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ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE INVESTIGATION

CASE NUMBER - IN09001

LOCATION - MICHIGAN

VEHICLE - 2008 MERCURY MILAN PREMIER

CRASH DATE - October 2008

Submitted:

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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 Certified Advanced 208-Compliant Vehicle Investigation involving a 2008 Mercury Milan Premier.					
16. <i>Abstract</i> This report covers an on-site Certified Advanced 208-Compliant Vehicle Investigation that involved a 2008 Mercury Milan Premier, which departed the roadway and impacted a tree. The focus of this on-site investigation was the Mercury's frontal air bag system, which was certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The Mercury's unrestrained male driver was traveling southeast on a 4-lane, divided city street. The vehicle departed the roadway into the median and rotated slightly counterclockwise prior to a frontal impact with a tree. The direction of principal force was within the 1 o'clock sector and the impact force was sufficient to deploy of the driver's frontal air bag. The driver was displaced forward and to the right and loaded his head and face on the center instrument panel and an after-market Global Positioning System, which was mounted on the center instrument panel. He also loaded his abdomen and chest on the console mounted gear shift lever. He sustained a brain injury, abdominal injuries, and multiple fractures. The driver was transported from the crash scene to a hospital where he was pronounced deceased.					
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This crash was brought to the National Highway Traffic Safety Administration's attention on December 19, 2008 by the sampling activities of the National Automotive Sampling System-General Estimates System. This on-site investigation was assigned on January 14, 2009. The crash involved a 2008 Mercury Milan Premier (**Figure 1**), which departed the roadway and impacted a curb and a tree. The crash occurred in October, 2008 at 2307 hours, in Michigan and was investigated by the local police agency. The focus of this on-site investigation was the Mercury's frontal air bag system, which was certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208. This contractor inspected the Mercury on January 21, 2009. The crash scene inspection and an interview with the driver's wife (non-passenger) were completed January 22, 2009. This report is based on the police crash report, scene and vehicle inspections, an exemplar vehicle inspection, an interview with the driver's wife, occupant kinematic principles, and this contractor's evaluation of the evidence.



Figure 1: Front damage to the 2008 Mercury Milan Premier from impact with a tree

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which the Ford was traveling was a 4-lane, divided, city street traversing in a northwest-southeast direction. The trafficway was straight with two through lanes in each direction and was separated by a grass median 8.7 m (28.5 ft) in width. A line of trees and luminaires were located in the center of the median, which was bordered by 15 cm (6 in) high curbs. Each travel lane was nominally 3.7 m (12.1 ft) in width and parking was allowed on the west side of the roadway. The roadway was level in the area of roadway departure, but had a negative 4% grade 60 m (197 ft) prior to the point of impact within the median. The roadway also straightened out from a right curve 69 m (226 ft) prior to the point of impact. The posted speed limit was 40 km/h (25 mph). At the time of the crash the light condition was dark, with overhead, artificial lighting. The atmospheric condition was clear and the roadway was dry bituminous. The traffic density was light and the site of the crash was suburban residential. See the Crash Diagram on page 8 of this report.

Pre-Crash: According to the police crash report, the Ford's unrestrained 54-year-old male driver



Figure 2: Approach of the Mercury to impact; arrow shows the impacted tree

was traveling southeast (**Figure 2**) in the right lane, and the driver veered sharply to the left and into the median. The driver's autopsy record indicated that his Blood Alcohol Content was 0.28. Drug tests were also performed and were negative.

Crash: As the Ford departed the left side of the roadway, the right front wheel impacted the median curb damaging the rim (event 1, **Figure 3**). The vehicle traveled an unknown distance through the median (the location of the roadway departure point could no be determined due to snow cover) and the right corner of the vehicle's front plane impacted a 46 cm (18.1 in) diameter tree (event 2, **Figures 1 and 4**). The curb strike and any tire mark evidence that may have been present within the median was covered by snow, so the vehicle's motion as it approached the tree could not be determined from scene evidence. However, the angle of the front crush pocket, the occupant contact evidence within the vehicle, and the police schematic's depiction of the vehicle at final rest all indicated that the vehicle was in an approximate 30 degree counterclockwise yaw at the moment of impact with the tree. The resulting direction of principal force acting on the vehicle was within the 1 o'clock sector and the impact force was sufficient to trigger a deployment of the driver's frontal air bag. Based on the police crash schematic, the vehicle rotated counterclockwise approximately 35 degrees and came to final rest heading east with the front plane against the tree.

Post-Crash: Police, rescue, and medical personnel responded to the crash scene. Rescue personnel pried the left front door open and removed the driver from the vehicle. The driver was transported from the crash scene by ambulance to a local hospital where he was pronounced deceased 66 minutes following the crash. The Mercury was towed due to damage.

CASE VEHICLE

The 2008 Mercury Milan Premier was a front wheel drive, 4-door, sedan (VIN: 3MEHM08Z38R-----), equipped with a 2.3L, 4-cylinder engine and 4-wheel anti-lock brakes. The front row was equipped with bucket seats, adjustable head restraints, lap-and-shoulder belts, dual stage driver and front right passenger frontal air bags, and front seat back-mounted side impact air bags. The second row was equipped with a bench seat with folding backs, lap-and-shoulder belts, integral head restraints, and Lower Anchors and Tethers for Children (LATCH) in the outboard seating positions.



Figure 3: Arrow shows dent and abrasion on right front rim due to curb impact



Figure 4: The impacted tree

Exterior Damage: The damage from the curb impact involved the vehicle’s right front wheel. The rim was dented and abraded (**Figure 3**) but the tire was undamaged. The damage from the tree impact involved the front plane (**Figures 1 and 5**). The right headlamp/ turn signal assembly, bumper and hood were directly damaged. The direct damage began at the front right bumper corner and extended 42 cm (16.5 in) to the left along the front bumper. The maximum residual crush was 55 cm (21.7 in) and occurred at C₅ (**Figure 6**). The table below shows the vehicle’s front crush profile.



Figure 5: The Mercury’s front crush viewed from left front corner

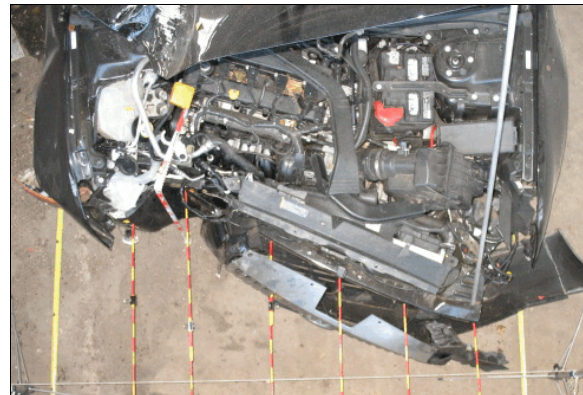


Figure 6: The Mercury’s front crush profile

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	2	42	55	124	0	9	26	38	55	29	0	41
in		16.5	21.7	48.8	0.0	3.5	10.2	15.0	21.7	11.4	0.0	16.1

The vehicle’s right side wheelbase was reduced 8 cm (3.1 in) while the left side wheelbase was extended 2 cm (0.8 in). The induced damage involved the hood, both fenders, left front door, and the right front door.

Damage Classification: The Mercury’s Collision Deformation Classifications were **12-FRWN-3** for the right front wheel impact to the curb (event 1) and **01-FREW-3 (30 degrees)** for the front right impact to the tree (event 2). The Barrier algorithm of the WinSMASH program calculated the vehicle’s total Delta V for the tree impact as 37 km/h (23.0 mph). The longitudinal and lateral velocity changes were -32 km/h (-19.9 mph) and -19 km/h (-11.8 mph), respectively.

The vehicle manufacturer’s recommended tire size was P225/50R17 and the Mercury was equipped with tires of the recommended size. 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	221	32	228	33	7	9	None	No	No
LR	221	32	228	33	7	9	None	No	No
RR	179	26	228	33	7	9	None	No	No
RF	Flat	Flat	228	33	6	8	None	Yes	Yes

Vehicle Interior: The inspection of the Mercury’s interior (**Figure 7**) revealed a scuff mark and fiber transfer on the lower left instrument panel immediately left of the steering column due to contact by the driver’s left knee. The center console was cracked and displaced (**Figure 8**) to the right due to contact by the driver’s lower right leg and thigh. The vehicle was equipped with an after market Global Positioning System (GPS), which was mounted on a metal bracket on the center instrument panel located on the right side of the compact disc player. The GPS unit was broken off the bracket (**Figure 9**) and the bracket was bent against the instrument panel (**Figure 10**). The instrument panel was also scuffed in the same area due to contact by the driver’s head. There was a large accumulation of blood on the front right seat cushion, which indicated the driver’s head and upper torso came to rest on the front right seat. The driver sustained a large laceration on the right frontal scalp during the crash from loading the GPS unit. This injury was the source of the blood deposit on the front right seat cushion.



Figure 7: Steering wheel and instrument panel



Figure 8: Center console was cracked and displaced to the right

The vehicle’s left front and right front doors were jammed closed due to damage, while the left rear and right rear were closed and operational. All of the vehicle’s window glazing was either fixed or closed. The windshield glazing was in place and cracked due to impact forces. The right

front glazing was disintegrated due to impact forces. The left front and left rear glazing were broken out during the extrication of the driver from the vehicle. The vehicle sustained no passenger compartment intrusions and there was no deformation to the steering wheel.

AUTOMATIC RESTRAINT SYSTEM

The Mercury was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system that consisted of dual stage driver and front right passenger air bags, driver seat position sensors, seat belt usage sensors, retractor mounted pretensioners and a front right passenger weight sensor. The frontal air bag sensor was located on the center radiator support. 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 driver's frontal air bag was located within the steering wheel hub and the module cover was a two flap configuration constructed of pliable vinyl. The top flap was 19 cm (7.5 in) in width at the top, 18 cm (7.1 in) at the bottom, and 9 cm (3.5 in) in height. The bottom flap was 18 cm (7.1 in) in width at the top, 8 cm (3.1 in) in width at the bottom, and 12 cm (4.7 in) in height. The cover flaps opened at the designated tear points and there was no damage to the deployed air bag. The air bag (**Figure 11**) was round with a diameter of 58 cm (22.8 in) and was designed with two tethers and two vent ports. The vent ports were located on the back of the air bag at the 3 and 9 clock positions. There was no discernable occupant contact evidence on the air bag. Two blood smears were present on the air bag, but they appeared to be related to blood splatter, which probably occurred during removal of the driver from the vehicle.

The front right passenger air bag was located in the top of the instrument panel. The deployment of this air bag was suppressed because there was no front right passenger seated in the vehicle.



Figure 9: The broken GPS unit



Figure 10: The bent GPS bracket



Figure 11: The driver's frontal air bag

The vehicle's seat back-mounted side impact air bags were located in the outboard side of the driver and front right seat backs. The side impact sensors were located within the lower left and right B and C-pillars. These air bags did not deploy because the vehicle did not sustain lateral deceleration of sufficient magnitude.

MANUAL RESTRAINT SYSTEM

The Mercury was equipped with lap-and-shoulder belts for the driver and front right seating positions. The driver's seat belt consisted of continuous loop belt webbing, an Emergency Locking Retractor (ELR), sliding latch plate, and an adjustable upper anchor that was in the full down position. The front right seat belt was equipped with a switchable ELR/Automatic Locking Retractor (ALR), sliding latch plate, and an adjustable upper anchor that was located in the full up position. The driver and front right passenger seat belts also were equipped with retractor-mounted pretensioners and load limiters.

The second row was equipped with lap-and-shoulder belts in all three seating positions. Each seat belt consisted of continuous loop belt webbing, switchable ELR/ALR retractors, sliding latch plates and fixed upper anchors.

The inspection of the driver's seat belt assembly revealed no evidence of occupant loading. There was also no evidence that the pretensioner actuated during the crash. The absence of occupant loading evidence on the seat belt indicated that the driver was not restrained in this crash. The police crash report also indicated that the driver was not restrained. The remaining seat positions were unoccupied.

CASE VEHICLE DRIVER KINEMATICS

The Mercury's driver [54-year-old, male; 178 cm and 123 kg (70 in, 272 lbs)] was seated in an unknown posture. The seat track was adjusted to between the middle and full rear position [i.e., 21 cm (8.2 in) rear of the full forward position], and the seat back was reclined to a 20 degree angle. The head restraint was adjusted to the full down position. The distance from the top of the seat to the top of the head restraint was 18 cm (7.1 in). The tilt steering column was located in the full up position.

Occupant kinematic principles indicate that the vehicle's impact to the curb probably displaced the driver forward to some degree, as well as up and down as the vehicle passed over the curb. His upper torso probably leaned to the right to some degree as the vehicle rotated counterclockwise as it approached impact with the tree. The tree impact to the front right corner of the vehicle displaced the unrestrained driver forward and to the right opposite the 1 o'clock direction of principal force. The driver's left knee loaded the lower left instrument panel. There was no discernable occupant contact evidence on the air bag, but the driver's chest probably contacted the right portion of the air bag. He continued to the right and forward, and his right thigh loaded the center console and his head and face loaded the GPS unit and center instrument panel (**Figures 7 and 8**). The contact to the GPS unit caused a large avulsion on the front right scalp and the contact to the center instrument panel caused a brain injury and fracture of C₁. The

driver's chest also loaded the console mounted gear shift lever, which caused multiple rib fractures and lacerations of the right lobe of the liver and spleen. The driver's upper torso came to final rest across the center console with his head on the front right seat cushion as indicated by a large deposit of blood on the seat cushion.

CASE VEHICLE DRIVER INJURIES

The driver was pronounced deceased in the emergency room of a local hospital 66 minutes following the crash. The table below shows the driver's injuries and injury sources.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Brain swelling, mild, not further specified	serious 140662.3,9	Center instrument panel	Certain	Autopsy
2	Lacerations x 2, 1.2 and 5.5 cm (0.5 & 2.2 in) right lobe of liver, superior to inferior	moderate 541820.2,1	Console-mounted transmission selector lever	Probable	Autopsy
3	Laceration, 4 cm (1.6 in), spleen, inferior aspect, not further specified	moderate 544220.2,2	Console-mounted transmission selector lever	Probable	Autopsy
4	Fracture C ₁ at junction with skull base ¹ , not further specified with hemorrhage in the right paraspinal muscle	moderate 650216.2,6	Center instrument panel {indirect injury}	Certain	Autopsy
5	Fractured ribs: right, 4 th through 12 th anteriorly; left, 3 rd through 5 th posteriorly, and 11 th posteriorly	severe 450240.4,3	Console-mounted transmission selector lever	Probable	Autopsy
6	Avulsion, 14.8 cm (5.8 in) right frontal scalp exposing underlying skull bone	minor 190802.1,1	Center instrument panel-mounted add-on global positioning unit	Certain	Autopsy
7 8	Contusions, periorbital, right greater than left	minor 297402.1,1 297402.1,2	Center instrument panel-mounted add-on global positioning unit	Certain	Autopsy
9	Abrasion, dicing, right cheek, not further specified	minor 290202.1,1	Noncontact injury: flying glass, right front glazing	Probable	Autopsy
10	Contusion, 9 x 7.5 cm (3.5 x 3.0 in) left cheek	minor 290402.1,2	Center instrument panel	Probable	Autopsy

¹ The spinal canal was not examined during this autopsy.

