CRASH DATA RESEARCH CENTER

Calspan Corporation
Buffalo, NY 14225

OFFICE OF DEFECTS INVESTIGATION

CALSPAN ON-SITE POTENTIAL UNINTENDED ACCELERATION CRASH INVESTIGATION

SCI CASE NO: CA09083

VEHICLE: 2010 TOYOTA CAMRY
LOCATION: NEW YORK
CRASH DATE: NOVEMBER 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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16. Abstract This on-site investigation focused on the potential unintended acceleration (UA) crash of a 2010 Toyota Camry and the source of injury for the 55-year-old female driver. The driver of the Toyota passed through several intersections against red traffic signals prior to entering a four-leg intersection on a red signal phase and impacting the left side of a 2006 Ford Taurus. The frontal impact deployed the driver's advanced frontal air bag and the knee bolster air bag in the Toyota. The Ford Taurus was not equipped with inflatable side impact protection. The 56-year-old driver of the Ford was fatally injured in the crash. The driver of the Toyota was removed from her vehicle by rescue personnel and transported to a local hospital where she was admitted for treatment of thoracic and shoulder fractures and deficits related to a stroke. Subsequent police investigation determined that the driver of the Toyota suffered a stroke prior to the crash that caused her to operate the vehicle without full control.			
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BACKGROUND

This on-site investigation focused on the potential unintended acceleration (UA) crash of a 2010 Toyota Camry and the source of injury for the 55-year-old female driver. The driver of the Toyota passed through several intersections against red traffic signals prior to entering a four-leg intersection on a red signal phase and impacting the left side of a 2006 Ford Taurus. The frontal impact deployed the driver's advanced frontal air bag and the knee bolster air bag in the Toyota. The Ford Taurus was not equipped with inflatable side impact protection. **Figure 1** is an on-scene police image of the crash site and the vehicles at final rest. The 56-year-old driver of the Ford was fatally injured in the crash. The driver of the Toyota was removed from her vehicle by rescue personnel and transported to a local hospital where she was admitted for treatment of thoracic and shoulder fractures and deficits related to a stroke. Subsequent police investigation determined that the driver of the Toyota suffered a stroke prior to the crash that caused her to operate the vehicle without full control.

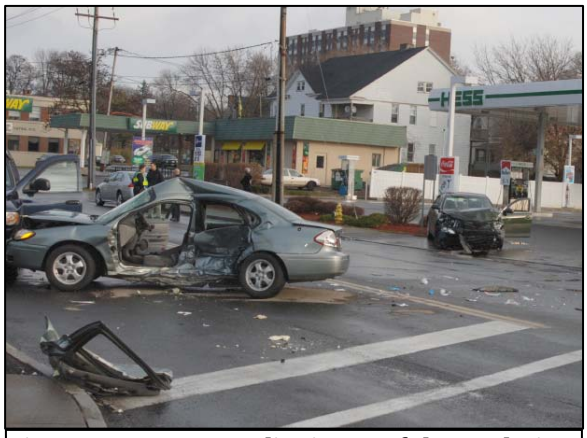

Figure 1: On-scene police image of the crash site.

The investigating police officer contacted the Calspan Special Crash Investigations (SCI) team on Monday, November 30, 2009, and reported the crash as a possible unintended acceleration incident. Details of the crash were summarized in an email by the Calspan SCI team and forwarded to the National Highway Traffic Safety Administration's (NHTSA) Crash Investigation Division (CID) on the same day. Images of the crash were also provided to NHTSA and the case was assigned for on-site investigation on the day of notification. The Calspan SCI team gained the full cooperation of the investigating police agency and the on-site investigation took place on December 3, 2009. The investigation involved the detailed documentation of the vehicle damage patterns, interior contact points and intrusion, an inspection of the Toyota's brake system with removal of the brake pads, a thorough inspection of the accelerator and brake pedals, and the floor mats that were installed in the Toyota at the time of the crash. The Toyota Camry was equipped with an Air bag Control Module (ACM) that had Event Data Recorder (EDR) capabilities. The ACM was removed from the vehicle for imaging of the EDR data by the manufacturer. A technical representative from Toyota imaged the EDR and provided a copy of the data to the NHTSA. The EDR data is summarized in this report. The ACM remains in the possession of the investigating police department.

SUMMARY

VEHICLE DATA

2010 Toyota Camry

The 2010 Toyota was manufactured in June 2009 and was identified by the Vehicle Identification Number (VIN): 4T1BF3EK2AU (production sequence deleted). **Figure 2** is an oblique view of an exemplar Toyota. The digital odometer reading at the time of the SCI inspection was 5,533 km (3,438 miles). The four-door sedan was equipped with a 2.5-liter, I4-cylinder engine linked to a five-speed automatic transmission. The Toyota was equipped with four-wheel disc brakes with four-wheel antilock (ABS). The interior of the vehicle was configured for five passenger seating. Each seat position was equipped with a 3-point lap and shoulder restraint. The front safety belts were equipped with retractor pretensioners. The Toyota was equipped with Certified Advanced 208-Compliant (CAC) frontal air bags for the driver and front right passenger positions. The vehicle's recommended tire size was P215/60R16 with a cold tire pressure of 234 kPa (34 PSI), front and rear. The vehicle was equipped with Michelin Energy MXV3 P215/60R16 tires mounted on OEM steel wheels. The specific tire data at the time of the SCI inspection was as follows:

Figure 2: Exemplar Toyota Camry.

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	214 kPa (31 PSI)	7 mm (9/32)	No	None
LR	214 kPa (31 PSI)	7 mm (9/32)	No	None
RF	221 kPa (32 PSI)	8 mm (10/32)	No	None
RR	214 kPa (31 PSI)	8 mm (10/32)	No	None

The Toyota was leased by the driver as a new vehicle approximately four months prior to this crash. There was no reported service history for this vehicle. The Toyota was equipped with the OEM carpeted floor mats that were secured to the vehicle with two hooks at the rear edge of the mat. Aftermarket rubber floor mats were positioned in all four outboard positions on top of the OEM carpeted mats **(Figure 3)**. These aftermarket mats measured 43 cm x 31 cm (17.1 in x 12.1 in) and were 2 mm (3/32 in) thickness. These mats were very pliable and did not appear to obstruct the operation of the accelerator pedal.

Figure 3: View of the aftermarket floor mat in the driver's foot well.

2006 Ford Taurus

The 2006 Ford Taurus was identified by the VIN: 1FAFP53U06A (production sequence deleted). The four-door, five passenger sedan was equipped with the SE level trim package. The power train consisted of a 3.0-liter, V-6 engine linked to a four-speed automatic transmission. The service brakes were a four-wheel disc system with ABS. The vehicle was manufactured in May 2005. The digital odometer could not be read due to crash related damage to the electrical system. The manual restraint systems consisted of three-point lap and shoulder belts in the five seat positions. The manual restraints in the front row were equipped with buckle pretensioners. The Ford was equipped with Certified Advanced 208-Compliant (CAC) air bags for the driver and front right passenger. The vehicle was not equipped with an inflatable side impact protection system. The Ford was equipped with Doral SDL60 P215/60R16 tires on OEM alloy rims. The tire size was the proper size recommended by the manufacturer. The recommended cold tire pressure was 207 kPa (30 PSI) front and rear. The specific measured tire data was as follows:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	290 kPa (42 psi)	7 mm (9/32)	No	None
LR	290 kPa (42 psi)	7 mm (9/32)	No	None
RF	283 kPa (41 psi)	7 mm (9/32)	No	None
RR	297 kPa (43 psi)	7 mm (9/32)	No	None

CRASH SITE

This two-vehicle intersection crash occurred during the afternoon hours of November 2009 in an urban setting. **Figure 4** is an overhead police image of the intersection and the final rest positions of the vehicles. At the time of the crash, the weather was cloudy and the asphalt road surface was wet. The crash occurred at the four-leg intersection of a 4-lane north/south road and a 4-lane, one-way westbound road. The total width of the north/south road measured 16.8 m (55.1 ft). The north and south traffic lanes were configured with two lanes in either direction that were separated by double-yellow center lines. The total width of the westbound road measured 15.6 m (51.2 ft). The westbound lanes were configured with a right turn only lane, two center-through lanes, and a left turn only lane. The intersection was controlled by standard (red/amber/green) overhead traffic signals that were operational at the time of the crash. The traffic light was green for the westbound traffic flow. The speed limit in the area of the crash was 48 km/h (30 mph). A schematic of the crash is attached to the end of this report as **Figure 19**.

Figure 4: Overhead view of the crash site. (Image courtesy of the investigating police department.)

CRASH SEQUENCE

Pre-Crash

Approximately 30 minutes prior to the crash, the 55-year-old female driver of the Toyota traveled to her daughter's apartment in order to give her a ride to work. The driver and her daughter were engaged in conversation during the short ride to the parking lot at her place of employment. The daughter stated that the driver's condition appeared normal at this time. On arrival to the parking lot, the daughter reported to the police investigator that the driver's speech had become slurred and that she was having difficulty understanding the driver. The daughter exited the vehicle and proceeded into her work place. The driver left the parking lot, turned right and traveled north. The parking lot was located approximately 0.8 km (0.5 mile) from the crash site. As the Toyota proceeded north, witnesses to the crash reported that the vehicle was operating at a high rate of speed. The Toyota traveled through three intersections against red traffic signals and was weaving lane-to-lane around stopped traffic. As the Toyota approached the crash site, the vehicle was in the outboard northbound traffic lane. A witness, who was stopped at an intersection, visually tracked the Toyota and noted that the brake lights were not illuminated.

The 2006 Ford Taurus was occupied by a 56-year-old female driver and a 10-year-old female front right passenger. The Ford was stopped in the right-center westbound lane. The Ford was stopped at the stop bar and was the first vehicle in this lane. A full-size van was stopped in the left-center westbound lane adjacent to the Ford. The traffic light cycled to green for the westbound traffic and the van and the Ford accelerated forward. The driver of the van observed the Toyota approaching from his left and braked his vehicle. The driver of the Ford was unaware of the encroaching vehicle and continued forward to the impact.

Crash

The front plane of the Toyota impacted the left side of the Ford, centered on the B-pillar. The front area of the Toyota pocketed into the occupant compartment resulting in 51 cm (20 in) of intrusion measured at the B-pillar. The northbound momentum of the Toyota displaced the Ford laterally and both vehicles initiated a counterclockwise (CCW) rotation. The Toyota separated from the Ford and slid to rest 28.4 m (93.2 ft) north of the point of impact facing south. The Ford was redirected to the northwest and rotated approximately 335 degrees CCW. The Ford came to rest 20.2 m (66.3 ft) from the point of impact. During the later stage of the Ford's post crash travel, the front right aspect of the Ford contacted the left side of a 2002 Dodge Ram pickup in a minor secondary crash.

The severity of the crash (delta-V) was calculated by the Damage Algorithm of the WinSMASH reconstruction program. The total delta V of the Toyota was 47.0 km/h (29.2 mph). The longitudinal and lateral delta-V components were -44.2 km/h (-27.4 mph) and -16.1 km/h (-10.0 mph). The total delta-V of the Ford was (also) 47.0 km/h (29.2 mph) with longitudinal and lateral components of -23.5 km/h (-14.6 mph) and 40.7 km/h (25.3 mph), respectively. An in-line momentum calculation determined the impact speed of the Toyota was 97 km/h (60 mph) with a delta-V of 47 km/h (29 mph).

Post-Crash

The police, fire and ambulance personnel responded to the crash site. The driver of the Toyota was initially unresponsive and was removed from the vehicle due to a perceived serious injury. She was transported by ambulance to a local hospital where she was evaluated and prepared for transfer to a regional trauma center where she was hospitalized for 19 days. The driver of the Ford was fatally injured in the crash and was pronounced deceased at the scene. The 10-year-old female passenger in the Ford was transported a local hospital, treated and released.

Follow-up investigation by the police determined the driver of the Toyota was having a stroke prior to the crash. The driver was observed to have a significant right side deficit in both speech and movement. Brain surgery was conducted in the days following the crash in order to remove a blood clot. It was the doctor's opinion that the stroke impaired the driver's ability to control the vehicle leading up to the crash.

EXTERIOR VEHICLE DAMAGE

2010 Toyota Camry

The Toyota sustained direct contact damage to its front plane that extended across the entire 157 cm (62 in) end width. **Figures 5 and 6** are front and left oblique views of the damage. The intersection impact resulted in a 28 cm (11 in) lateral displacement of the bumper reinforcement due to the 1 o'clock direction of the impact force. The front fascia and energy absorbing foam separated during the impact exposing the bumper reinforcement bar. The residual crush profile measured along the reinforcement bar was as follows: C1 = 29 cm (11.4 in), C2 = 26 cm (10.2 in), C3 = 23 cm (9.1 in), C4 = 18 cm (7.1 in), C5 = 17 cm (6.7 in), C6 = 7 cm (2.8 in). The maximum crush was located at C1. The hood buckled up and the forward aspects of both fenders were crushed. All the doors remained closed during the impact and were operational post-crash. The left wheelbase was reduced 4 cm (1.6 in). The right wheelbase was reduced 2 cm (0.9 in). The windshield and all the side glazing were intact. The Collision Deformation Classification was 01-FDEW2.

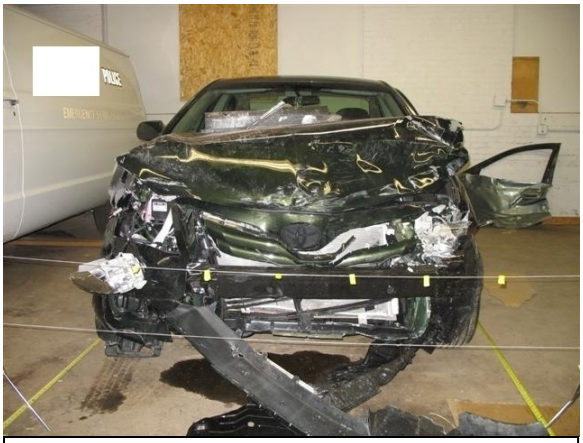

Figure 5: View of the Toyota's frontal damage.

Figure 6: Oblique view of the Toyota's extent of crush.

2006 Ford Taurus

The left side of the Ford sustained severe impact damage as a result of the intersection crash. **Figures 7 and 8** are overall left side views of the vehicle depicting the extent of the damage. The direct contact damage began at the left A-pillar area, 50 cm (19.7 in) aft of the left front axle. The direct contact extended across the left side of the occupant compartment 202 cm (79.5 in) ending 4 cm forward of the left rear axle. The combined length of the direct and induced damage measured 235 cm (92.5 in). The residual crush profile was measured at the mid-door elevation and was as follows: C1 = 0, C2 = 24 cm (9.5 in), C3 = 74 cm (29.1 in), C4 = 75 cm (29.5 in), C5 = 46 cm (18.1 in), C6 = 0. The maximum lateral crush was located 11 cm (4.5 in) aft of the B-pillar and measured 75 cm (29.5 in). The Door Sill Differential (DSD) at that location was 32 cm (12.5 in). The center aspect of the roof was buckled up 36 cm (14.0 in). The sill and floor pan deformed and rolled vertically 24 cm (9.5 in) at the B-pillar. The left door was removed during the extrication of the driver. The left rear door was jammed closed. The right doors remained closed during the impact and were operational. The left wheelbase dimension was reduced 19 cm (7.6 in) and the right wheelbase lengthened 3 cm (1.1 cm) due to body deformation. The CDC was 10-LPAW4.

Figure 7: Left side impact damage of the Ford.

Figure 8: Overhead view depicting the Ford's extent of crush at the B-pillar.

2010 TOYOTA CAMRY

Interior Damage

The interior of the Toyota was configured with cloth-surfaced front bucket seats and a three-passenger rear bench seat with a split forward-folding seat back. The front seats were wrapped with a form fitting aftermarket seat cover that extended around the seat back. The synthetic cover was stretched over the seat back-mounted side impact air bags and the adjustable head restraints. There was no cutout in the seat cover for the side impact air bags. The seats and seat back covers were not damaged as a result of the crash.

The driver loaded the safety belt system in response to the frontal crash forces. Her loading of the belt system resulted in frictional abrasions of the webbing at the D-ring location and of the latch plate from interaction with the webbing. This loading evidence is detailed in the *Safety Belt System* section that follows.

The driver's loading force was transmitted through the deployed driver's air bag into the energy absorbing steering column. The steering column shear capsules were fully separated and the column was resting on the knee bolster post-crash. The four-spoke steering wheel rim was not deformed; however, its mounting flange was deformed. The top aspect of the flange was closed with a scuff mark on the aft aspect of the steering column cover. The lower aspect of the flange was open approximately 6 mm (0.25 in).

A subtle lipstick transfer was present on the center aspect of the face of the driver's air bag, within the tether reinforcement. Scattered specks of dried blood were also present on the air bag.

Foot Controls

The Toyota was equipped with an automatic transmission; therefore the front left floor area of the vehicle was configured, from right to left, with an accelerator pedal, a brake pedal, a parking brake pedal, and a foot rest located forward of the parking brake pedal integrated into the toe pan and the floor carpet **(Figure 9)**. The accelerator pedal was part of the electronic throttle system that used sensors to open and close the throttle based on pedal position. This system did not utilize a cable connecting the accelerator pedal to the throttle plate. The brake pedal was a conventional configuration with a direct linkage to the power booster unit of the hydraulic brake system. The parking brake pedal was foot activated to apply and release the cable-activated system by pushing forward on the pedal. The foot rest was a raised area at the left aspect of the toe pan that extended (8.9 in) inboard of the left kick panel at the lower aspect and 21 cm (8.1 in) at the top aspect.

Figure 9. Floor, toe pan and foot controls of the Toyota Camry.

The accelerator pedal was manufactured by Denso Corporation and consisted of a curved foot pedal that was 4 cm (1.6 in) in width and 11 cm (4.4 in) in height with mitered corners. A ribbed rubber pad was present over the face of the pedal. The right side of the accelerator pedal was located 4 cm (1.4 in) left of the left side of the center console. The pedal arm was formed plastic that angled to the right immediately above the foot pedal then extended vertically to the mounting pivot. The pivot pin was steel with a push-nut type keeper on the left side of the pedal arm. The enclosed sensor was mounted directly above the pedal pivot. There was no damage or evidence of interference to accelerator pedal or the pivot. The full travel length of the accelerator pedal from the rest position to full-throttle was 9 cm (3.4 in), measured at the midpoint of the accelerator pedal. The pedal was manually depressed repeatedly by hand during the SCI inspection and each time the pedal returned to the rest position without issue. It should be noted that when the pedal was fully depressed to the full-throttle position, the bottom aspect of the pedal engaged the OEM carpet; however, the carpet did not snag or restrict the return of the pedal to the rest position.

The steering column angled through the toe pan between the brake pedal and the accelerator pedal. A rubber boot concealed the flex joint of the column. This assembly did not interfere with the operation of the foot pedals.

The brake pedal was rectangular in shape with a rubber pad that measured 7 cm (2.75 in) vertically, 11 cm (4.5 in) horizontally at the top aspect of the pedal and tapered to 10 cm (3.75 in) at the bottom aspect of the rubber pad. The pedal was welded to a steel arm that extended above the toe pan to the mounting point. The lateral offset between the brake pedal and the accelerator pedal was 7 cm (2.8 in) from the top of the brake pedal and 8 cm (3.25 in) at the bottom aspect of the brake pedal **(Figure 10)**. The accelerator pedal was positioned at a lower point than the brake pedal with a 4 cm (1.5 in) height differential between the pedals **(Figure 11)**. There was no damage or evidence of occupant foot loading/scuffing to the brake pedal.

Figure 10. Lateral offset of the accelerator and brake pedals of the Toyota Camry.

Figure 11. Height differential between the foot controls of the Toyota Camry.

Floor Mats

The Toyota was equipped with the OEM carpeted floor mats at the four outboard seat positions. The driver's OEM carpeted floor mat was factory cut around the travel distance of the accelerator pedal. With the accelerator pedal depressed to the full throttle position, the OEM carpeted mat did not interfere or capture the bottom of the pedal pad **(Figure 12)**.

The OEM carpeted floor mat was held secure by two hooks installed in the aft aspect OEM base carpeting. These hooks were positioned on 36 cm (14 in) centers and extended through grommets in the OEM floor mat **(Figure 13)**. The hooks extended above the level of the mat and were formed rearward to prevent the mat from moving forward. The left hook secured the floor mat 4 cm (1.75 in) inboard of the left edge of the mat and the right was 6 cm (2.4 in) inboard of the right aspect of the mat. Based on the SCI inspection of the OEM mats, the OEM hooks held the mat secure and in place to the carpeted floor of the Toyota.

Figure 12. Overall view of the OEM floor mat in relation to the foot pedals in the Toyota Camry.

Figure 13. Positioning hooks of the OEM carpeted floor mats in the Toyota Camry.

An aftermarket rubber/foam-like floor mat was placed over the OEM mats at all four positions and was in use at the time of the crash. These aftermarket mats were rectangular in shape and were 43 cm (17.1 in) in width and 31 cm (12.1 in) in height **(Figure 14)**. The thickness of these mats was 2 mm (3/32 in). These mats were extremely pliable due to the thin construction and composition of the mats. During the SCI inspection, this mat was folded against the accelerator pedal in an attempt to capture the pedal in an open throttle position. The return tension of the accelerator pedal overrode the aftermarket mat on all attempts. The floor mat was not rigid enough for bottom edge entrapment to occur.

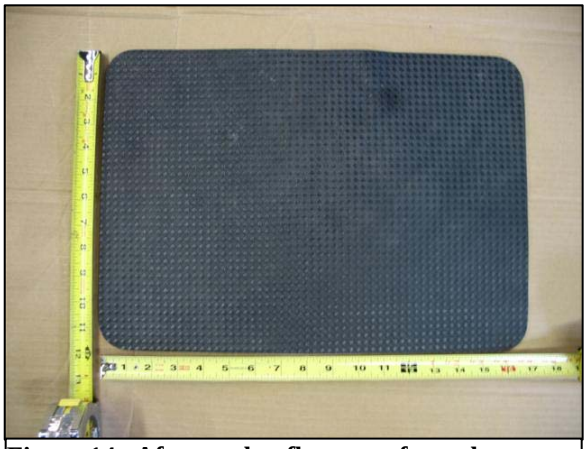

Figure 14. Aftermarket floor mat from the Toyota Camry.

Safety Belt Systems

The Toyota was equipped with 3-point lap and shoulder belt systems in the five designated seating positions. The safety belt systems utilized sliding latch plates and continuous loop webbing. The driver belt system retracted onto an Emergency Locking Retractor (ELR). The front right and rear seat systems utilized switchable ELR/Automatic Locking Retractors (ALR). The front positions were equipped with adjustable D-rings. The driver's D-ring was adjusted to the lowest position at the time of the SCI inspection. In addition to the D-rings, the front seat belt systems were equipped with retractor pretensioners. The driver's pretensioner actuated during the crash event. The front right pretensioner was suppressed by the CAC air bag system as the seat was unoccupied.

The driver wore the safety belt system at the time of the crash. Belt usage was supported by the observations of the first responders, the locked position of the belt webbing due to the actuation

of the retractor pretensioner, and the loading evidence on the webbing and hardware components. A diagonally oriented D-ring transfer was on the inboard aspect of the belt webbing located 4-8 cm (1.5-3 in) below the adjustable D-ring. The friction abrasion extended across the full width of the webbing.

A diagonally oriented crease in the webbing was located at the area of the latch plate. This crease was located 102-107 cm (40-42 in) below the D-ring. A friction abrasion from the belt webbing extended across the full width of the top surface of the latch plate.

Air Bag Systems

The Toyota was equipped with a CAC frontal air bag system for the driver and front right passenger positions. The system consisted of dual-stage frontal air bags, seat track positioning sensors, safety belt buckle and retractor pretensioners, safety belt buckle switches, and a front right occupant presence sensor. The manufacturer of the Toyota has certified that the vehicle is compliant to the advanced air bag requirements of Federal Motor Vehicle Safety Standard No. 208. In addition to the CAC frontal air bags, the Toyota was equipped with a driver's knee bolster air bag, seat back mounted side impact air bags, and roof side rail mounted Inflatable Curtain (IC) air bags. The frontal crash event triggered the deployment of the driver's frontal air bag and the knee bolster air bag and actuated the driver's retractor pretensioner **(Figure 15)**.

Figure 15. Deployed air bags in the Toyota Camry and the locked safety belt webbing due to pretensioner activation.

The driver's air bag was mounted within the four-spoke steering wheel rim with spoke placement at the 3/9 and 5/7 o'clock positions. The air bag was concealed by H-configuration cover flaps with a horizontal tear seam that was 12 cm (4.75 in) in width. The vertical heights of the flaps were 9 cm (3.6 in) for the upper flap and 8 cm (3 in) for the lower flap. The hinge point of the upper flap was 9 cm (3.6 in) in width and the lower flap having a hinge width of 6 cm (2.25 in).

The driver's air bag was 61 cm (24 in) in diameter in its deflated state and was tethered by two internal wide band tether straps that were 13 cm (5 in) in width and sewn to the face of the bag at the 3 and 9 o'clock positions. The maximum excursion of the air bag was 13 cm (5.25 in) at the tether location and 27 cm (10.75 in) at the 12 and 6 o'clock locations. Two 3 cm (1.25 in) diameter vent ports were located on the back side of the air bag at the 11 and 1 o'clock positions and were located 7 cm (2.75 in) inboard of the peripheral seam. A previously identified lipstick transfer and small blood spatters were the only contact evidence on the face of the air bag. There was no damage to the deployed air bag. The following nomenclature was stamped on the air bag:

GA120-01880
0188S031586

The knee bolster air bag deployed from an H-configuration cover flap in the center of the bolster panel. Horizontally, the flaps were 25 cm (10 in) in width. The upper flap was 3 cm (1.25 in) in height and the lower flap was 4 cm (1.5 in) in height. The knee air bag was 56 cm (22 in) in length with an excursion of 24 cm (9.5 in) rearward of the cover flaps. There was no damage or occupant contact evidence to the knee bolster 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 ACM was removed by the SCI investigator during the inspection and transferred to the police investigator as evidence. The investigating police department contacted Toyota for imaging of the EDR. The EDR data was imaged by a Toyota technical representative via a proprietary hardware and software interface. The data was imaged through a direct cable connection to the module using external 12-volt electrical power. A copy of the imaged data was supplied to the NHTSA by Toyota.

The EDR in the 2010 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 buffers stored data elements related to each individual event.

The imaged EDR had one stored event designated the "Latest". The data appeared to be related to the investigated crash. The imaged data reported that the driver's belt was buckled and that the front right passenger seat was unoccupied. The pretensioner actuated at 7 milliseconds and a "High-Stage" driver air bag deployment was commanded at 12 milliseconds. A field within the imaged data indicated a complete writing of the data. The maximum recorded frontal delta-V was 56.5 km/h (35.1 mph) at 180 milliseconds. The recorded pre-crash data is displayed in the following table.

Parameter	**-5 sec**	**-4 sec**	**-3 sec**	**-2 sec**	**-1 sec**
Speed	76.0 km/h (47.2 mph)	78.1 km/h (48.5 mph)	82.1 km/h (51.0 mph)	85.9 km/h (53.4 mph)	85.9 km/h (53.4 mph)
Engine	3600 RPM	3600 RPM	3600 RPM	2800RPM	2800 RPM
Accelerator	Off	Middle	Middle	Off	Middle
Brake	Off	Off	Off	Off	Off

The recorded pre-crash data was not consistent with the circumstances of UA. The accelerator pedal fluctuated between the "Off" and "Middle" positions. The brake switch circuit status was recorded as "Off" throughout the 5-second pre-crash recording.

Brake Inspection

During the course of the SCI inspection, the Toyota's brakes were inspected for signs of wear or heat stress. This inspection was conducted in order to ascertain if the brakes had been applied by the driver for an extended period during the pre-crash phase of the event in an attempt to stop the vehicle. In turn, each wheel was removed from the Toyota and the rotors and the brake pads were inspected. **Figures 16 and 17** are views of the right front rotor and the right front brake pads. The condition of these components was typical of the other three wheel positions. The

brake components did not display indications of extensive wear or evidence of overheating. The observations of the SCI brake inspection determined that the driver was not braking the vehicle for a prolonged, extended period of time. There was no physical evidence of pre-crash braking identified at the crash site during the police investigation.

The brake lights of the Toyota were inspected during this SCI investigation. The left rear brake light bulb was removed from the socket and examined for signs of filament damage. The bulb appeared to be in normal operating condition with no evidence of filament separation or discoloration of the globe. The bulb was placed back in the socket and reconnected to the lens assembly. A 12-volt jump box was connected to the OEM battery and the ignition was turned to the run position. The brake pedal was depressed and all brake lights illuminated.

The cruise control switch was mounted on a stalk at the 4 o'clock position of the steering column. With the ignition turned to the run position, the Cruise light on the instrument panel did not illuminate, indicating the cruise control was in the off position. The switch was engaged to turn the cruise control to the on-position and the instrument panel light illuminated. The ignition was recycled and the light failed to illuminate indicating this system cycled to the off-position at the power-down mode of the ignition cycle. The cruise control switch was not a hard-switch.

Figure 16: View of the condition of the Toyota's right front rotor.

Figure 17: View of the condition of the Toyota's right front brake pads.

OCCUPANT DEMOGRAPHICS/DATA

2010 Toyota Camry Driver Demographics

Age/Sex:	55-year-old/Female
Height:	173 cm (68 in)
Weight:	102 kg (225 lb)
Seat Track Position:	Mid-to-rear track
Safety Belt Use:	3-point lap and shoulder belt system
Usage Source:	Vehicle inspection
Egress from Vehicle:	Removed by rescue personnel
Mode of Transport from Scene:	Ambulance to a local hospital with transport to a regional trauma center
Type of Medical Treatment:	Admitted for 19 days. Transferred and admitted to a rehabilitation facility.

Driver Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Source
Right 6th and 9th posterolateral rib fracture with bilateral hemothoraces and small right apical pneumothorax	Serious (450222.3,1)	Safety belt webbing
Displaced fracture of the sternum with associated posterior hematoma	Moderate (450804.2,4)	Safety belt webbing
Right scapula fracture, non displaced	Moderate (753000.2,1)	Rebound contact into the seat back
Right forearm and wrist contusion	Minor (790402.1,1)	Fling injury into the center instrument panel

Source – Hospital Medical Records (Emergency Room Report, Discharge Summary, Radiology)

Driver Kinematics

The driver was seated in a mid-to-rear seat track position and was restrained by the manual safety belt system. Safety belt use was supported by loading evidence of the latch plate and belt webbing in addition to the locked position of the webbing due to the actuation of the pretensioner.

At impact, the driver's retractor pretensioner actuated and the driver's frontal and knee bolster air bags deployed. She initiated a forward and right trajectory in response to the 1 o'clock direction of force. The driver initially loaded the safety belt webbing as evidenced by the frictional abrasions on the webbing at the D-ring and at the latch plate. Her loading of the belt resulted in the right posterior rib fracture and the displaced sternum fracture.

The driver continued to move forward as the belt compressed into her body and the load limiting retractor spooled out webbing to provide a ride down of the crash forces. Her head flexed forward as she engaged the deployed frontal air bag with her face and chest. The facial contact was evidenced by the subtle lipstick transfer of the center aspect of the air bag. Her torso compressed the air bag against the steering wheel rim. As a result, the steering wheel flange

deformed **(Figure 18)**. Her loading force was transmitted through the air bag into the energy absorbing steering column. The column compressed and the shear capsules completely separated. The column subsequently dropped onto the top aspect of the knee bolster.

Figure 18. Deformed steering wheel flange of the Toyota from driver loading.

The driver's right hand probably separated from the steering wheel rim as a result of air bag deployment. She sustained a contusion of the right wrist and forearm that probably occurred from contact with center instrument panel. There was no contact evidence to support this sequence. The driver's knees contacted the deployed knee bolster air bag. This air bag prevented knee contact to the bolster panel. There was no injury associated with the contact.

During the crash event, the Toyota rotated in a CCW direction due to the lateral component of the 1 o'clock impact force. She rebounded into the seat back where she came to rest. The driver sustained a non-displaced fracture of the right scapula from this rebound contact. There was no deformation of the seat back.

Medical Treatment

The crash occurred within two blocks of the police and fire stations. A call to the 9-1-1 emergency response center provided immediately response of these professional services. The driver of the Toyota was evaluated in the vehicle for possible injury and was removed by paramedics and transported by ambulance to a local hospital for evaluation.

She was transferred within one hour of the crash to a regional trauma center where she was treated for her injuries and evaluated for signs consistent with a stroke. The treating physician determined that the stroke preceded the crash. The driver was hospitalized for 19 days prior to transfer to a rehabilitation facility for therapy of deficits resultant to the stroke that included weakness of the right extremities.

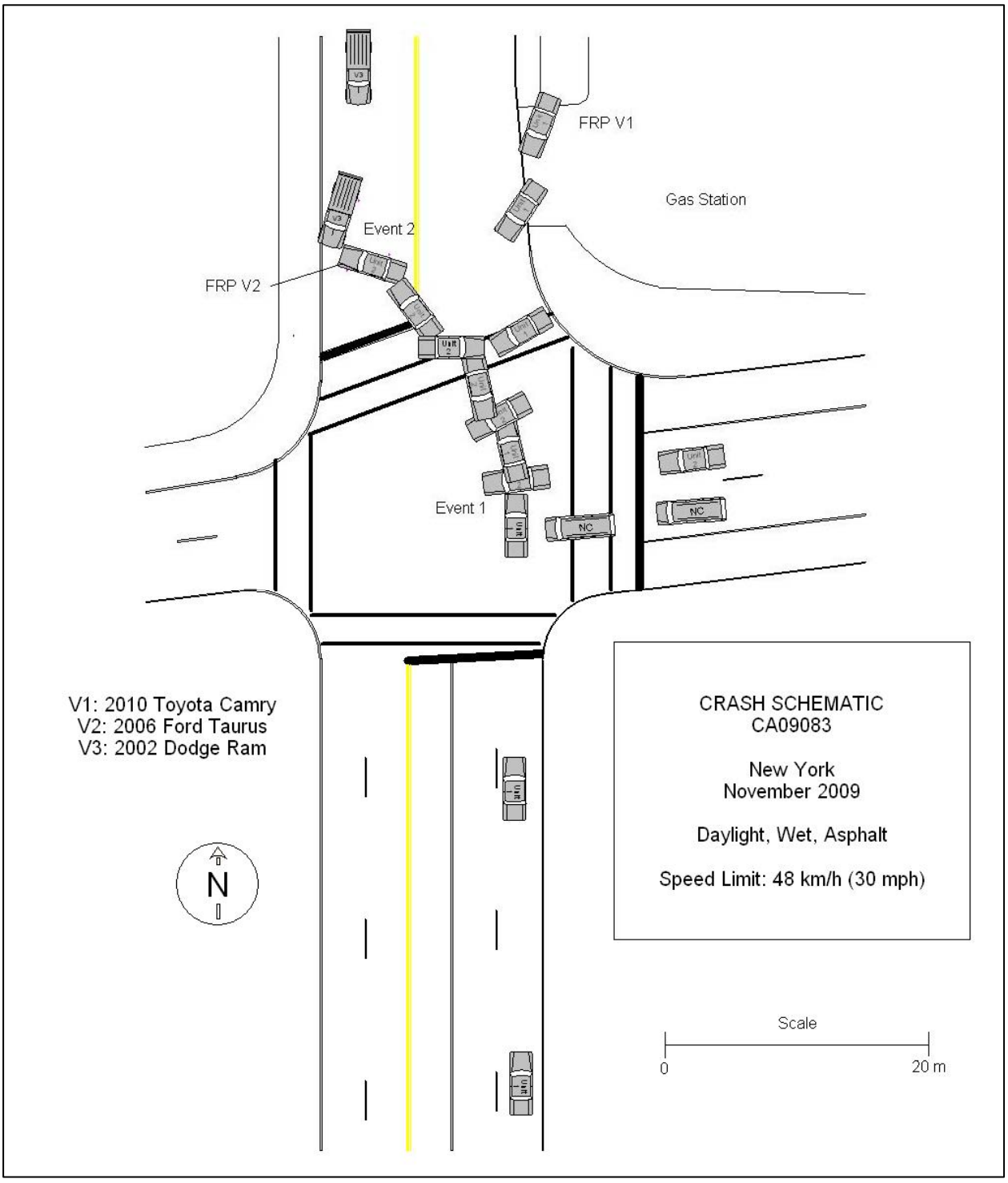

Figure 19: Crash Schematic