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ON-SITE OFFICE OF DEFECTS INVESTIGATION POTENTIAL UNINTENDED ACCELERATION INVESTIGATION

CASE NUMBER - IN10021
LOCATION - NEW MEXICO
VEHICLE - 2009 TOYOTA MATRIX S
CRASH DATE - March 2010

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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 be 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.

Technical Report Documentation Page

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15. <i>Supplementary Notes</i> On-site potential unintended acceleration investigation involving a 2009 Toyota Matrix S.					
16. <i>Abstract</i> This on-site investigation focused on a 2009 Toyota Matrix S, which was alleged to have experienced an Unintended Acceleration (UA) that led to an alleged loss of control by the driver. The recall service, which required Toyota to modify or replace the accelerator pedal and replace the driver's all-weather floor mat with a newly designed floor mat had not been performed. The driver (also the owner) of the vehicle was aware of the recall. The Toyota was driven by a restrained 20-year-old female and occupied by a restrained 19-year-old female front right passenger, a restrained 20-year-old female second row left passenger, and a restrained 20-year-old female second row right passenger. The driver was returning from lunch and intended to drop off the second row right passenger at the passenger's residence. The passenger's residence was located on the intersecting street that the driver was approaching. During the SCI interview, the driver stated that as she was approaching the intersection, she removed her foot from the accelerator pedal but the pedal did not release and the vehicle continued to accelerate. The driver stated that she applied hard braking but the vehicle was not stopping, so she immediately fully applied the emergency brake and initiated a left steer maneuver to turn onto the intersecting street. The vehicle yawed counterclockwise and the front undercarriage and right front wheel (events 1 and 2) impacted a 20 cm high concrete curb. The impact triggered a deployment of the driver's and front right passenger's frontal air bags. The driver and second row left passenger sustained minor injuries. The other passengers were not injured. No one was transported to a medical facility. The vehicle was towed due to damage. The SCI inspection revealed no evidence of entrapment of the accelerator pedal by the floor mat. The accelerator pedal functioned smoothly and did not bind. Inspection of the brake rotors and pads revealed no evidence of overheating. The vehicle's Event Data Recorder recorded the accelerator as "Full" at 5 seconds prior to the impact trigger and "Off" for the remainder of the pre-crash recording. The brakes were recorded as "On" from 3 seconds prior to the impact trigger to the end of the pre-crash recording at 0.9 seconds prior to the impact trigger.					
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This on-site investigation focused on a 2009 Toyota Matrix S (**Figure 1**), which was alleged to have experienced an Unintended Acceleration (UA) that led to an alleged loss of control by the driver. The Crash Investigation Division (CID) of the National Highway Traffic Safety Administration (NHTSA) was notified of this crash through the weekly sampling of police reported crashes conducted by the National Automotive Sampling System (NASS). The NHTSA/CID assigned this investigation on June 25, 2010. This crash involved the Toyota, which departed the roadway and impacted a raised concrete curb. The crash occurred in March, 2010, at 1637 hours, in New Mexico and was investigated by the city police department. The Toyota was inspected and the Event Data Recorder (EDR) was imaged on July 16, 2010 with the manufacturer's EDR readout tool with software version 1.1.0. The imaged EDR data was read and printed with version 1.4.1.0 of the readout tool software. The crash scene was inspected and the driver was interviewed on July 15, 2010. This report is based on the police crash report, vehicle inspection, exemplar vehicle inspection, EDR data, crash scene inspection, driver interview, occupant kinematic principles, and evaluation of the evidence.



Figure 1: The damaged 2009 Toyota Matrix S

The Toyota was subject to NHTSA recall campaign number 1093000, which began March 16, 2010. The recall required Toyota to modify or replace the accelerator pedal and replace the driver's all-weather floor mat with a newly designed floor mat. The driver stated during the SCI interview that she was aware of the recall campaign having heard about it on a news broadcast approximately 3 weeks prior to the alleged event. She stated that she received the recall letter the day before the crash. The recall work had not been performed on the vehicle. The driver purchased the vehicle new in August of 2008. She was the primary driver and drove the vehicle daily. She estimated that she drove the vehicle 80 to 161 kilometers (50 to 100 miles) per week.

CRASH CIRCUMSTANCES

Crash Environment: The crash occurred within a residential subdivision on a 2-lane undivided roadway during daylight hours and clear weather conditions. The roadway traversed in a northwest-southeast direction and had a positive 1.4% grade in the westbound direction of travel. The crash occurred on the southwest side of a 3-leg intersection, which was bordered by concrete curbs 20 cm (7.9 in) in height. The approach to the intersection was uncontrolled. The roadway pavement was dry bituminous and the speed limit was 40 km/h (25 mph). The Crash Diagram is on page 14 of this report.

Pre-Crash: The Toyota was driven by a restrained 20-year-old female and occupied by a restrained 19-year-old female front right passenger, a restrained 20-year-old female second row left passenger, and a restrained 20-year-old female second row right passenger. At the time of the

alleged UA event, the vehicle had been in operation for approximately 30-45 minutes. The cruise control was not engaged and the heating and air conditioning system was not in use. No cell phone was reported to be in use within the vehicle at the time of alleged UA event. The driver was familiar with the roadway. She was returning from lunch and intended to drop off the second row right passenger at the passenger’s residence, which was on the intersecting street. The driver stated that she was traveling northwest (Figure 2) at approximately 72-80 km/h (45-50 mph) on a 40 km/h (25 mph) roadway and intended to turn left at the intersection. She stated that she removed her foot from the accelerator



Figure 2: Approach of the Toyota to the intersection; arrow shows location of impact with 20 cm (7.9 in) high concrete curb

pedal but the pedal did not release and the vehicle continued to accelerate. The driver stated that she applied hard braking, which she claimed made a grinding noise as she braked. She stated that the vehicle was not stopping, so she fully applied the emergency brake immediately after applying the service brakes and initiated a left steer maneuver to turn onto the intersecting street. At the SCI vehicle inspection, the emergency brake was found in the fully applied position. The police crash report indicated that yaw marks from the right side tires were left on the roadway. A yaw mark is indicative of a tire that is rotating and slipping sideways. The police reported yaw marks had dissipated since the crash and were no longer visible. The police crash report indicated that the tire mark evidence on the roadway did not show evidence of locked wheel braking. The investigating police officer used the critical speed equation, which incorporates the radius of curvature of the vehicle’s yaw path, the friction coefficient of the roadway, and the grade of the roadway to calculate the speed of the vehicle as 68.8 km/h (42.7 mph) at the onset of the yaw marks. The table below presents the pre-crash data related to the curb impact that was recorded by the Toyota’s EDR. A column was added to convert mph to km/h.

Sec	Speed (mph)	Speed (km/h)	Engine (rpm)	Accelerator (volts)	Brake
-5.0	50.9	81.9	4400	3.01 (Full)	OFF
-4.0	54.7	88.0	4400	0.78 (Off)	OFF
-3.0	50.9	81.9	2400	0.78 (Off)	ON
-2.0	31.1	50.0	1600	0.78 (Off)	ON
-1.0	13.7	22.0	800	0.78 (Off)	ON
-0.9	13.7	22.0	800	0.78 (Off)	ON

Crash: The undercarriage and bottom of the engine (Figure 3) located immediately behind the bottom of the radiator frame impacted the concrete curb (Figure 4, event 1). The vehicle was rotating counterclockwise at the moment of impact, which produced a force direction on the vehicle within the 1 o'clock sector. The impact force was sufficient to trigger deployment of the driver's and front right passenger's frontal air bags. The front wheels also impacted the curb as the vehicle traveled over the curb. The right front wheel rim was dented (Figure 5, event 2) and the wheel was displaced rearward 10 cm (3.9 in). The left front wheel was undamaged. The vehicle came to final rest heading southwest with the front half of the vehicle off the roadway.

Post-Crash: The driver and passengers exited the vehicle through their respective doors. The police and emergency medical service responded to the crash scene. The passengers were examined at the crash scene by emergency medical personnel but were not transported to a medical facility. The driver stated she was not examined by emergency medical personnel or transported. The vehicle was towed from the crash scene due to damage.

CASE VEHICLE

The 2009 Toyota Matrix S was an all wheel drive, 5-passenger, 5-door hatchback (VIN: 2T1LE40E69C-----) that was manufactured in May 2008. The vehicle was equipped with a 2.4-liter, 4-cylinder engine, a 5-speed automatic transmission, 4-wheel anti-lock disc brakes with electronic brake force distribution, traction control, and Electronic Stability Control. The front row was equipped with bucket seats, adjustable head restraints, lap-and-shoulder safety belts, driver and front right passenger frontal air bags, seat-mounted side impact air bags, and side impact inflatable curtain (IC) air bags that provided protection for the front and second row outboard seating positions. The second row was equipped with a bench seat with folding backs, lap-and-shoulder safety belts, adjustable head



Figure 3: Yellow tape and colored rod show area of damage on the front undercarriage and bottom of the engine

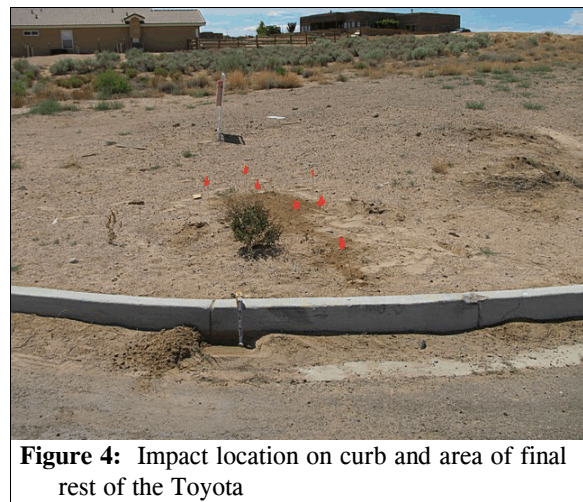


Figure 4: Impact location on curb and area of final rest of the Toyota



Figure 5: Damage on the right front wheel from the curb impact

restraints, and Lower Anchor and Tethers for Children (LATCH) in the outboard seating positions. The vehicle's mileage at the SCI inspection was 31,297 miles (50,638 kilometers). The specified wheelbase was 260 cm (102.4 in).

CASE VEHICLE DAMAGE

Exterior Damage Event 1: The front plane impact with the curb involved the front undercarriage and the bottom of the engine. The bumper was not engaged during this impact. The direct damage on the undercarriage began 26 cm (10.2 in) left of the vehicle's centerline and extended to the right 102 cm (40.1 in). The impact on the undercarriage slightly buckled the right stub frame member and the induced damaged displaced the front right corner of the bumper bar 3 cm (1.2 in) rearward.

Damage Classification Event 1: The Collision Deformation Classification (CDC) for the undercarriage impact with the curb was 01UFDW1 (20 degrees). The WinSMASH program could not be used to calculate a Delta V for this impact since an impact on the undercarriage is out of scope for the program. The vehicle's EDR recorded the maximum velocity change as 8.8 mph (14.2 km/h) occurring at 80 ms following the impact trigger. Based on the damage on the undercarriage, the severity of the damage was moderate.

Exterior Damage Event 2: The right front wheel impact with the curb created a dent on the outside of the rim 19 cm (7.5 in) in length. Concrete residue transfer was on the rim. The tire bead was also separated, which deflated the tire. The impact displaced the right front wheel rearward 10 cm (3.9 in).

Damage Classification Event 2: The CDC for the right front wheel impact with the curb was 01FRWN3 (20 degrees). The WinSMASH program could not be used on this impact since an impact with a wheel is out of scope for the program. Based on the displacement of the wheel, the severity of the damage was moderate.

The manufacturer's recommended tire size was P205/55R16. The Toyota was equipped with the recommended size tires. The vehicle's tire data are shown in the table below.

Tire	Measured Pressure		Vehicle Manufacturer's Recommended Cold Tire Pressure		Tread Depth		Damage	Restricted	Deflated
	kPa	psi	kPa	psi	milli-meters	32 nd of an inch			
LF	414	60	241	35	4	5	None	No	No
LR	345	50	241	35	5	6	None	No	No
RR	Flat	Flat	221	32	5	6	None	No	No
RF	Flat	Flat	221	32	4	5	None	Yes	Yes

Vehicle Interior: The inspection of the interior of the Toyota revealed scuff marks on the lower left instrument panel from contact by the driver's knees. A small scuff mark was also present on the glove box door from contact by the front right passenger's right knee. There was no discernable evidence of occupant contact in the second row. There was no deformation of the steering wheel rim or compression of the energy absorbing steering column.

All of the vehicle's door remained closed and operational. Based on the SCI interview with the driver, the operable side glazing for each door was open at the time of the crash. These windows were all closed at the SCI inspection. The remaining windows were fixed. There was no damage to any of the window glazings. The passenger compartment sustained no intrusions as a result of the crash.

ACCELERATOR PEDAL, FLOOR MAT, AND BRAKE COMPONENTS

The initial status of the CTS accelerator pedal, brake pedal, and Toyota OEM floor mat at the time of the SCI inspection is shown in **Figure 6**. The driver's floor mat was secured by the two floor mounted attachments located immediately in front of the driver's seat tracks. The product codes on the back of the driver's floor mat (**Figure 7**) were PT206-02090-XX, PT206-12090-XX, 58510-YY250-XX, 58510-YY190-XX, PT206-02091-XX, PT206-12091-XX, 58510-YY010-XX. The distance from the front of the floor mat to the bottom end of the accelerator pedal was 7 cm (2.8 in). The lateral distance between the accelerator pedal and the brake pedal was 6 cm (2.4 in). The accelerator pedal was 4 cm (1.6 in) in width and 13 cm (5.1 in) in length. The brake pedal was 10 cm (3.9 in) in width at the top, 8.5 cm (3.3 in) in width at the bottom, and 6 cm (2.4 in) in length. The lateral distance between the centerline of the driver's seat and the right edge of the brake pedal was 7 cm (2.8 in). The longitudinal distance (i.e., offset) from the face of the brake pedal to the face of the accelerator pedal was 2.5 cm (1.0 in). The accelerator pedal functioned smoothly and did not bind. **Figure 8** shows the CTS accelerator mechanism housing. The product numbers on the accelerator housing were 78110-07011, 08149A1A X, and 49501032080 LHD.



Figure 6: The initial status of the brake pedal, accelerator pedal, and Toyota floor mat at the SCI inspection; please note that the vertical scale does not represent the centerline of the driver's seat

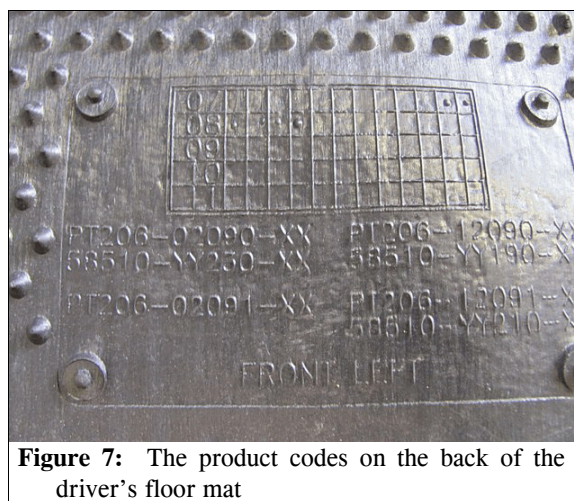


Figure 7: The product codes on the back of the driver's floor mat

The right front and right rear wheels were removed and the brake rotors and brake pads were inspected. The right front and right rear brake rotors and brake pads showed no discernable evidence of overheating (**Figures 9 and 10**). The right rear brake rotor was slightly rusted. The emergency brake was found in the fully applied position at the SCI inspection. The photographs of the brake pads and brake rotors were taken with the emergency brake in the fully applied position.

EVENT DATA RECORDER

Due to crash related electrical problems, it was not possible to image the EDR via connection to the diagnostic link connector. The Air Bag Control Module (ACM), which contains the EDR was removed from the vehicle and the data was imaged via direct connection to the ACM using the manufacturer's EDR readout tool with software version 1.1.0. The imaged data was subsequently read and printed using version 1.4.1.0 of the readout tool software. The EDR recorded data for three frontal events. The event indicated as the "Latest/Frozen BANK2, Event counter 3" was related to this crash. The event indicated as the "Next most recent BANK1, Event counter 2" was not related to this crash since the occupant detection data for the front right passenger was recorded as "Unoccupied." The event indicated as the "Past max. DeltaV BANK0, Event counter 1" may be related to this crash. The EDR also recorded g-force data at the B-pillar, C-pillar, and floor. The data for these events with the exception of the unrelated "Next most recent BANK1, Event counter 2" event are presented below on pages 7 and 8.

The pre-crash data presented on page 2 and related to the curb impact reflected a vehicle speed that was 42-48 km/h (26-30 mph) higher than the speed limit; which was consistent with the driver's estimate of her travel speed prior to the alleged unintended acceleration event. The EDR also reported that there was no braking until the



Figure 8: The CTS accelerator mechanism housing

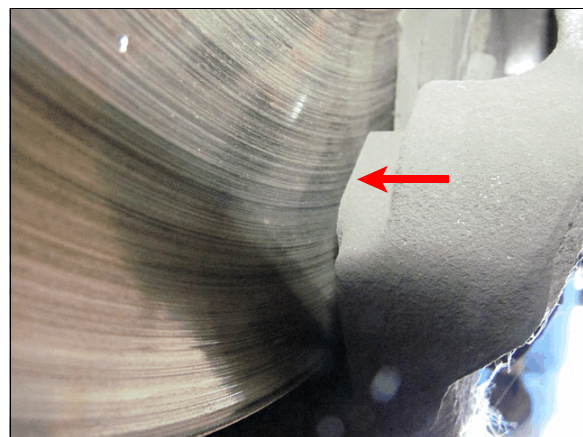


Figure 9: The outside bottom surface of the right front brake rotor and the bottom portion of the brake pad (arrow); the photo was taken with the emergency brake in the fully applied position

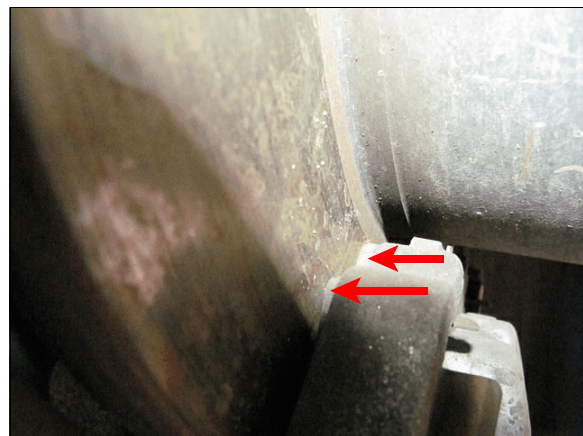


Figure 10: The outside bottom surface of the right rear brake rotor; arrows show the bottom portion of the brake pad; the photo was taken with the emergency brake in the fully applied position

acceleration signal was reported as “Off.” The decrease in engine RPM following the reported acceleration off signal was consistent with the engine returning to idle.

“Latest/Frozen BANK2, Event counter 3”: The EDR recorded the driver’s and front right passenger’s safety belt switch status as “Belted.” The driver’s seat position was recorded as “RW.” The transmission shifter position was recorded as “Others,” which is understood to indicate that the transmission was not in the park, neutral, reverse positions nor was it invalid data. The deployment time for the driver’s and front right passenger’s frontal air bags was recorded as 30 ms. The deployment stage for each air bag was recorded as “ExLo,” which is understood to indicate a stage one deployment. The EDR recorded 150 ms of velocity change data; which are presented in the following table. A column was added to convert mph to km/h. The pre-crash data for this event was discussed in the Pre-Crash section on page 2 of this report.

ms	Vel Chg (mph)	Vel Chg (km/h)	ms	Vel Chg (mph)	Vel Chg (km/h)	ms	Vel Chg (mph)	Vel Chg (km/h)
10	0.3	0.5	60	7.2	11.6	110	8.4	13.5
20	0.5	0.8	70	7.9	12.7	120	8.3	13.4
30	1.0	1.6	80	8.8	14.2	130	8.3	13.4
40	3.4	5.5	90	8.8	14.2	140	8.1	13.0
50	5.2	8.4	100	8.6	13.8	150	7.9	12.7

“Past max. DeltaV BANK0, Event counter 1”: The EDR recorded the driver’s and front right passenger’s safety belt switch status as “Belted.” The driver’s seat position was recorded as “RW.” The transmission shifter position was recorded as “Others.” The following two tables presents the Pre-crash data and the velocity change data recorded for this event.

Pre-Crash Data Table:

Sec	Speed (mph)	Speed (km/h)	Engine (rpm)	Accelerator (volts)	Brake
-5.0	1.2	1.9	400	0.98 (Off)	OFF
-4.0	3.7	6.0	800	1.09 (Off)	OFF
-3.0	7.5	12.1	1600	1.13 (Off)	OFF
-2.0	8.7	14.0	1200	1.05 (Off)	OFF
-1.0	9.9	15.9	1200	1.09 (Off)	OFF
-0.4	11.2	18.0	1200	1.13 (Off)	OFF

Velocity Change Data Table:

ms	Vel Chg (mph)	Vel Chg (km/h)	ms	Vel Chg (mph)	Vel Chg (km/h)	ms	Vel Chg (mph)	Vel Chg (km/h)
10	0.3	0.5	60	-0.2	-0.3	110	-0.7	-1.1
20	0.3	0.5	70	-0.2	-0.3	120	-0.9	-1.4
30	0.2	0.3	80	-0.2	-0.3	130	-0.9	-1.4
40	0.0	0.0	90	-0.3	-0.5	140	-0.9	-1.4
50	-0.2	-0.3	100	-0.5	-0.8	150	-0.9	-1.4

The following table presents the g-force data recorded by the EDR at the B-pillar, C-pillar, and floor.

ms	B-pillar g	C-pillar g	Floor g
-24.0	-0.3	0.0	0.1
-18.0	0.0	-0.2	0.3
-12.0	0.0	-0.3	0.4
-6.0	-0.5	-0.5	0.6
0.0	0.0	-0.3	0.8
6.0	0.0	0.0	1.0
12.0	0.5	0.3	2.6
18.0	1.3	0.9	2.6
24.0	1.5	0.9	2.8
30.0	2.1	1.0	2.8
36.0	1.5	1.2	2.8
42.0	1.5	1.4	2.6
48.0	2.3	1.5	2.5
54.0	1.5	1.4	2.3

The Toyota was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system that consisted of dual stage driver and front right passenger frontal air bags, driver seat position sensor, seat belt usage sensors, retractor mounted pretensioners and a front right passenger weight sensor. Based on the Holmatro Rescuer's Guide to Vehicle Safety Systems, the frontal air bag sensors were located on the inner fenders. The driver's and front right passenger frontal air bags deployed in this crash. The manufacturer has certified that the vehicle is compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208.

The Toyota was also equipped with a side impact air bag system that consisted of roof rail-mounted side impact inflatable curtain (IC) air bags and front seat-mounted side impact air bags. Based on the Holmatro Rescuer's Guide to Vehicle Safety Systems, the IC air bag inflators were located within the roof side rails between the B- and C-pillars and the side impact sensors were located within the lower B- and C-pillars. Neither of the IC air bags nor the front seat-mounted side impact air bags deployed in this crash.

The driver's frontal air bag was located within the steering wheel hub. The air bag module cover was a three flap configuration constructed of pliable vinyl. The top cover flap was 12.5 cm (4.9 in) in width and 9 cm (3.4 in) in height. Each of the lower flaps was 7 cm (2.8 in) in width and 10 cm (3.9 in) in height. An inspection of the cover flaps revealed that they opened at the designated tear points and were undamaged. The deployed air bag was 55 cm (21.7 in) in diameter. It had one 10 cm (3.9 in) wide tether and two 4.5 cm (1.8 in) diameter vent ports located at the 11 and 1 o'clock positions. The air bag was undamaged and there was no discernable evidence of occupant contact.

The front right passenger's frontal air bag was located within the top of the instrument panel. The air bag module cover was a two flap configuration constructed of firm vinyl. Each cover flap was 22 cm (8.7 in) in width and 6 cm (2.4 in) in height. The cover flaps opened at the designated tear points and were undamaged. The deployed air bag was 55 cm (21.7 in) in height and 39 cm (15.4 in) in width. There was a 5.5 cm (2.2 in) diameter vent port on each side of the air bag. The air bag was undamaged and there was no discernable evidence of occupant contact.

MANUAL RESTRAINT SYSTEM

The Toyota was equipped with lap-and-shoulder safety belts for all the seating positions. The driver's safety belt consisted of continuous loop belt webbing, an Emergency Locking Retractor (ELR), a sliding latch plate, and an adjustable upper anchor that was located in the middle position. The front right passenger safety belt was similar, but was equipped with an ELR/Automatic Locking Retractor (ALR). The upper anchor was located in the middle position. Both safety belts were equipped with retractor-mounted pretensioners, which actuated during the crash. The second row lap-and-shoulder safety belts consisted of continuous loop belt webbing, sliding latch plates, ELR/ALRs, and fixed upper anchors.

The inspection of the driver's safety belt assembly revealed historic usage scratches on the latch plate and load abrasions on the latch plate belt guide. The retractor was jammed with a

length of belt webbing extending out of the retractor consistent with usage. The length of the belt webbing as measured from the stop button to the D-ring was 100 cm (39.4 in). This evidence was consistent with the driver's interview statement that she was restrained by the lap-and-shoulder safety belt at the time of the crash. The EDR also recorded the driver's safety belt switch status as "belted."

The inspection of the front right passenger's safety belt assembly revealed historic usage scratches on the latch plate and load abrasions on the latch plate belt guide. The safety belt webbing also had a stretched appearance. The retractor was jammed with a length of belt webbing extending out of the retractor consistent with usage. The length of the belt webbing as measured from the stop button to the D-ring was 99 cm (39 in). This evidence was consistent with the driver's interview statement that the front right passenger was restrained by the lap-and-shoulder safety belt at the time of the crash. The EDR also recorded the front right passenger's safety belt switch status as "belted."

The inspection of the second row left passenger's safety belt assembly revealed historic usage scratches on the latch plate. There was a scuff on the safety belt webbing located 10 cm (3.9 in) from the stop button. The retractor was not jammed and functioned normally. While the physical evidence was inclusive regarding safety belt usage by this passenger, the driver stated that the second row left passenger was restrained by the lap-and-shoulder safety belt at the time of the crash.

The inspection of the second row right passenger's safety belt assembly revealed historic usage scratches on the latch plate. There was no evidence of loading and the retractor was not jammed and functioned normally. While the physical evidence was inclusive regarding safety belt usage by this passenger, the driver stated that the second row right passenger was restrained by the lap-and-shoulder safety belt at the time of the crash.

CASE VEHICLE DRIVER KINEMATICS

Based on the SCI interview, the driver of the Toyota [20-year-old female, 155 cm (61 in) and 61 kg (135 lbs)] was seated in an upright posture with her back against the seat back and both hands on the steering wheel at the approximate 10 and 2 o'clock positions. The seat track was adjusted to between the middle and rear position and the seat back was slightly reclined. The recline angle of the seat back at the time of the SCI inspection was 30 degrees and the anti-submarine angle of the seat cushion was 18 degrees. The adjustable head restraint was located in the full-down position. The tilt and telescoping steering column was adjusted to full-down position and full-back position, respectively. The driver reported that the safety belt was snug across the hips and over the left shoulder. The driver was not wearing glasses at the time of the crash.

Prior to the impact, the driver initiated a left steering maneuver and the vehicle yawed counterclockwise, which probably displaced the driver to the right within the safety belt. The frontal undercarriage impact with the curb redirected the driver forward and to the right opposite the 1 o'clock direction of force and she loaded the safety belt. Both knees also contacted and scuffed the lower left instrument panel. The driver sustained no injuries from these contacts. The

driver stated that she sustained a contusion on the left forearm from contacting the frontal air bag. She also sustained a contusion on the right forearm from the front right passenger’s frontal air bag when she extended her right arm to protect the front right passenger. Following the crash, the driver exited the vehicle through the left front door.

CASE VEHICLE DRIVER INJURIES

The driver was not examined at the crash scene by emergency medical personnel and was not transported to a medical facility. The table below presents the injuries reported by the driver and the injury sources. The driver lost no work days as a result of the crash.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Contusion (bruise) anterolateral right proximal forearm	minor 710402.1,1	Air bag, front right passenger’s	Probable	Interviewee (same person)
2	Contusion (bruise) anterior left proximal forearm	minor 710402.1,2	Air bag, driver’s	Probable	Interviewee (same person)

CASE VEHICLE FRONT ROW RIGHT PASSENGER KINEMATICS

The front right passenger [19-year-old female, 160 cm (63 in) and 57 kg (125 lbs)] was seated in an upright posture with her back against the seat back. Her right arm was on the right front door arm rest and the left arm was on the center arm rest. The seat track was located between the middle and rear position. The seat track was adjusted to between the middle and rear position and the seat back was slightly reclined. The recline angle of the seat back at the time of the SCI inspection was 30 degrees and the anti-submarine angle of the seat cushion was 18 degrees. The adjustable head restraint was located in the full-down position. The safety belt was snug across the hips and over the right shoulder. The passenger was wearing glasses at the time of the crash.

The front right passenger was probably displaced to the right as the vehicle yawed counterclockwise prior to the impact. The frontal impact with the curb redirected her forward and to the right opposite the 1 o’clock direction of force and she loaded the safety belt. The passenger’s right knee contacted and scuffed the lower right portion of the glove box door, but she sustained no injury from this contact. Following the crash, she exited the vehicle through the right front door.

CASE VEHICLE FRONT ROW RIGHT PASSENGER INJURIES

The front row right passenger complained of a sore neck and was examined at the crash scene by emergency medical personnel. She was not transported from the crash scene to a medical facility and sought no medical treatment later. The passenger lost no work days as a result of the crash.

The second row left passenger [20-year-old female, 160 cm (63 in) and 64 kg(140 lbs)] was seated in an upright posture with her back against the seat back and both feet on the floor. The adjustable head restraint was located in the full-down position. The safety belt was across her hips and left shoulder. The passenger was wearing glasses at the time of the crash.

The second row left passenger was probably displaced to the right within the safety belt as the vehicle yawed counterclockwise. The frontal impact with the curb redirected her forward and to the right opposite the 1 o'clock direction of force and she loaded the safety belt. The passenger sustained a contusion on her left shoulder from the safety belt. There was no discernable evidence that she contacted the back of the driver's seat. Following the crash, she exited the vehicle through the left rear door.

CASE VEHICLE SECOND ROW LEFT PASSENGER INJURIES

The second row left passenger was examined at the crash scene by emergency medical personnel. She was not transported from the crash scene to a medical facility and sought no medical treatment later. The table below presents the injury reported by the driver and the injury source. The passenger lost no work days as a result of the crash.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Contusion (bruise) over left shoulder, not further specified	minor 710402.1,2	Torso portion of safety belt system	Probable	Interviewee (driver)

CASE VEHICLE SECOND ROW RIGHT PASSENGER KINEMATICS

The second row right passenger [20-year-old female, 157 cm (62 in) and 54 kg (120 lbs)] was seated in an upright posture with her back against the seat back. She had both feet on the floor. Her right arm was resting on the right rear window sill and her left arm was on her lap. The adjustable head restraint was located in the full down position. The safety belt was across her hips and left shoulder. The passenger was not wearing glasses at the time of the crash.

The second row right passenger was probably displaced to the right as the vehicle yawed counterclockwise. The frontal impact with the curb redirected her forward and to the right opposite the 1 o'clock direction of force. There was no discernable evidence that she contacted the back of the front right passenger's seat. Following the crash, she exited the vehicle through the right rear door.

The second row right passenger was examined at the crash scene by emergency medical personnel. The driver reported that the passenger sustained no injury. She was not transported from the crash scene to a medical facility and sought no medical treatment later. She missed no work days as a result of the crash.

