-1/2 hours post-crash. The second-row passengers were both transported by ground ambulance to a hospital with incapacitating injuries.

Figure 1: Left side view of the Toyota Camry.

The crash was reported to the National Highway Traffic Safety Administration's (NHTSA) Office of Defects Investigations (ODI) by an attorney representing the family of the deceased driver as a potential UA crash. The Toyota was subject to both the Floor Mat recall (NHTSA Campaign No. 09V388000) and the Sticky Pedal recall (Campaign No. 10V01700). The deceased driver's family did not know if the accelerator pedal maintenance had been performed prior to the date of the crash. ODI requested that NHTSA's Crash Investigation Division assign further research of the crash to the Calspan Special Crash Investigations (SCI) team on April 1, 2010. Calspan SCI contacted and established cooperation with the attorney's office on April 6, 2010 and an on-site inspection took place on April 12 and 13, 2010. The vehicle was located at a tow facility in the vicinity of the crash. The on-site investigation involved the detailed inspection

and documentation of the vehicle and crash site. The vehicle's Event Data Recorder (EDR) was also imaged.

SUMMARY

VEHICLE DATA

2007 Toyota Camry

The 2007 Toyota Camry was identified by the Vehicle Identification Number (VIN): 4T1BE46K27U (production sequence deleted). The vehicle was manufactured in October 2006 and the digital odometer reading was unknown. The 4-door sedan was equipped with a 2.4-liter, I4 engine linked to a 5-speed automatic transmission. The Camry was equipped with 4-wheel disc brakes with antilock (ABS). The interior of the vehicle was configured with seating for five passengers. Each seat position was equipped with a 3-point lap and shoulder safety belt. The front safety belts were equipped with retractor pretensioners. The Toyota Camry was equipped with Certified Advanced 208-Compliant (CAC) air bags for the driver and front right passenger, a driver knee bolster air bag, front seat-mounted side impact air bags, and side impact Inflatable Curtain (IC) air bags. The vehicle's recommended tire size was P215/60R16 with a cold tire pressure of 207 kPa (30 PSI), front and rear. The vehicle was equipped with Definity EX600 P215/60R16 tires mounted on OEM steel wheels. The specific tire data measured at the time of the SCI inspection was as follows:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	Tire Flat	4 mm (5/32)	Yes	None
LR	248 kPa (36 PSI)	3 mm (4/32)	Yes	None
RF	Tire Flat	3 mm (4/32)	No	None
RR	110 kPa (16 PSI)	3 mm (4/32)	No	None

The four outboard positions of the Toyota were equipped with unsecured aftermarket all-weather floor mats positioned on top of the OEM carpeted floor mats. The OEM carpeted mat in the driver's position was secured to the vehicle by the two floor hooks that were located immediately forward of the driver seat. **Figure 2 and 3** are views of the driver's floor area and the position of the aftermarket mat. The driver's OEM floor mat was not removed from the vehicle's interior during the SCI inspection. Refer to the *Interior Damage* section of this report for further information regarding the foot controls and the intrusion into the driver's floor area.

Figure 2: Driver floor area and the aftermarket floor mat.

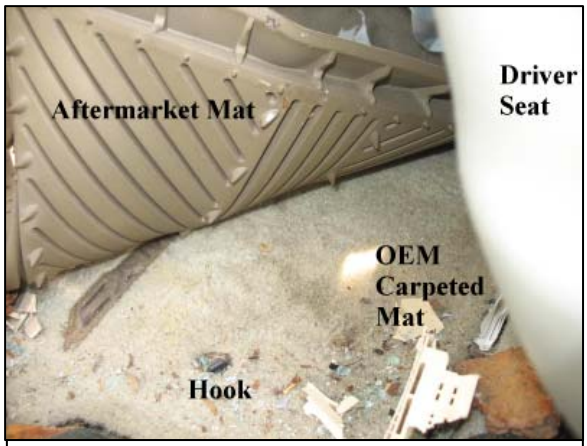

Figure 3: Aftermarket mat on top of OEM mat.

Figure 4 is a view of the right front aftermarket floor mat. It was found outside the vehicle. This floor mat appeared to be similar to the driver's floor mat. The overall dimensions of the mat measured 74 cm x 46 cm (29 in x 18 in), length by width. The forward aspect of the mat tapered to a 37 cm (14.5 in) width. The underside of the mat was embossed with the following manufacturer's label: V450 7055-Uf-C. Clock stamps embossed into the mat indicated that the mat was manufactured during the 4th month of 2008. The top surface of the mat consisted of a symmetrical raised-rib pattern. The height of the ribs at the forward-most aspect of the mat measured 2 mm (2/32 in). The rib height in the aft section of the mat measured 9 mm (11/32 in).

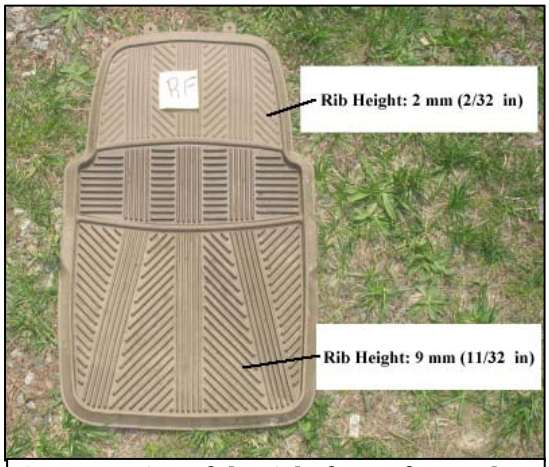

Figure 4: View of the right front aftermarket floor mat.

CRASH SITE

This roadside departure/fixed-object crash occurred during the nighttime hours of March 2010. The rural crash site was not illuminated by street lighting and there were no adverse weather conditions at the time of the crash. The crash occurred on a 2-lane north/south State Route. The Toyota departed the road in a level section located at the base of a long downgrade. The width of the road measured 7.0 m (23.0 ft). The travel lanes were separated by yellow centerlines that designated a passing zone for northbound traffic. The edges of the lanes were bordered by white fog lines. **Figure 5** is a northbound trajectory view 15 m (49.2 ft) south of the area of the impacts. The west road shoulder consisted of a 5.3 m (17.4 ft) wide earth/grass terrain that had a (minimal) negative slope away from the road for drainage. Beyond the shoulder, there was an embankment with a negative 45 percent slope. A line of trees growing along the embankment

was the point of impact. Four trees exhibited contact damage as a result of the crash. **Figure 6** is a trajectory view immediately prior to the impacts.

Figure 5: Northbound trajectory view of the Toyota.

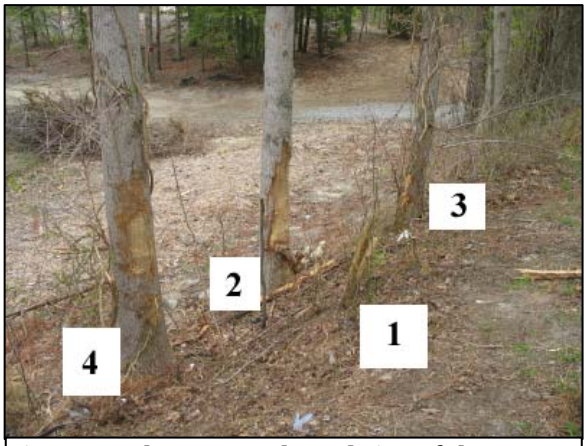

Figure 6: Close-up northward view of the impacted trees.

The first tree that was impacted was located 6.0 m (19.7 ft) west of the road edge. The tree was small and had a double trunk that measured 6 cm (2.5 in) in diameter. The tree was sheared off 81 cm (32 in) above the ground as it was impacted by the Toyota's front plane and overridden. The second tree impacted measured 31 cm (12.4 in) in diameter and was located 7.4 m (24.3 ft) west of the road edge. This tree was impacted by the forward aspect of the Toyota's left plane and the left front wheel/tire. The tree was scarred from the ground level to a height of 183 cm (72.2 in). Bark was removed over 45 percent of the circumference within the scarred area. The third tree was impacted by the right corner of the front plane and the forward right plane of the Toyota. The tree measured 24 cm (9.4 in) in diameter and was located 6.3 m (20.7 ft) from the road edge. The tree was scarred from a height 10 cm (4.0 in) above the ground to 89 cm (35.0 in). The quadrant of the tree facing away from the road was damaged, indicative of its contact with the right side of the vehicle. The fourth tree was impacted by the left rear door and C-pillar area of the Toyota. This tree measured 37 cm (14.5 in) in diameter and was scarred over an area that was located 42 cm (16.5 in) to 173 cm (68.0 in) above the ground. Within the area of the scarring, bark was removed over 35 percent of the tree's circumference. The tree was located 7.4 m (24.3 ft) west of the road edge. The four trees were located within a longitudinal distance of 3.2 m (10.5 ft). A schematic of the crash is included at the end of this report as **Figure 25**.

CRASH SEQUENCE

Pre-Crash

The 37-year-old driver left her home during the early morning hours and travelled approximately 40 km (25 miles) and picked up the two second row passengers. At the time of the crash, she was operating the vehicle northbound returning to her residence. Her residence was located

approximately 16 km (10 miles) north of the crash site. For reasons that could not be determined, the vehicle drifted over the centerline of the road, departed the left side of the road and travelled onto the shoulder. The EDR reported speed of the vehicle was 86.0 km/h (53.4 mph) approximately 2.2 seconds prior to the crash. This was the speed of the vehicle in the approximate area of the roadside departure.

Crash

The right aspect of the Toyota's front plane impacted and sheared the 6 cm (2.5 in) diameter tree (Event 1). This contact abraded the bumper fascia, but otherwise had little effect on the vehicle's trajectory. The vehicle continued forward 1.8 m (6 ft) and the left corner of the bumper structure engaged the 31 cm (12.4 in) diameter tree with an 11 o'clock direction of force (Event 2). The forward left side structures deformed into the left aspect of the cowl and left A-pillar. This impact resulted in the actuation of the driver's safety belt pretensioner and the deployment of the driver's air bag, the knee air bag and driver seat-mounted side impact air bag. As the left side structures crushed, the outboard right aspect of the front bumper engaged the 24 cm (9.4 in) diameter tree (Event 3). Bark and debris from the tree was embedded in the vehicle's components forward of the right front wheel assembly. This impact induced a clockwise rotation to the Toyota. The left rear door and C-pillar area of the vehicle impacted the 37 cm (14.5 in) diameter tree (Event 4). This impact resulted in the deployment of the left IC air bag. Due to the multiple/overlapping impacts and damage, analysis of the crash was beyond the scope of the WinSMASH program. Collectively, the damage to the vehicle was categorized as severe. The overall combined change in velocity (delta-V) experienced in the crash was approximately 64 km/h (40 mph) based on SCI field experience.

Post-Crash

The police, fire and ambulance personnel responded to the scene. The Toyota sustained severe damage as a result of the multiple impacts; the occupants required extensive extrication. The roof's support pillars were cut. The roof and left doors were removed from the vehicle. The driver sustained multiple blunt force injuries and was unresponsive upon removal from the vehicle. She was flown by helicopter to a regional trauma center. During the transport, the driver lost her pulse and received Advanced Cardiovascular Life Support (ACLS). Upon arrival at the trauma center, her Glasgow Coma Score (GCS) was 3T. Aggressive life support and treatment was unsuccessful and she was pronounced deceased 6-1/2 hours post-crash. The two female child passengers seated in the second row sustained incapacitating injuries, were transported by ground ambulance to the regional trauma center and admitted for treatment.

The Toyota was removed from the crash site by a local tow company and impounded pending the conclusion of the police investigation. At the conclusion of the police investigation, a hold was placed on the vehicle by the attorney representing the family. The Toyota was located at the initial tow facility at the time of the SCI inspection.

2007 TOYOTA CAMRY

Exterior Damage

The Toyota Camry sustained severe impact damage to the left plane as a result of the multiple tree impacts. **Figure 7** is a left front oblique view of the vehicle. The front bumper fascia exhibited three regions of surface abrasions that were related to the three tree impacts. The first region of abrasions began 12 cm (4.7 in) right of center and extended 29 cm (11.4 in) to the right. This damage was related to Event 1. The left aspect of the fascia was abraded over a 30 cm (11.8 in) width. This abraded region began 58 cm (22.8 in) left of center, extended to the left and around left front corner. This damage resulted from Event 2. The right aspect of the fascia was abraded over a 30 cm (11.8 in) region that began 46 cm (18.1 in) right of center and extended to the right corner. This abraded region resulted from Event 3.

Figure 7: Left front oblique view of the Toyota Camry.

The front bumper fascia had separated during the impacts and exposed the bumper reinforcement beam. The reinforcement measured 120 cm (47.2 in) in width and was relatively undamaged. There was no measurable residual crush along the width of the beam. Only the extreme outboard ends of the beam exhibited damage from the tree impacts (**Figure 8**). The left end of the beam was deformed over an 8 cm (3.1 in) width beginning 52 cm left of center. The residual deformation was less than 5 cm (2 in). There was no compression of the Toyota's left uni-body frame rail. The right end of the reinforcement beam was deformed over a 10 cm (3.9 in) width. The deformation began 50 cm (19.7 in) right of center. The deformation within the region measured approximately 5 cm (2.1 in). There was no compression of the right uni-body frame rail. Based on the physical evidence, the front corners of the Toyota engaged the respective trees. Then as the vehicle continued forward, the trees became engaged with the vehicle's structures outboard of the frame rails.

Figure 8: Close-up view of the reinforcement beam.

The left side of the Toyota (**Figure 9**) sustained impact damage that extended from the front corner to the A-pillar area, as a result of the tree contact of Event 2. The direction of the impact

force was in the 11 o'clock sector. The left fender and components of the left inner fender separated during the impact. The left aspect of the hood exhibited direct contact damage that measured 23 cm (9.0 in) laterally by 91 cm (36.0 in) longitudinally. The tree engaged the aft aspect of the wheelhouse and pocketed into the left aspect of the cowl and A-pillar. The spot welds at the base of the A-pillar separated from the sill due to overload. The longitudinal crush at the mid-aspect of the A-pillar measured 51 cm (20.1 in). There was no change in the left wheelbase dimension.

Figure 9: View of the forward left side damage to the Toyota.

The forward aspect of the right plane exhibited damage extending from the front corner consistent with the tree impact of Event 3 (**Figure 10**). The lower aspect of the right fender was deformed and the right wheel assembly was deformed rearward. The right wheelbase was reduced 7 cm (2.8 in). Tree bark was observed to have adhered to the damaged components.

Figure 10: View of the damage to the forward right side of the Toyota.

The direct contact damage from Event 4 began at the forward edge of the left rear door and ended 9 cm (3.5 in) aft of the left rear axle. Refer to **Figure 11**. The damage within this region extended vertically onto the left roof side rail. The left aspect of the roof was buckled. The tree pocketed in the area of the left C-pillar. The measured depth of the pocketing was 20 cm (8.0 in). The direction of force was in the 11 o'clock sector.

Figure 11: View of the damage at the rear aspect of the left side.

The first responders cut the roof support pillars during the extrication process. The roof and left doors were removed. Additionally, the base of the left B-pillar was cut and the pillar was removed. The right rear door was jammed closed and exhibited indications of attempted extrication. The right front door was operational.

Although the events are coded individually, impacts 2, 3 and 4 occurred nearly simultaneously. The Collision Deformation Classification (CDC) for each of the events in the crash sequence is summarized in the following table:

Event	Object Contacted	CDC
1	6 cm (2.5 in) dia. tree	12FZEN1
2	31 cm (12.4 in) dia. tree	11FLEE6
3	24 cm (9.4 in) dia. tree	12FREE3
4	37 cm (14.5 in) dia. tree	11LZAW3

Interior Damage

The interior of the Toyota sustained moderate damage as a result of the crash. **Figure 12** is a left lateral view across the front row depicting the intrusion into the driver's interior. **Figure 13** is an overhead view of the interior. The instrument panel, toe pan and associated components intruded into the driver's position. The roof and left C-pillar intruded into occupant space of the second row left passenger. The measured intrusions are listed in the table below:

Position	Component	Intrusion	Direction
1st Row Left (Driver)	Left Instrument Panel	27 cm (10.5 in)	Longitudinal
	Left Instrument Panel	25 cm (10.0 in)	Lateral
	Steering Wheel Hub	38 cm (14.9 in)	Longitudinal
	Upper A-pillar	23 cm (9.0 in)	Longitudinal
	Upper A-pillar	24 cm (9.5 in)	Lateral
	Lower A-pillar	44 cm (17.3 in)	Longitudinal
	Knee Bolster	26 cm (10.2 in)	Longitudinal
	Toe Pan	24 cm (9.5 in)	Longitudinal
	Kick Panel	8 cm (3 in)	Lateral
	Brake Pedal	14 cm (5.5 in)	Longitudinal
1st Row Center	Instrument Panel	18 cm (7.0 in)	Longitudinal
2nd Row Left	C-pillar	12 cm (4.7 in)	Lateral
	Roof	10 cm (4.0 in)	Vertical

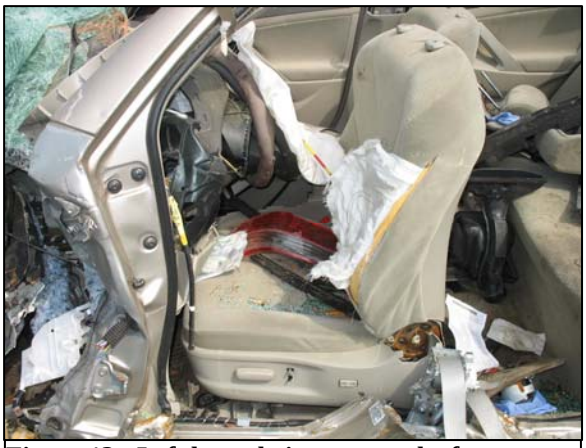

Figure 12: Left lateral view across the front row.

Figure 13: Overhead view of the interior.

The driver seat was located in a rear-track position that measured 4 cm (1.5 in) forward of full-rear. The total seat track travel of an exemplar vehicle measured 27 cm (10.5 in). The post-crash seat back angle measured 5 degrees aft of vertical. The intruded A-pillar trim panel exhibited an 18 cm x 5 cm (7 in x 2 in) area of contact (**Figure 14**). The center of the contact area was located 18 cm (7.0 in) below the top of trim. This contact was attributed to the driver's head. A left lower extremity contact was identified to the left aspect of the knee bolster (behind the knee air bag). The contact measured 8 cm x 5 cm (3.0 in x 2.0 in) and was located 11 cm (4.5 in) right of the outboard edge of the bolster panel.

Figure 14: View depicting the head contact to the left A-pillar.

The backs of the driver seat and front right seat were loaded from behind by the unrestrained occupants in the second row. The contact area to the driver seat back measured 38 cm x 36 cm (15.0 in x 14.0 in), width by height. The inboard upper aspect of the driver seat was deformed slightly forward. The contact to the front right seat back measured 18 cm x 39 cm (7.0 in x 15.5 in), width by height. Post-crash body fluid evidence was noted on both seat backs and on the center console, **Figure 15**.

Figure 15: View of the contacts to the front row seat backs

Manual Restraint Systems

The Toyota Camry was equipped with 3-point lap and shoulder belts in the five seat positions. The driver's restraint consisted of continuous loop webbing, a sliding latch plate, an adjustable D-ring and an Emergency Locking Retractor. The driver's D-ring was adjusted to the full-down position. The retractor was equipped with a pretensioner that actuated as a result of the crash. The retractor was exposed due to the removal of the left B-pillar. The webbing was stowed on the retractor and was tightly wound on the spool. The retractor was inoperative. The actuation of the pretensioner had removed the slack within the stowed webbing and had rendered the retractor inoperative. The upper aspect of the webbing was cut with the B-pillar. The cut section and the latch plate were missing. Based on the observations of the vehicle inspection, the driver was unrestrained. The imaged EDR data recorded that the driver's safety belt was unbuckled at the time of the crash.

Each second row safety belt consisted of continuous loop webbing, a sliding latch plate and a switchable Automatic Locking Retractor/ELR (ALR/ELR). At inspection, the second row left belt was fully extended from the retractor; the webbing was lying on the seat cushion. Examination of the latch plate revealed minor evidence of historical use. There was no crash related evidence on the webbing or the latch plate that was related to the crash. Based on the inspection of the belt system, the second row left passenger was unrestrained at the time of the crash.

The second row right safety belt was stowed on the retractor at the time of the inspection. The latch plate exhibited minor indications of historical use. Examination of the latch plate and webbing was unremarkable for crash related evidence. It was determined that the second row right passenger was unrestrained at the time of the crash.

Air Bag Systems

The CAC driver air bag, the knee bolster air bag, the driver seat-mounted side impact air bag and the let IC air bag deployed as a result of the multiple impact crash. **Figure 16** is an oblique view of the Toyota with the roof repositioned. The driver air bag deployed from an H-configuration module that was located in the center hub of the steering wheel. The deployed driver air bag measured 61cm (24.0 in) in diameter in its deflated state. The air bag was tethered by two internal straps sewn to the face of the bag. It was vented by two ports located in the 11 and 1 o'clock sectors on the back side of

Figure 16: Oblique view of the Toyota with the roof repositioned.

the bag. The air bag exhibited post-crash body fluid evidence in the 10 to 2 o'clock sectors and the 5 to 7 o'clock sectors.

The driver seat-mounted side impact air bag was mounted in the outboard bolster of the seat. The air bag deployed through a 51 cm (20.0 in) separation of the bolster seam. The air bag was oval-shaped and measured 33cm (13.0 in) in height. The bottom of the air bag was located 8 cm (3.0 in) above the seat bight. The width of the air bag measured 28 cm (11.0 in). There was no contact evidence to the air bag.

The left IC air bag deployed from its stored location in the left roof side rail. The air bag was rectangular and measured 41 cm (16.0 in) in height by 168 cm (66.0 in) in length. It was tethered at the A-pillar by a 25 cm (10.0 in) long strap. The IC air bag was designed with two inflatable chambers for the protection of the outboard occupants. The inflated chamber in row 1 was located from the mid-aspect of the front window opening rearward to the B-pillar. The inflated chamber in row 2 was located adjacent to the C-pillar. **Figure 17** is an interior post-test view of a 2007 Toyota Camry from NHTSA crash test #5674. NHTSA test #5674 was a New Car Assessment Program Side Impact Crash. Note the locations of the inflated sections of the IC air bag in the image. The IC was comprised of a non-inflating fabric panel that began immediately forward of the C-pillar and spanned the left rear window opening to the B-pillar.

Figure 17: Right interior post-crash test view of a 2007 Toyota Camry, NHTSA test #5674.

During the crash, the left A-pillar deformed rearward. This in-turn deformed the left roof side rail and caused a rearward displacement of the most forward attachment point of the IC. The A-pillar and attachment point displacement allowed a pocket to form at the left front window and reduced the tension across the length of the IC. The reduced tension allowed a partial ejection through the left rear window opening. During the crash, the left forearm of the unrestrained second row left passenger was partially ejected and injured. **Figure 18 and 16** (above) depict the pocketing and reduced tension in the IC.

Figure 18: Right lateral view of the deployed left IC and seat-mounted air bag.

The knee air bag deployed through an H-configuration module that was located in the knee bolster. The air bag measured 51 cm x 10 cm (20 in x 8 in), width by height. There was no residual evidence of driver contact to the knee air bag.

Event Data Recorder

The air bag systems were controlled by an Air bag Control Module (ACM) located under the center instrument stack. The ACM had Event Data Recording (EDR) capabilities. The EDR data was imaged at the time of the SCI investigation through the use of a Toyota's ROT tool and software version 1.10. The data was imaged through a direct cable connection to the ACM and supplying external 12-volt electrical power. The ACM was located under the center instrument stack forward of the transmission selector. The original *.rot file that was imaged during the SCI inspection was reread with upgraded software version 1.4.1.1 and is reported below.

The EDR in the 2007 Toyota Camry had the capability and capacity to record and store two longitudinal events and two lateral crash events. The events were designated "Latest" and "Next Most-Recent" and two 5 second pre-crash memory buffers stored data elements related to each individual event.

The imaged EDR had two stored events. The "Latest" event appeared to be related to the subject crash. The "Next Most-Recent" event was ruled out as related data due to data fields within the recording that stated the front right Occupant Detection System reported a "Child" passenger for this position. A front right passenger was inconsistent with the circumstances of this crash. The historical (time) relationship between the recorded events was not known.

The "Latest: event data reported that the driver's belt was unbuckled and the front right seat was unoccupied. This data was consistent with the SCI inspection. The deployment times for the driver seat-mounted air bag, the left IC air bag and the driver's frontal air bag were reported. All times were reported with respect to the trigger of the "Latest" pre-crash data. The driver seat-mounted air bag deployed at 152 milliseconds. The left IC air bag deployed at 184 milliseconds and the driver frontal air bag deployed at 190 milliseconds. The left pretensioner was also actuated at 190 milliseconds. The deployment time of the driver knee air bag was not reported.

The EDR reported 200 milliseconds of longitudinal delta-V data. The maximum reported longitudinal was 23.2 km/h (14.4 mph) at 200 milliseconds. The maximum reported lateral delta-V was 32.3 km/h (20.1 mph). This maximum lateral delta-V value occurred at 224 milliseconds. The graphs of the respective crash pulses had positive slopes at the end of the recording. The longitudinal and lateral delta-V's were still increasing indicating that the entire crash pulse was not recorded. The recorded pre-crash data of the "Latest" event is displayed in the following table:

Parameter	-4.2 sec	-3.2 sec	-2.2 sec	-1.2 sec	-0.2 sec	0 sec
Speed	94.0 km/h (58.4 mph)	94.0 km/h (58.4 mph)	85.9 km/h (53.4 mph)	85.9 km/h (53.4 mph)	90.0 km/h (55.9 mph)	84.0 km/h (52.2 mph)
Engine	1600 RPM	1600 RPM	1600 RPM	1600 RPM	3200 RPM	4000 RPM
Accelerator	Off 0.78 volts	Off 1.02 volts	Off 0.78 volts	Off 1.37 volts	Full 3.63 volts	Full 3.71 volts
Brake	Off	Off	On	Off	Off	Off

Accelerator and Brake Inspection

The Toyota was equipped with the CTS accelerator pedal and was subject to the Sticky Pedal Recall. It could not be determined if the pedal had been serviced prior to the crash. The shape of the pedal did not appear to have been modified as required by the recall. **Figure 19** is a view of the accelerator pedal taken during the SCI inspection. The pedal was identified by the following:

78110-07010
06287A1B
44902942906
LHD

Figure 19: Post-crash position of the Toyota's accelerator pedal.

It was noted that the accelerator pedal was in contact with the floor mat. However, the pedal was in the closed position. It was not jammed or captured by the after-market floor mat. The deformation of the toe pan caused the pedal assembly (as a whole) to rotate downward (clockwise) and contact the floor. The pedal assembly was in a near-vertical position. The intrusion prevented fore/aft movement of the pedal. There was minor lateral pedal movement. **Figure 20** is a close-up view of the accelerator at its contact with floor. **Figure 21** is a view of the arrangement of the foot controls in an exemplar 2007 Toyota Camry. The accelerator pedal measured 8 cm (3 in) above the floor in its undamaged condition. The toe pan intrusion and subsequent rotation of the pedal in the case vehicle reduced its clearance above the floor.

Figure 20: View of the accelerator pedal in contact with the floor mat.

Figure 21: View of the foot controls in an exemplar undamaged 2007 Toyota Camry. Note the angle of the accelerator pedal, as compared to Figure 19.

At the time of the SCI inspection, the left front wheel was removed and the brakes were examined for excessive wear. The surface of the rotor was lightly rusted from extended exposure to the environment. There was no sign of prolonged heating to the rotor or pads. The brake pads thickness was not measured, but visually the pad appeared to have adequate thickness.

DRIVER DEMOGRAPHICS

	Driver
Age/Sex:	37-year-old/Female
Height:	178 cm (70 in)
Weight:	100 kg (220 lb)
Seat Track Position:	Rear-track
Restraint Use:	None
Restraint Usage Source:	SCI interior inspection, EDR, PAR
Mode of Transport From Scene:	Transported by air ambulance to a trauma center
Type of Medical Treatment	Expired prior to admission

Driver Injuries

Injury	**Injury Severity (AIS 2008 Update)**	**Injury Source**
Vascular injury in abdomen, NFS	Unknown Severity (520099.9,9)	Unknown

Injury	Injury Severity (AIS 2008 Update)	Injury Source
Spleen laceration (ruptured, shattered)	Critical (544228.5,2)	Left door panel armrest – rear lower quadrant
Femur fracture NFS	Serious (853000.3,9)	Knee bolster (indirect)
Flail chest (left side ribs)	Serious (450211.3,2)	Left door panel – rear upper quadrant
Pelvic ring fracture	Moderate (856151.2,4)	Knee bolster (indirect)
Large mesenteric hematoma	Moderate (542010.2,8)	Steering wheel/column
Pancreas laceration NFS	Moderate (542820.2,7)	Steering wheel/column
Left side pneumothorax	Moderate (442202.2,2)	Left door panel – rear upper quadrant
Left lower leg fracture NFS	Moderate (852002.2,2)	Knee bolster
Left maxilla fracture NFS	Moderate (250800.2,2)	Left A-pillar
Left scalp laceration (at temple area, 10 x 3 cm)	Minor (110600.1,2)	Left A-pillar
Center forehead abrasion (3 x 3 cm)	Minor (210202.1,7)	Left A-pillar
Left eyelid contusion (8 x 8 cm)	Minor (210402.1,2)	Left A-pillar
Left upper arm contusion (15 x 20 cm)	Minor (710402.1,2)	Left door panel – rear upper quadrant
Right flank contusion (8 x 8 cm)	Minor (510402.1,1)	Steering wheel
Left flank contusion (18 x 15 cm)	Minor (510402.1,2)	Left door panel – rear upper quadrant
Left thigh abrasion (lateral aspect, 8 x 8 cm)	Minor (810202.1,2)	Left door panel armrest – rear lower quadrant
Bilateral thigh contusions (right thigh, 20 x 20 cm and left thigh 46 x 30 cm)	Minor (810402.1,3)	Steering wheel rim
Left shin laceration (3 x 1 cm)	Minor (810602.1,2)	Knee bolster

Source of injury data: Medical Examiner's report of external examination and hospital records.

Discussion: The Medical Examiner (ME) only conducted an external autopsy of the driver and listed the cause of death as blunt force trauma to head, chest and abdomen. An internal examination was not conducted. It should be noted that both the hospital records and ME's report reference an obvious head injury. Specifically, the Discharge Summary identified "significant damage to the left side of her cranium" and the external examination stated "an obvious head injury". It is believed that the driver sustained a significant (unknown) head injury that contributed to her death. Unfortunately, due to the identification of the scalp (head) laceration in the records, current AIS injury coding conventions do not allow the above statements to be used as an injury identifier. The source of the (probable) head trauma would have been attributed to the left A-pillar as evidenced by the identified occupant contact. Refer to **Figure 14** above. Per protocol, the NASS coded cause of death was unknown.

Driver Kinematics

The 37-year-old driver was operating the vehicle northbound returning to her residence after picking up the two second row passengers. The driver was unrestrained and seated in a rear-track position. For unknown reasons, the Toyota departed the left side of the road and impacted a series of trees with the front and left side planes of the vehicle. The driver air bag, knee air bag and driver seat-mounted air bag and the left IC air bag deployed.

The driver responded to the frontal and left impacts by initiating a forward and left trajectory. The vehicle was also pitching down and rolling left due to the embankment at the tree line. Coincident to her kinematic pattern, the left side structure and instrument panel were intruding into the driver's space. The steering column was displaced rearward and inboard (right) as a result of the deformation. As the driver translated forward and left, her torso contacted the outboard aspect of the deployed driver air bag and steering assembly. The off axis loading of the deployed air bag resulted in the unrestrained occupant rotating off and engaging the steering wheel rim. The driver loaded the steering assembly resulting in the abdominal trauma and the bilateral thigh contusions. The driver's head contacted the intruding left A-pillar resulting in the soft tissue injuries to the face and head, the left maxilla fracture and the (probable) unknown head injury. The left side of her chest loaded the intruding door panel. This contact resulted in the rib fractures, pneumothorax, pelvic fracture, the spleen laceration and the soft tissue injuries of the left flank and thigh. The driver's lower extremities through loaded the deployed knee air bag and loaded the intruding knee bolster. The left femur and lower extremity were fractured during this contact. The driver's seat back was also loaded from behind by the unrestrained second row passenger's. The seat back deformed forward. This loading and deformation may have resulted in additional driver loading. The driver then rebounded back into the seat where she was found by the first responders.

The driver was removed from the vehicle after a prolonged extrication. She was unresponsive and was transported to a regional trauma center via helicopter. Upon arrival at the trauma center,

her Glasgow Coma Score (GCS) was 3T. Aggressive life support was unsuccessful and the driver succumbed to the multiple blunt force traumatic injuries 6-1/2 hours post-crash.

SECOND ROW LEFT PASSENGER DEMOGRAPHICS

	Second Row Left Passenger
Age/Sex:	11-year-old/Female
Height:	Unknown
Weight:	45 kg (99 lb)
Seat Track Position:	Not adjustable
Restraint Use:	None
Restraint Usage Source:	SCI interior inspection, PAR
Mode of Transport From Scene:	Transported via ground ambulance to a regional trauma center
Type of Medical Treatment	Hospitalized 17 days

Second Row Left Passenger Injuries

Injury	**Injury Severity (AIS 2005/Update 08)**	**Injury Source**
Left orbital floor fracture (comminuted and displaced)	Moderate (251221.2,2)	Left B-pillar
Left lateral orbital wall fracture (comminuted and displaced)	Moderate (251235.2,2)	Left B-pillar
Right maxillary sinus fractures (anterior and lateral walls, comminuted, with minimally displaced left lateral pterygoid plate fracture)	Moderate (250800.2,2)	Left B-pillar
Left sacral fracture (tiny buckle type fracture of the anterior left sacrum)	Moderate (856100.2,4)	Driver seat back (indirect)
Complete transection of the left ulnar nerve	Moderate (730804.2,2)	37 cm diameter tree
Left proximal forearm and elbow degloving (dirt impregnated in muscle)	Moderate (714002.2,2)	37 cm diameter tree
Left elbow sprain (avulsion of the medial epicondyle, the flexor mass of forearm and the medial collateral ligament)	Minor (772010.1,2)	37 cm diameter tree
Left scalp avulsion (exposing bone)	Minor (110802.1,2)	Left B-pillar

Injury	Injury Severity (AIS 2005/Update 08)	Injury Source
Left forehead avulsion (10 x 7 cm area, including the left eyelids, cheek and upper lip)	Minor (210802.1,7)	Left B-pillar
Left cheek and eyelid avulsion (exposing maxilla, avulsion of the lateral canthal tendon)	Minor (210802.1,2)	Left B-pillar
Upper lip avulsion	Minor (210802.1,8)	Left B-pillar
Left periorbital ecchymosis	Minor (210402.1,2)	Left B-pillar
Left zygomatic arch fracture (displaced)	Minor (251806.1,2)	Left B-pillar
Bilateral mandibular ramus fractures (incomplete)	Minor (250608.1,3)	Left B-pillar
Multiple facial abrasions NFS	Minor (210202.1,9)	Left IC air bag
Left corneal abrasion	Minor (240602.1,2)	Left IC air bag
Left axilla laceration (6 cm)	Minor (710602.1,2)	Left rear window frame/glass
Upper extremity abrasions NFS	Minor (710202.1,9)	Unknown
Lower extremity abrasions NFS	Minor (810202.1,9)	Unknown

Source of injury data: Hospital records

Second Row Left Passenger Kinematics

The 11-year-old child was seated in the second row left position of the Toyota and was unrestrained. Upon impact, the child initiated a forward and left trajectory. The child's lower extremities contacted and loaded the driver seat back evidenced by the observed area of contact. Her loading resulted in the left sacral fracture. The child continued along the left forward trajectory and her head impacted the aft aspect of the B-pillar. This region of the B-pillar was not protected by an inflated section of the IC air bag. The impact resulted in the multiple facial fractures (left orbit, right sinus and bilateral mandible) and the avulsions of the scalp, forehead, cheek and lip. During her forward kinematic pattern, the child's left arm was partially ejected through the left rear window opening (beneath the deployed IC air bag). Her arm came into contact with the 37 cm diameter tree and sustained the ulnar nerve transection, forearm avulsion, and elbow injury. With her arm was outside the vehicle, the left axilla became exposed to the

left rear window frame/glass and was lacerated. She most likely rebounded rearward and to the left contacting the left rear door panel and the IC air bag. She came to rest in the second row of the Toyota in an unknown manner. She was transported by ground ambulance to a regional trauma center and was hospitalized for 17 days.

Additional research into the deployment pattern of the Toyota's IC air bag was conducted by the SCI team. The side impact test films indicated that there existed an opening during the deployment sequence of the IC. An intermittent gap between the window sill and the deploying IC air bag develops and closes as the chambers inflate and tension develops across the IC. **Figures 22 – 24** are frame captures from the test crash video depicting the gap opening. It should be noted that in the lateral crash test, there was no A-pillar displacement and the IC should have been under maximum tension. However, the opening was still present. The displacement of the A-pillar during the subject crash would have greatly reduced the tension across the IC, thereby allowing the left arm of the second row left occupant to become partially ejected.

Figure 22: Right interior view of the deploying IC in NHTSA test #5674 at 26 milliseconds post-impact.

Figure 23: Right interior view of the deploying IC in NHTSA test #5674 at 41 milliseconds post-impact.

Figure 24: Right interior view of the deploying IC in NHTSA test #5674 at 70 milliseconds post-impact.

SECOND ROW RIGHT PASSENGER DEMOGRAPHICS

	Second Row Right Passenger
Age/Sex:	11-year-old/Female
Height:	132 cm (52 in)
Weight:	46 kg (101 lb)
Seat Track Position:	Not adjustable
Restraint Use:	None
Restraint Usage Source:	SCI interior inspection, PAR
Mode of Transport From Scene:	Transported via ground ambulance to a regional trauma center
Type of Medical Treatment	Hospitalized 4 days

Second Row Right Passenger Injuries

Injury	**Injury Severity (AIS 2005/Update 08)**	**Injury Source**
Left femoral head fracture (Salter I fracture)	Serious (853171.3,2)	Front right seat back (indirect)
Left femoral neck fracture	Serious (853161.3,2)	Front right seat back (indirect)
Left distal humeral diaphysis fracture (comminuted, with posterior displacement)	Moderate (751251.2,2)	Driver seat back
Bilateral nasal bone fractures (mildly displaced)	Moderate (251002.2,4)	Driver seat back
Left hip dislocation (with articular cartilage involvement)	Moderate (873034.2,2)	Front right seat back (indirect)
Forehead abrasions	Minor (210202.1,7)	Driver seat back
Forehead lacerations (2 puncture wounds, approximately ¼ cm)	Minor (210602.1,7)	Flying glass
Multiple contusions, NFS	Minor (910400.1,0)	Unknown

Source of injury data: Hospital records.

Second Row Right Passenger Kinematics

The 11-year-old child was seated in the second row right position of the Toyota and was unrestrained. Upon impact, the child initiated a forward and left trajectory (parallel to the second row left passenger). The child contacted and loaded the inboard aspect of the front right passenger seat back (at the junction with the center console) with her lower extremities. This loading resulted in the multiple left femur fractures and the left hip dislocation. As the

passenger's lower extremities decelerated, her torso continued forward and jackknifed down. The passenger's head/face and left torso impacted the upper inboard aspect of the driver seat back. The seat back deformed forward and imparted additional loading to the driver. The passenger sustained a nasal fracture, a left humerus fracture, and soft tissue injuries as a result of the loading. The forehead lacerations resulted from disintegrated glazing. The passenger rebounded into an unknown position within the second row. She was removed from the vehicle after a prolonged extrication, transported by ground ambulance to a regional trauma center and hospitalized 4 days.

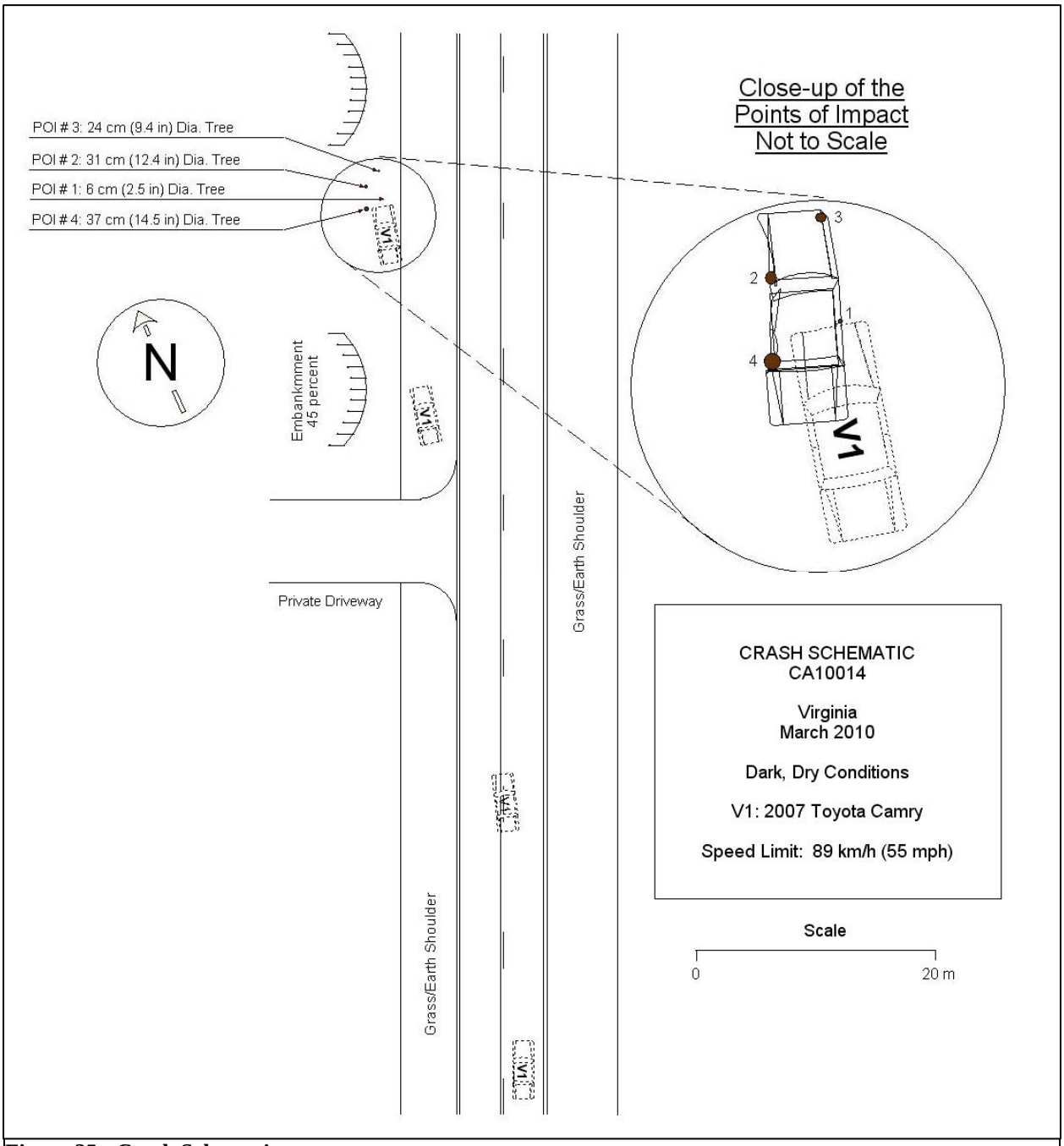

Figure 25: Crash Schematic.