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ON-SITE CHILD SAFETY SEAT INVESTIGATION

CASE NUMBER - IN08014
LOCATION - MINNESOTA
VEHICLE - 2004 TOYOTA CAMRY LE
CRASH DATE - March 2008

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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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16. <i>Abstract</i> This report covers an on-site Child Safety Seat (CSS) investigation that involved a 2004 Toyota Camry LE and a 2002 Freightliner FLD-120 truck-tractor with semi-trailer, which were involved in a rear end collision. This case focused on the child occupant (19-month-old, female) who was seated within a Cosco/Dorel Juvenile Group Summit High Back Belt Positioning Booster seat that was installed in the forward facing position in the Toyota's second row right position. The child was restrained within the CSS by the 5-point internal harness system. The Toyota was stopped in an active traffic lane on an interstate highway and the Freightliner was in the same lane approaching the Toyota. The front of the Freightliner impacted the rear of the Toyota and both vehicles came to rest heading in a nominal west direction. The Toyota's three occupants were transported to a hospital. The second row center passenger (4-year-old female), who was not seated in a CSS was fatally injured. The level of treatment for the driver and second row right passenger was not determined. Both vehicles were towed due to damage.					
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CRASH DIAGRAM 8

This crash was brought to the National Highway Traffic Safety Administration's attention on March 14, 2008 by an on-line article from a Minnesota newspaper. This crash involved a 2004 Toyota Camry LE (**Figure 1**) and a 2002 Freightliner FLD-120 truck-tractor with semi-trailer. The crash occurred in March, 2008, at 0823 hours, in Minnesota and was investigated by the Minnesota State Police. This crash is of special interest because the Toyota's second row right passenger (19-month-old, female), was restrained in a Cosco/Dorel Juvenile Group Summit High Back Belt Positioning Booster Child Safety Seat (CSS). This contractor inspected the Toyota, CSS, and the scene on April 1, 2008. A partial interview was conducted with driver on April 4, 2008. The Freightliner was not available and was not inspected. This report is based on the police crash report, scene and vehicle inspections, occupant kinematic principles, and this contractor's evaluation of the evidence.



Figure 1: The damaged 2004 Toyota Camry LE

CRASH CIRCUMSTANCES

Crash Environment: This crash occurred on a 9-lane, divided Interstate highway, that traversed in an east-west direction (**Figure 2**). Both the Toyota and Freightliner were traveling west, and the crash occurred within an interchange area. The roadway had four through lanes, an entrance lane, and wide bituminous shoulders. The trafficway was divided by a grass median and the eastbound side of the Interstate highway had three through lanes, an entrance lane and wide bituminous shoulders. Each lane of the trafficway was nominally 3.5 meters (11.5 feet) in width and the pavement markings consisted of dashed white lane lines, yellow median lines and solid white edge lines. The posted speed limit for both vehicles was 88 km/h (55 mph). At the time of the crash, the light condition was daylight, the atmospheric condition was cloudy, and the roadway pavement was level, dry bituminous. Traffic density was moderate to heavy and the site of the crash was a rural/suburban area. See the Crash Diagram on page 8 of this report

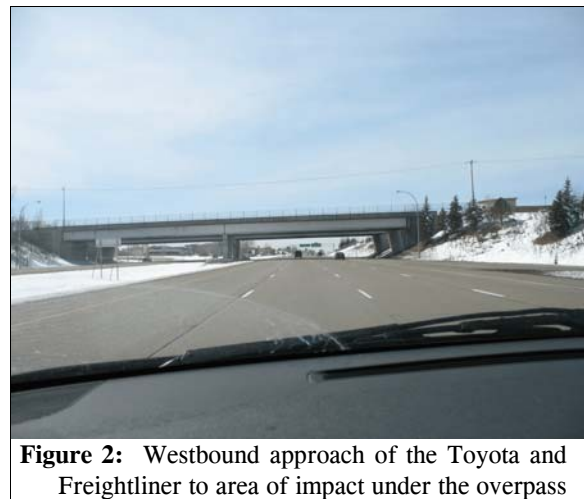


Figure 2: Westbound approach of the Toyota and Freightliner to area of impact under the overpass

Pre-Crash: The Toyota was occupied by a 37-year-old female driver (unknown if restrained), a 4-year-old female second row center passenger (unknown if restrained) and the restrained 19-month-old female second row right passenger. The Freightliner was occupied by a restrained 47-

year-old male driver. According to the police crash report, as the Toyota was traveling west in the inside center lane (**Figure 3**), the driver felt dizzy and pulled into the outside center lane and stopped the vehicle. The Freightliner was traveling west in the outside center lane approaching the Toyota as it stopped. The Toyota's driver made no attempt to avoid the crash.

Crash: The front of the Freightliner impacted and overrode the back of the Toyota (**Figure 4**). The Freightliner remained engaged with the Toyota and pushed it an unknown distance west. Both vehicles came to final rest on the outside center lane facing west.

Post-Crash: Police and emergency personnel were notified and responded to the crash scene. The Toyota's second row center passenger was assisted medically by a passerby who was a physician and then removed from the vehicle by rescue personnel. The driver's and second row right passenger's method of exit from the vehicle was not determined. All of the Toyota's occupants were transported by ambulance to a hospital. The Toyota and Freightliner were both towed from the scene due to damage.



Figure 3: Overview of area of impact in westbound outside center lane (arrow)



Figure 4: Damage to the back of the Toyota from the impact by the Freightliner

CASE VEHICLE

The 2004 Toyota Camry LE (**Figure 1**) was a front wheel drive, four-door sedan (VIN: 4T1BE32K94U-----) equipped with a 2.4L, I-4 engine and a 3-speed automatic transmission. The front row was equipped with dual stage driver and front right passenger air bags, bucket seats with adjustable head restraints, and lap-and-shoulder belts with adjustable upper anchors. The second row was equipped with a split bench seat with folding backs, adjustable head restraints at the outboard seating positions, and lap-and-shoulder belts for all three seating positions. The Toyota was also equipped with Lower Anchors and Tethers for Children (LATCH) at the second seat outboard positions. The Toyota's mileage at the time of inspection was 92,182 kilometers (57,281 miles) and the specified wheelbase was 272 centimeters (107.1 inches).

CASE VEHICLE DAMAGE

Exterior Damage: The Toyota's impact with the Freightliner involved the back end of the vehicle. The back bumper, both taillight assemblies, the trunk lid, both C-pillars and both quarter panels

sustained direct damage. The direct damage began at the back right bumper corner and extended 146 centimeters (57.5 inches) across the back of the vehicle. Due to the override, crush measurements were taken at the bumper level and trunk lid level. The back bumper had been torn off the vehicle during the crash, so the bumper level crush was taken to the structure behind the bumper. The residual maximum crush at the bumper level was 30 centimeters (11.8 inches) occurring at C₆. The residual maximum crush at the trunk lid level was 140 centimeters (55.1 inches) occurring at C₄. The table below shows the vehicle’s rear crush profile, which is the average of the crush at the bumper level and trunk lid level.

Units	Event	Direct Damage		Field L	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	Direct	Field L
		Width CDC	Max Crush								±D	±D
cm	1	146	140	146	73	75	79	80	80	84	0	0
in		57.5	55.1	57.5	28.7	29.5	31.1	31.5	31.5	33.1	0.0	0.0

The left side wheelbase was reduced 7 centimeters (2.8 inches) while the right side wheelbase was reduced 6 centimeters (2.4 inches). Induced damage involved the left and right rear doors, backlight, right rear window, and the roof.

Damage Classification: The Toyota’s Collision Deformation Classification (CDC) was **06-BDAW-6 (180 degrees)** for the impact with the front of the Freightliner. Impacts with heavy trucks are out of scope for the WinSMASH program; however, the program was used to determine a Barrier Equivalent Speed (BES) based on the crush to the back of the Toyota. WinSMASH calculated the BES as 62.4 km/h. (38.5 mph)

The manufacturer’s recommended tire size was P205/65R15. The Toyota was equipped with P205/65R15 size tires. The vehicle’s tire data are shown in the table below.

Tire	Measured Pressure		Vehicle Manufacturer’s Recommended Pressure		Tread Depth		Damage	Restricted	Deflated
	kPa	psi	kPa	psi	milli-meters	32 nd of an inch			
LF	214	31	200	29	6	7	None	No	No
LR	193	28	200	29	4	5	None	Yes	No
RR	193	28	200	29	6	7	None	Yes	No
RF	207	30	200	29	7	9	None	No	No

Vehicle Interior: Inspection of the Toyota's interior revealed extensive intrusion into the back seat occupant space. The CSS was found entrapped in the second row right seat position (**Figure 5**). No evidence of occupant contacts were found in the vehicle. In spite of the severe back impact, the driver's seat back was not deformed rearward and was found in the slightly reclined position. The trunk lid, second row seat back, and backlight header intruded into all of the second row seat positions. The extent of intrusion of the trunk lid, second row seat back, and backlight header were, respectively: 86 centimeters (33.9 inches) 70 centimeters (27.5 inches), and 17 centimeters (6.7 inches). There was no deformation to the steering wheel or compression of the energy absorbing steering column. All windows were closed at the time of the crash and only the backlight and right rear window glazing disintegrated due to impact forces. None of the doors opened during the crash and both rear doors were jammed shut.



Figure 5: Child safety seat as found, entrapped in the Toyota's second row right seat position

AUTOMATIC RESTRAINT SYSTEM

The Toyota was equipped with a frontal air bag system that was certified by the manufacturer to be compliant to the Advanced Air Bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The driver's air bag was located within the steering wheel hub and the front right passenger's air bag was located on the top of the instrument panel. Neither air bag deployed in this crash.

MANUAL RESTRAINT SYSTEM

The Toyota was equipped with lap-and-shoulder belts for all seating positions. The driver's seat belt consisted of continuous loop belt webbing, a sliding latch plate, an Emergency Locking Retractor (ELR), and an adjustable upper anchor that was in the full up position. The front right seat belt was similar but had a switchable ELR/Automatic Locking Retractor (ALR). Its adjustable upper anchor was in the full up position. The second row seat belts were of the same type as the front right seat belt with the exception of a non-adjustable upper anchor.

Inspection of the driver's, second row center, and second row right passenger seat belt assemblies revealed no evidence of loading. The remaining seat positions were unoccupied.

The Toyota's back right passenger 19-month-old, female; 89 centimeters and 11 kilograms (35 inches, 24 pounds)] was seated in a Cosco/Dorel Juvenile Group Summit High-Back Belt Positioning Booster seat (**Figure 6**) that was being used in the forward facing position. The CSS was manufactured on February 20, 2004 and its model number was 22-260-HOU. The CSS was designed for children who weigh 14-40 kilograms (30-100 pounds) and who's height is 73-102 centimeters (29-40 inches).

The CSS was equipped with a three-position recline feature and a 5-point internal harness with harness retainer clip. The seat's recline feature was adjusted to the middle position. The harness buckled into a non-recessed buckle located between the child's legs. There was one set of slots to thread the harness straps through and a four position height adjustment mechanism located on the back of the CSS. The harness strap adjustment was set to the third position from the bottom. The CSS was also equipped with height adjustable belt guides on each side of the seat back and belt paths on each side of the seat cushion to accommodate a vehicle's seat belt. The CSS was also equipped with a LATCH system.

The CSS was constructed of a one piece plastic shell and a plastic base with molded-in storage compartments and slide-out cup holder. The seat back and seat cushion were fitted with a cloth covered foam pad.

The CSS was secured in the second row right seat position by the CSS LATCH anchor straps, which were secured to the lower anchors. The tether strap was not used. Due to the intrusion of the Toyota's seat back, the CSS was held tightly in place by the LATCH anchor straps and had to be cut in order to remove the CSS for inspection. The CSS was deformed as a result of the seat back intrusion, which bent the back of the CSS forward as well as to the left 10 degrees. The right arm rest was also displaced outward, and the lower left side of the seat back sustained a crack in the shell 13 centimeters (5.1 inches) in length (**Figure 7**). The left harness strap was broken (**Figure 8**) due to loading on the harness slot as the seat back was bent forward. The harness retainer clip was also broken and the right harness strap was cut by rescue personnel.



Figure 6: Front view of CSS



Figure 7: Damage to the CSS's lower left side



Figure 8: Arrow shows CSS's broken left harness strap; right harness strap was cut by rescue personnel to remove the child from the seat



Figure 9: Broken CSS retainer clip

CASE VEHICLE DRIVER KINEMATICS

The Toyota's driver [37-year-old, female; unknown height and weight] was seated in an unknown posture. The seat track was found located between the center and rearmost position, the seat back was slightly reclined, and the tilt steering wheel was located in its full up position. It was unknown if the driver was wearing glasses or contact lenses, or if she was restrained by the lap-and-shoulder belt.

The Freightliner's impact with the back of the Toyota displaced the driver rearward opposite the 6 o'clock direction of principal force and she loaded the seat back. There was no evidence that she contacted any interior surfaces of objects during the crash.

CASE VEHICLE DRIVER INJURIES

The driver sustained a C (possible) injury. The specific injuries she sustained in the crash were not known. The treating hospital refused to release her medical records.

CASE VEHICLE SECOND ROW CENTER PASSENGER KINEMATICS

The Toyota's second row center passenger [4-year-old; female (unknown height and weight)] was seated in an unknown posture and was not seated within a CSS. It was unknown if she was restrained by the lap-and-shoulder belt.

The Freightliner's impact with the back of the Toyota displaced the second row center passenger rearward opposite the 6 o'clock direction of principal force, and she loaded the seat back. The passenger was then displaced forward as the seat back intruded.

The second row center passenger was fatally injured. The specifics of her injuries are not known because the treating hospital refused to release her medical records.

CASE VEHICLE SECOND ROW RIGHT PASSENGER KINEMATICS

The Toyota's second row right passenger [19-month-old, female; 89 centimeters and 11 kilograms (45 inches, 39 pounds)] was seated in an unknown position within the CSS. She was restrained by the 5-point internal harness.

The Freightliner's impact with the back of the Toyota displaced the second row right passenger rearward opposite the 6 o'clock direction of principal force and she loaded the back of the CSS. The intrusion of the Toyota's seat back caused the back of the CSS to bend forward and the second row right passenger moved forward with the seat back. The CSS remained secured in the vehicle during the crash and the passenger remained in the CSS. Rescue personnel cut the right harness strap in order to remove the passenger from the CSS.

CASE VEHICLE SECOND ROW RIGHT PASSENGER INJURIES

The second row right passenger sustained C (possible) injuries. The specific injuries that she sustained are unknown because the treating hospital refused to release her medical records.

OTHER VEHICLE

The 2002 Freightliner FLD-120 was a 6 x 4, truck-tractor (VIN: 1FUJAHBD92L-----). There were no photographs available of the Freightliner, so a Truck Deformation Classification (TDC) could not be assigned. This vehicle was not inspected.

Freightliner's Occupants: The Freightliner's driver (47-year-old, male) was restrained by his lap-and-shoulder belt and was not injured.

