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ON-SITE ROLLOVER INVESTIGATION

CASE NUMBER - IN07008
LOCATION - TEXAS
VEHICLE - 2003 FORD EXPLORER SPORT TRAC
CRASH DATE - December 2006

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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.

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15. <i>Supplementary Notes</i> On-site rollover investigation involving a 2003 Ford Explorer Sport Trac equipped with manual safety belts and driver and front right passenger air bag system.					
16. <i>Abstract</i> This report covers an on-site rollover investigation that involved a 2003 Ford Explorer Sport Trac and a 2006 Nissan Maxima, which were involved in an intersection crash. This crash is of special interest because the Ford rolled over, and the driver (25-year-old, male) and front right passenger (21-year-old, female) sustained police reported C (possible) injuries as a result of the crash. The Ford was traveling southeast approaching a four leg, signalized, intersection. The Nissan was traveling east also approaching the intersection. As both vehicles entered the intersection, the front of the Nissan impacted the right side of the Ford. The Ford rotated clockwise, rolled over one-quarter turn onto its left side and came to final rest within the intersection facing southwest. The Nissan rotated clockwise and came to final rest within the intersection facing southeast. Both the driver and front right passenger were unrestrained. They were both transported by ambulance to a hospital.					
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CRASH DIAGRAM 8

This crash was brought to the National Highway Traffic Safety Administration's attention on or before January 19, 2007 through sampling activities of the National Automotive Sampling System. This crash involved a 2003 Ford Explorer Sport Trac and a 2006 Nissan Maxima. The crash occurred in December, 2006, at 7:52 p.m. in Texas and was investigated by the applicable city police department. This crash is of special interest because the Ford rolled over, and the Ford's driver (25-year-old, male) and front right passenger (21-year-old, female) sustained police reported C (possible) injuries as a result of the crash. This contractor inspected the scene and Ford on March 20, 2007. This contractor was unable to conduct an interview with the Ford's driver and his passenger. Neither the driver nor the passenger could be located. The Nissan was already repaired prior to the investigation. This report is based on the police crash report, scene and Ford inspections, occupant kinematic principles, and this contractor's evaluation of the evidence.

SUMMARY

The Ford was traveling southeast in the through/left turn lane of a five-lane, divided trafficway approaching a four leg signalized intersection. The Nissan was traveling east in the inside center left through lane of a five lane, one way trafficway. As both vehicles entered the intersection, the front of the Nissan impacted the right side of the Ford. The Ford rotated clockwise, rolled over one-quarter turn onto its left side and came to final rest within the intersection facing southwest. The Nissan rotated clockwise and came to final rest within the intersection facing southeast. At the time of the crash, the light condition was dark, but illuminated by overhead luminaires, the atmospheric condition was clear, and the roadway pavement was dry.

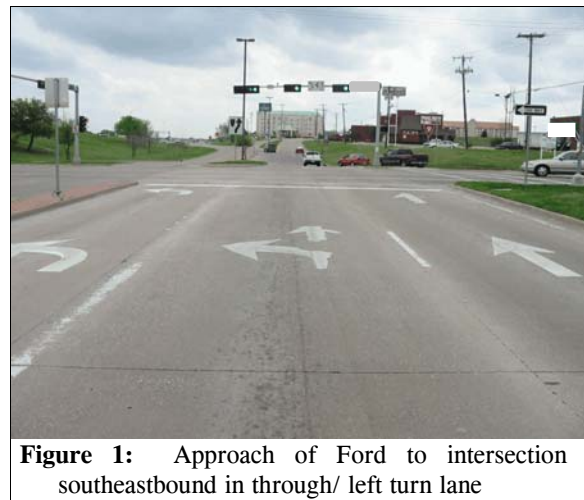
The Collision Deformation Classifications (CDCs) for the Ford were **02-RZEW-01 (60 degrees)** for the impact with the Nissan and **00-LDAO-02** for the rollover. The Ford sustained 4 centimeters (1.6 inches) of maximum crush to its right side occurring at C₃. This was the result of the left front portion of the Nissan contacting the Ford's left rear wheel and not heavily engaging the sheet metal. As a result of the minor crush to the vehicle, the WinSMASH reconstruction results were low and not reasonable. This contractor estimated the crash severity for this impact to be 14-23 km.p.h. (9-14 m.p.h.). The crash severity of the rollover was considered to be minor based on the single quarter turn and minor left side crush. Both vehicles were towed due to damage.

The driver of the Ford was not restrained by his lap-and-shoulder safety belt. He impacted his head on the roof near the left roof side rail during the rollover. He was transported by ambulance to a hospital. His injuries are not known.

The front right passenger was not restrained by her lap-and-shoulder safety belt. She probably impacted the right front door during the first impact. She then probably impacted the center console and the driver during the rollover. The passenger was transported by ambulance to a hospital. Her injuries are not known.

Crash Environment: The trafficway on which the Ford was traveling was a five-lane, divided, city street, traversing in a northwesterly and southeasterly direction. The Ford was approaching a four-leg intersection. The Ford's trafficway had a southeastbound through lane, a combination left turn/through lane, a left turn lane, a raised concrete median, and two northwestbound through lanes. Each lane was approximately 3.7 meters in width (12.1 feet). The median was 1.2 meters (3.9 feet) in width. The trafficway on which the Nissan was traveling was a six-lane, one-way, undivided, city street, traversing in an easterly direction. There were five eastbound through lanes with a channelized right turn lane. Each lane was approximately 3.7 meters (12.1 feet) in width. Roadway pavement markings consisted of broken white lane lines, solid white directional arrows for southeastbound traffic, solid white stop bars and solid white pedestrian crossing lines. The intersection was controlled by three-phase traffic signals. At the time of the crash, the light condition was dark, but illuminated by overhead luminaires. The atmospheric condition was clear, and the roadway pavement was dry, level concrete. The Ford's speed limit was 72 km.p.h. (45 m.p.h.). The Nissan's speed limit was 64 km.p.h. (40 m.p.h.). Traffic density at the time of the crash could not be determined. The crash occurred within a commercial district. See the Crash Diagram at end of this report.

Pre-Crash: The Ford was traveling southeast in the through/left turn lane (**Figure 1**). The Ford's driver was intending to continue through the intersection. The Nissan was traveling east in the center left through lane (**Figure 2**). The Nissan's driver was also intending to continue through the intersection. It is not known if the Ford's driver made any pre-crash avoidance maneuvers. There was no indication of any avoidance maneuvers on the police crash report for either driver. The police crash schematic gave no indication of pre-crash braking. The crash occurred within the four-leg intersection.



Crash: The front of the Nissan impacted the right side of the Ford (**Figure 3**). As a result of the impact, the Ford was redirected further to the southeast and began to rotate clockwise. As it rotated, the Ford rolled over one-quarter turn onto its left side (**Figure 4**). The Ford's air bags did not deploy in this crash.

Post-Crash: The Ford came to final rest within the intersection facing southwest (**Figure 5**). The Nissan was redirected to the southeast and came to final rest within the intersection facing southeast (**Figure 5**).



Figure 2: Approach of Nissan to the intersection eastbound in the inside center through lane



Figure 3: Overview of damage to right side of Ford due to impact with the Nissan



Figure 4: Overview of minor rollover damage to left side of



Figure 5: Overview southeast to area of final rest of Ford (left arrow) and Nissan (right arrow)

CASE VEHICLE

The 2003 Ford Explorer Sport Trac was a rear wheel drive, four-door pickup/utility vehicle (VIN: 1FMZU67E23U-----) equipped with a 4.0 L, V6 engine, four-speed automatic transmission and four-wheel anti-lock brakes. The vehicle was also equipped with second generation driver and front right passenger air bags, bucket seats with adjustable head restraints, and driver and front right passenger lap-and-shoulder safety belt systems with adjustable upper anchors. The back seating row was equipped with a split bench seat with folding backs, adjustable head restraints and lap-and-shoulder safety belt systems. In addition, the back seat was equipped with a LATCH system for securing child safety seats. Side curtain air bags were optional for this model; however, it was not so equipped.

CASE VEHICLE DAMAGE

Exterior Damage: The Ford’s impact with the Nissan involved the right side. The Ford’s right front and rear doors, nerf bar, right rear tire, and the right side of the truck bed were all directly damaged. The direct damage began 95 centimeters (37.4 inches) rear of the right front axle and extended 270 centimeters (106 inches) along the lower right door area and rearward. The residual maximum crush was measured as 4 centimeters (1.6 inches) occurring at C₃. There was minimal crush to the right side due to the Nissan’s engagement of the right rear wheel, which prevented

significant engagement with the side sheet metal. The induced damage was minimal as well with the right rear door displaced outward slightly at the top. No other induced damage or remote buckling was noted. The table below shows the '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	1	270	4	270	0	1	4	2	0	0	-66	-66
in		106.3	1.6	106.3	0.0	0.4	1.6	0.8	0.0	0.0	-26.0	-26.0

The rollover damage to the Ford involved the entire length of the left side. The left fender, both doors, left roof side rail, the left side view mirror, and left side of the truck bed were all directly damaged and crushed minimally. The left front window disintegrated as a result of ground impact to the door. No other induced damage or remote buckling was noted on the remainder of the left side. The vehicle's wheelbase was unaltered due to the crash.

The vehicle manufacturer's recommended tire size was P255/70R16. The vehicle's tires were of the recommended size. The vehicle's tire data are shown in the table below.

Tire	Measured Pressure		Recommend Pressure		Tread Depth		Damage	Restricted	Deflated
	kpa	psi	kpa	psi	milli-meters	32 nd of an inch			
LF	221	32	221	32	7	9	None	No	No
RF	234	34	221	32	8	10	None	No	No
LR	234	34	241	35	7	9	None	No	No
RR	221	32	241	35	3	4	None	No	No

Vehicle Interior: An inspection of the Ford's interior (**Figures 6 and 7**) revealed dirt and grease smears though out the interior. The only occupant contact found was on the roof above the driver's seat and there was no passenger compartment intrusion. In addition, there was no deformation of the steering wheel or compression of the energy absorbing steering column.

Damage Classification: The CDCs for the Ford were **02-RZEW-01 (60 degrees)** for the impact with the Nissan and **00-LDAO-02** for the rollover. The WinSMASH reconstruction program, missing vehicle algorithm was initially used to reconstruct the Delta Vs for the right side impact with the Nissan (i.e., the highest severity impact). The Total, Longitudinal, and Lateral Delta Vs are, respectively: 5 km.p.h. (3.1 m.p.h.), -2.5 km.p.h. (-1.5 m.p.h.), and -4.3 km.p.h. (-2.3 m.p.h.). The results were considered too low and not reasonable given the vehicle's post-impact trajectory and rollover. The low WinSMASH results were due to the minor sheet metal crush

sustained by the vehicle. The crush was minor because the front of the Nissan primarily engaged the vehicle's right rear wheel. The estimated crash severity for this impact was 14-23 km.p.h. (9-14 m.p.h.). In addition, the crash severity of the rollover was considered to be minor based on minor left side crush and the fact it rolled over only one quarter turn. The Ford was towed due to damage.

AUTOMATIC RESTRAINT SYSTEM

The Ford's driver air bag was located in the steering wheel hub. The front right passenger's air bag was located in the middle of the instrument panel. Neither of these air bags deployed as a result of the crash. The vehicle's crash sensing algorithm probably determined that the vehicle's longitudinal deceleration during the first impact was below the threshold required to deploy the air bags.

CASE VEHICLE DRIVER KINEMATICS

Prior to the crash, the Ford's driver [25-year-old, male, unknown height and 82 kilograms (180 pounds)] was seated in an unknown posture. His seat track was located in its middle position, the seat back was moderately reclined, and the tilt steering wheel was located in the center position.

Based on the vehicle inspection, the driver was not using his lap-and-shoulder safety belt. Inspection of the driver's safety belt webbing, D-ring, and latch plate revealed no evidence of loading.

The vehicle's right side impact with the Nissan caused the driver to continue forward and to the right opposite the vehicle's 60 degree direction of principal force. Based on occupant kinematic principles, as the vehicle rotated clockwise, the driver was displaced to the left and loaded his door as the vehicle rolled over onto its left side. When the vehicle impacted the ground, the driver impacted the left front door and was displaced toward the roof. He impacted his head on the roof, just above the left roof side rail (Figure 8). The driver came to rest against the left front door. It is not known how he exited the vehicle.



Figure 6: Overview of driver's seating position, yellow tape shows hair transfer on roof



Figure 7: Overview of 's front right seat position

The driver of the Ford was transported by ambulance to a hospital. He sustained police reported C (possible) injuries. His treatment status and specific injuries are unknown. The treating hospital had no record of the driver being treated at their facility.

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

Prior to the crash, the Ford's front right passenger [21-year-old, female, 157 centimeters and 56 kilograms (62 inches, 124 pounds)] was seated in an unknown posture. Her seat track was located in its middle position and the seat back was slightly reclined.



Figure 8: Yellow tape shows area of hair transfer on roof above left front roof side rail

Based on the vehicle inspection, the vehicle's front right passenger was not using her lap-and-shoulder safety belt. No evidence of loading was found on the belt webbing or D-ring, and there was little evidence of historical usage. In addition, the police crash report indicated the front right passenger was not restrained.

The vehicle's right side impact with the Nissan caused the front right passenger to continue forward and to the right opposite the vehicle's 60 degree direction of principal force. Based on occupant kinematic principles, the right side of the passenger's body probably impacted the right front door and she rebounded to the left. As the vehicle rotated clockwise, the passenger moved to the left. When the vehicle rolled over and impacted the ground, the passenger's left hip probably impacted the center console and she landed on the driver. It is not known how the passenger exited the vehicle.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The front right passenger was transported by ambulance to a hospital. She sustained police reported C (possible) injuries. The front right passenger's treatment status and injuries are unknown. The reported treating hospital had no record of the passenger being treated at their facility.

OTHER VEHICLE

The 2006 Nissan Maxima was a front wheel drive, four-door sedan (VIN: 1N4BA41E56C-----) equipped with a 3.5L, V6 engine. The Nissan was also equipped with driver and front right passenger dual stage air bags, side curtain air bags, front seat back-mounted side impact air bags, active head restraints, lap-and shoulder safety belts with pretensioners and load limiters, a front right passenger presence sensor, an energy absorbing steering column and a LATCH system for securing child safety seats. In addition, the

manufacturer of this vehicle has certified that it meets the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. According to the police crash report, the driver's air bag deployed as a result of the crash.

Exterior Damage: The Nissan was already repaired and therefore not inspected. The Nissan was towed due to damage.

Nissan's Driver: The police crash report indicated that the Nissan's driver [44-year-old, female] was restrained by her lap-and-shoulder safety belt. The police crash report also indicated that the driver sustained a police reported C (possible) injury and was transported by ambulance to a hospital.

