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ON-SITE SIDE IMPACT INFLATABLE OCCUPANT PROTECTION INVESTIGATION

CASE NUMBER - IN08013
LOCATION - TEXAS
VEHICLE - 2007 TOYOTA CAMRY LE
CRASH DATE - January 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. *Abstract* This report covers an on-site side impact inflatable occupant protection investigation that involved a 2007 Toyota Camry LE and a 1999 Mitsubishi Diamante. The Toyota was traveling southwest on a four-lane city street and the driver turned left at a four-leg intersection through a left turn channel. The westbound Mitsubishi impacted the left side of the Toyota causing the Toyota's left side curtain air bag and driver's seat back-mounted side impact air bag to deploy. The Toyota rotated counterclockwise, the right rear wheel impacted a curb, and the right side impacted a traffic signal pole, which caused the right side curtain air bag to deploy. The Toyota came to final rest heading southeast and the Mitsubishi came to final rest heading southwest. The Toyota's driver was restrained by the lap-and-shoulder belt, contacted the left side curtain air bag with the left side of her face, and sustained no injury.			
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BACKGROUND

IN08013

This crash was brought to the National Highway Traffic Safety Administration's attention on or before March 7, 2008 by the sampling activities of the National Automotive Sampling System. The crash involved a 2007 Toyota Camry LE and a 1999 Mitsubishi Diamante. The crash occurred in January, 2008, at 9:30 hours, in Texas and was investigated by the applicable city police department. This crash is of special interest because the Toyota (**Figure 1**) was equipped with side curtain air bags and front seat back-mounted side impact air bags. This contractor inspected the scene and the Toyota on March 18, 2008. No driver interview was conducted because the driver could not be contacted, and the Mitsubishi was not inspected because it could not be located. 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 2007 Toyota Camry

SUMMARY

This crash occurred during daylight hours under clear and dry weather conditions. The Toyota was traveling southwest on a four-lane city street and the driver turned left at a four-leg intersection from a left turn channel. A westbound Mitsubishi impacted the left side of the Toyota causing the Toyota's left side curtain air bag and driver's seat back-mounted side impact air bag to deploy. The Toyota rotated counterclockwise, the right rear wheel impacted a curb, and the right side impacted a traffic signal pole, which caused the right side curtain air bag to deploy. The Toyota came to final rest heading southeast and the Mitsubishi came to final rest heading southwest. The Toyota's Delta V for the left side impact was 25 km/h (15.5 mph), and the Delta V for the right side impact with the traffic signal pole was 14.0 km/h (8.7 mph). The driver was restrained by the lap-and-shoulder belt, contacted the left side curtain air bag with the left side of her face, and sustained no injury.

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which the Toyota was traveling was a four-lane, city street, traversing in a northeasterly and southwesterly direction, and the Toyota was traveling southwest approaching a four-leg intersection. The trafficway on which the Mitsubishi was traveling was a five-lane, divided, city street, traversing in an east-west direction, and the Mitsubishi was traveling west approaching the same intersection. The Toyota's roadway had two through lanes and a left turn channel at the intersection. A raised concrete traffic island was present prior to the left turn channel. The outside through lane was 2.7 meters (8.9 feet) in width, the inside through lane was 3.3 meters (10.8 feet) in width, and the left turn channel was 4.6 meters (15.1 feet) in width. The roadway pavement markings were broken white lane lines and double yellow center lines, which separated the northeastbound side of the trafficway. The

Mitsubishi's roadway had two through lanes and a right turn lane, and the trafficway was divided by a raised grass median. The roadway pavement markings were broken white lane lines. The intersection was controlled by multiple three-phase traffic signals and the speed limit for both vehicles was 48 km/h (30 mph). At the time of the crash, the light condition was daylight, the atmospheric condition was clear, and the roadway pavement was dry, level bituminous. The traffic density at the time of the crash was unknown and the site of the crash was urban commercial. See the Crash Diagram at the end of this report.

Figure 2: Approach of Toyota (right arrow) to the intersection and left turn lane channel; left arrow is approach of Mitsubishi

Pre-Crash: The Toyota was traveling southwest in the inside through lane approaching the left turn channel at the intersection (**Figure 2**). The Toyota's driver intended to turn left and travel southeast. The Mitsubishi was traveling west in the inside through lane (**Figure 3**), and the driver intended to continue straight through the intersection. It was not known if the Toyota's driver took any actions to avoid the crash. The crash occurred in the intersection (**Figure 4**).

Figure 3: Approach of Mitsubishi to the intersection

Crash: The left side of the Toyota (**Figure 5**) was impacted by the front of the Mitsubishi (event 1) causing the Toyota driver's seat back-mounted side impact air bag and the left side curtain air bag to deploy. The impact caused the Toyota to rotate counterclockwise and its right rear wheel (**Figure 6**) impacted a curb (event 2) as the vehicle departed the roadway into the median. The Toyota's right side (**Figure 6**) then impacted a traffic signal pole (event 3, **Figure 4**). This impact caused the Toyota's right side curtain air bag to deploy. The Toyota's front right seat back-mounted side impact air bag did not deploy because there was no front right occupant in the vehicle. The Toyota came to final rest partially on the median heading southeast with its right side against the traffic signal pole. The police crash schematic did not show the final rest position of the Mitsubishi, and there was no evidence of the final rest position present during the scene inspection. Based on the impact configuration and the

Figure 4: Left arrow shows impact area in intersection(view from Toyota's path of travel); right arrow shows impacted traffic signal pole

damage to the Toyota, the Mitsubishi probably came to final rest within the intersection heading southwest.

Figure 5: Damage to left side of Toyota from impact with front of Mitsubishi

Figure 6: Arrow shows damage to right rear wheel from curb impact; damage to right rear door from impact with the traffic signal pole

Post-Crash: The police and emergency medical personnel responded to the scene. The Toyota's driver sustained no police reported injury and was not transported to a hospital. The Mitsubishi's front right passenger was transported to a hospital by ambulance. The Mitsubishi's driver refused transport and left the scene in a private vehicle. The Toyota and Mitsubishi were towed due to damage.

CASE VEHICLE

The 2007 Toyota Camry LE was a front wheel drive, four-door sedan (VIN: 4T1BE46K47U------) equipped with a 2.4L, 4 cylinder engine, automatic transmission, and four wheel anti-lock brakes. The vehicle was also equipped with driver and front right passenger seat back-mounted side impact air bags, right and left side curtain air bags, dual stage driver and front right passenger frontal air bags, a driver knee air bag, tilt and telescoping steering column, height adjustable seat belts with retractor mounted pretensioners and load limiters, and there was an occupant weight sensor within the front right passenger seat. The supplemental restraint system in the vehicle was certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208.

CASE VEHICLE DAMAGE

Exterior Damage: The Toyota's impact with the Mitsubishi involved the left side of the vehicle. The left front door, left rear door and a small area of the left fender adjacent to the front door were directly contacted. The direct damage began 47 centimeters (18.5 inches) rear of the left front axle and extended 159 centimeters (62.5 inches) rearward across both doors. The crush measurements were taken at the lower door level and the residual maximum crush was measured as 13 centimeters (5.2 inches) occurring at both C_4 and C_5. The table below shows the vehicle's left side crush profile.

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	159	13	197	1	8	8	13	13	3	14	3
in		62.6	5.1	77.6	0.4	3.2	3.2	5.1	5.1	1.2	5.5	1.2

The impact with the curb involved the right rear wheel. The rim was dented and the tire's side wall was punctured. No crush measurements were taken for this impact because tire impacts are out of scope of the measurement protocol.

The impact with the traffic signal pole involved the right side of the vehicle. The right rear door, right rear wheel and a small portion of the right quarter panel were directly contacted. The direct damage began 228 centimeters (89.8 inches) rear of the right front axle and extended 38 centimeters (15 inches) rearward. The crush measurements were taken at the mid-door level and the residual maximum crush was 20 centimeters (7.9 inches) occurring at C_3. The table below shows the vehicle's right side crush profile.

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	3	38	20	131	0	6	20	5	3	0	-100	-89
in		15.0	7.9	51.6	0.0	2.4	7.9	2.0	1.2	0.0	-39.4	-35.0

The induced damage from the left side impact involved the left fender and the upper portions of the left front and left rear doors. The induced damage from the right side impact involved the right quarter panel, right C-pillar, and right rear door. The Toyota's right and left side wheelbases were extended 8 centimeters (3.1 inches).

Damage Classification: The Collision Deformation Classifications for the Toyota were **10-LPEW-1** (**290** degrees) for the impact with the front of the Mitsubishi (event 1), **03-RBWN-1** (**90** degrees) for the curb impact (event 2), and **03-RPEN-2** (**90 degrees**) for the impact with the traffic signal pole (event 3). The WinSMASH reconstruction program, Missing Vehicle Algorithm was used to reconstruct the vehicle's Delta V for the left side impact with the Mitsubishi. The Total Delta V was 25 km/h (15.5 mph), and the Longitudinal and Lateral components were -8.6 km/h (-5.3 mph) and 23.5 km/h (14.6 mph). The WinSMASH reconstruction program, Barrier Algorithm was used to reconstruct the Delta V for the right side impact to the traffic signal pole. The Total Delta V was 14.0 km/h (8.7 mph), and the Longitudinal and Lateral components were 0.0 km/h and -14.0 km.p.h. (-8.7 m.p.h).

The vehicle manufacturer's recommended tire size was P205/65R15. The vehicle was equipped with P215/60R16 size tires. The Toyota'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	32nd of an inch			
LF	138	20	200	29	6	8	None	No	No
LR	165	24	200	29	7	9	None	No	No
RR	Flat	Flat	200	29	6	8	Puncture in sidewall	No	Yes
RF	152	22	200	29	6	8	None	No	No

Vehicle Interior: A smear of makeup was found on the left side curtain air bag (**Figure 7**), which indicated the left side of the driver's face contacted the deployed air bag during the initial impact. The driver's seat belt webbing was slightly stretched (i.e., stiff and wavy), which indicated it was probably loaded by the driver during the crash. The right rear door intruded laterally 5 centimeters (2 inches) as a result of the traffic signal pole impact. There was no intrusion of the left side doors or B-pillar due to the impact with the Mitsubishi. There was also no deformation of the steering wheel or compression of the energy absorbing steering column.

Figure 7: Yellow tape shows makeup smear from driver contact on left side curtain air bag

Figure 8: Back portion of left side curtain air bag

AUTOMATIC RESTRAINT SYSTEM

The Toyota's frontal air bags, driver's knee air bag, and the front right passenger's seat back-mounted side impact air bag did not deploy in this crash. The Toyota's left side curtain air bag and driver's seat back-mounted side impact air bag deployed as a result of the Toyota's impact with the Mitsubishi. The right side curtain air bag most likely deployed as a result of the impact with the traffic signal pole. The driver's retractor mounted pretensioner did not actuate during the crash.

The Toyota's left side curtain air bag (**Figures 7** and **8**) and right side curtain air bag were located along the roof side rails, inside the head liner and extended the A-pillar to the C-pillar.

The side curtain air bags were 170 centimeters (66.9 inches) in length and 37 centimeters (14.6 inches) in height. They were designed with inflation chambers adjacent to the front and back outboard seat positions and the B-pillars, and there no external vent ports. The front of each air bag was anchored to the A-pillar via a fabric cord. The evidence of occupant contact involved the smear of makeup (Figure 6) mentioned above to left side curtain air bag. There was no evidence of occupant contact to the right side curtain air bag. There were no right side occupants within the vehicle at the time of the crash. There was also no indication of damage due to deployment to either side curtain air bag.

Figure 9: Toyota driver's seat back-mounted side impact air bag

The Toyota driver's seat back-mounted side impact air bag was located in the left side of the driver's seat back. The air bag deployed through a tear-seam in the side of the seat back. The deployed air bag (**Figure 9**) was 32 centimeters (12.6 inches) in height and 28 centimeters (11 inches) in width. Both sides of the air bag were stitched together in a trapezoid-shaped area near the top and there were no external vent ports. Inspection of the air bag revealed no evidence of occupant contact or damage during the deployment.

CASE VEHICLE DRIVER KINEMATICS

The Toyota's driver (52-year-old, female; unknown height and weight) was seated in an unknown posture and the position of her feet and hands was not known. The driver's seat track was found adjusted to the middle position and the seat back was slightly reclined. The driver's steering column was found adjusted to its full up position and the telescoping column was adjusted to it full forward position.

The driver was restrained by the lap-and-shoulder seat belt. The slightly stretched condition of the seat belt webbing indicted that it was probably loaded by the driver during the crash.

The vehicle's left side impact with the front of the Mitsubishi locked the driver's safety belt retractor and displaced the driver to the left opposite the 290 degree direction of principal force. The left side of the driver's face contacted the deployed side curtain air bag and the left side of her torso impacted the deployed the seat back-mounted side impact air bag. The vehicle's subsequent right side impact to the curb and traffic signal pole displaced the driver to the right within her seat belt opposite the 90 degree direction of principal force. It was not known how the driver exited the Toyota.

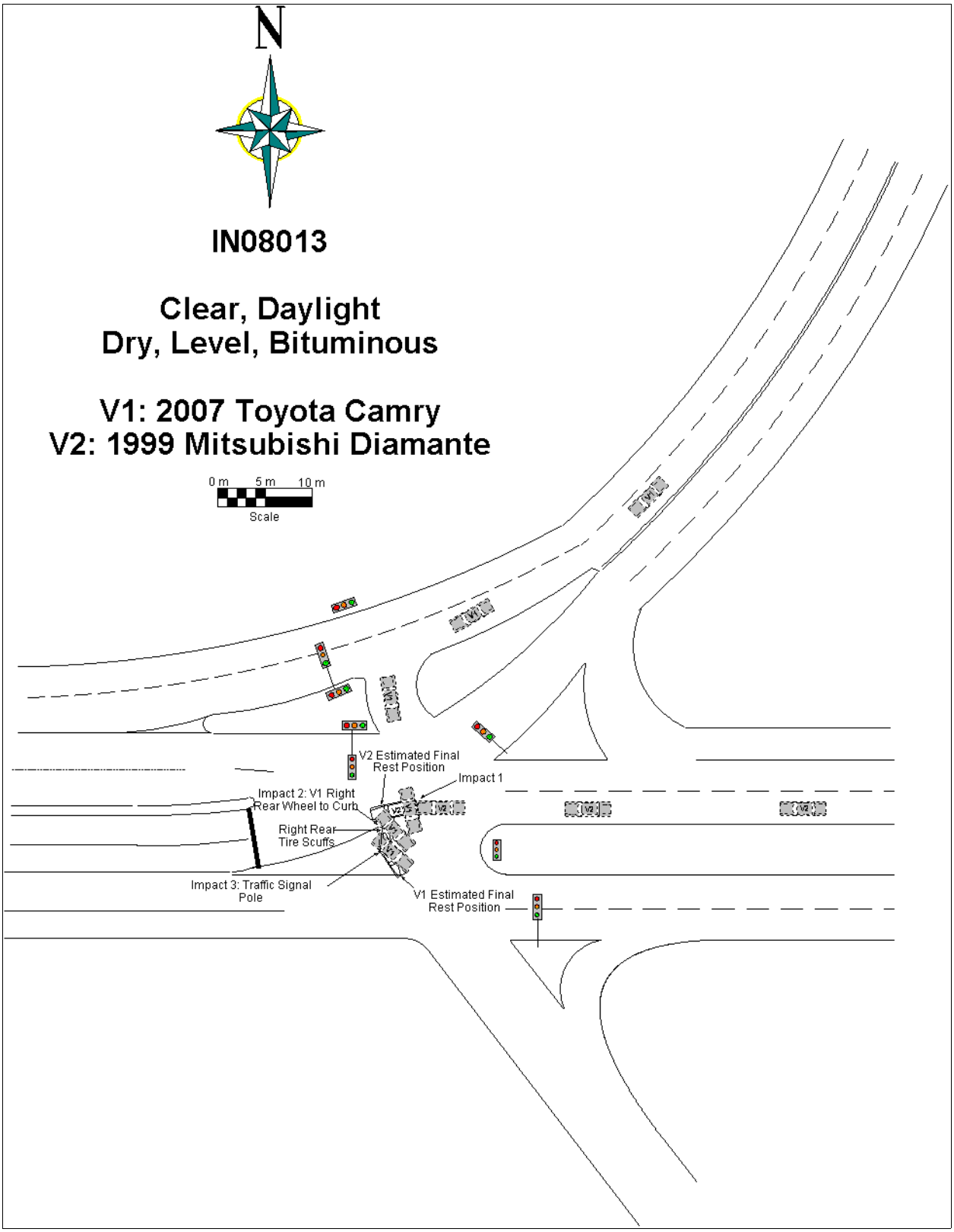
The driver sustained no injury as a result of this crash.

OTHER VEHICLE

The 1999 Mitsubishi Diamante was a front wheel drive, four-door sedan (VIN: 6MMAP47P4XT------) equipped with redesigned driver and front right passenger frontal air bags and lap-and-shoulder seat belts. The police crash report indicated that neither air bag deployed in this crash.

Exterior Damage: The Mitsubishi was not inspected and there were no available photographs of the vehicle. The WinSMASH reconstruction program, Missing Vehicle Algorithm was used to reconstruct the vehicle's Delta V for the front impact with the Toyota. The Total Delta V was 23 km/h (14.3 mph), and the Longitudinal and Lateral components were -22.7 km/h (-14.1 mph) and -4.0 km/h (-2.5 mph).

Other Vehicle's Occupants: According to the police crash report, the Mitsubishi's driver (61-year-old, female) and front right passenger (46-year-old, female) were restrained by the lap-and-shoulder seat belt and reportedly sustained C (possible) injuries.


N
IN08013
Clear, Daylight
Dry, Level, Bituminous
V1: 2007 Toyota Camry
V2: 1999 Mitsubishi Diamante
0 m 5 m 10 m
Scale
V2 Estimated Final Rest Position
Impact 1
Impact 2: V1 Right Rear Wheel to Curb
Right Rear Tire Scuffs
Impact 3: Traffic Signal Pole
V1 Estimated Final Rest Position