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ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE INVESTIGATION

CASE NUMBER - IN09002

LOCATION - MICHIGAN

VEHICLE - 2007 FORD FOCUS XZ4

CRASH DATE - November 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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16. <i>Abstract</i> This report covers an on-site Certified Advanced 208-Compliant Vehicle Investigation that involved a 2007 Ford Focus XZ4 SE, which departed the roadway and impacted a tree. The focus of this on-site investigation was the Ford'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 Ford's driver was traveling east on a 2-lane county roadway negotiating a left curve. The driver reached down to the right to retrieve a compact disc and the vehicle departed the right side of the roadway. The front of the Ford impacted a tree, which triggered a deployment of the driver's frontal air bag. The driver was unrestrained and his chest loaded and rode down the deployed air bag. His knees loaded the instrument panel and his head impacted the windshield. He was transported by ambulance from the crash scene to a hospital where he was admitted for treatment of his injuries and hospitalized for eight days.					
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The focus of this on-site investigation was the 2007 Ford Focus' frontal air bags, which were certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208. This crash was brought to the National Highway Traffic Safety Administration's attention on January 23, 2009 by the sampling activities of the National Automotive Sampling System-General Estimates System. This on-site investigation was assigned on January 30, 2009. The crash involved a 2007 Ford Focus XZ4 SE (**Figure 1**), which departed the roadway and impacted a tree. The crash occurred in November, 2008, at 2110 hours, in Michigan, and was investigated by the local county sheriff's department. This contractor inspected the Ford and the crash scene on February 3 and 4, 2009. The driver interview was completed on February 9, 2009. This report is based on the police crash report, scene and vehicle inspections, exemplar vehicle inspection, driver interview, occupant kinematic principles, and this contractor's evaluation of the evidence.

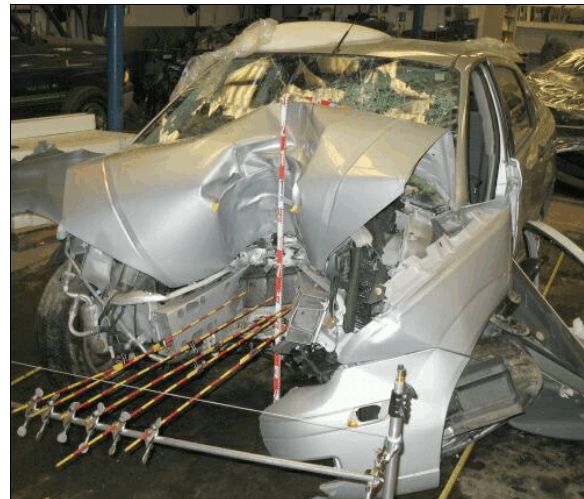


Figure 1: The damaged 2007 Ford Focus XZ4 SE

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which the Ford was traveling was a curved, 2-lane, undivided, county roadway, traversing in an east-west direction. The trafficway had one through lane in each direction and was bordered by narrow bituminous shoulders 0.7 m (2.3 ft) in width, and grass shoulders 1 m (3.3 ft) wide. A line of trees was located approximately 3 m (9.8 ft) off the south side of the roadway. Each travel lane was 3.3 m (10.8 ft) in width. The roadway pavement markings consisted of solid white edge lines and solid, double yellow, no-passing center lines. The roadway was level in the area of roadway departure but had a negative 1.2% grade 60 m (197 ft) prior to the point of impact. The posted speed limit was 80 km/h (50 mph). At the time of the crash, the light condition was dark, the atmospheric condition was snowing, and the roadway was slush covered bituminous. There was no other traffic at the time of the crash and the crash site was rural residential. See the Crash Diagram on page 9 of this report.

Pre-Crash: The Ford's unrestrained 28-year-old male driver was traveling east negotiating a left curve (**Figure 2**). He was leaning forward to the



Figure 2: Ford's approach to roadway departure and area of impact (arrow)

right and reaching down for a compact disc. The vehicle ran off the right (south) side of the roadway where the crash occurred. The driver's medical records indicated that his blood alcohol content was 0.22. The driver also tested positive for benzodiazepine, cannabinoids, and opiates.

Crash: After the Ford departed the right side of the roadway, it traveled an unknown distance on the roadside. The distance the Ford traveled off road to impact could not be determined due to heavy snow that covered any physical evidence that may have been present. The front of the Ford (Figure 3) impacted a 30 cm (11.8 in) diameter tree (Figure 4). The photographs provided by the local sheriff and the frontal damage pattern indicate that the Ford traveled straight into the tree and was not yawing. Based on the police photos, the vehicle came to final rest with the front plane against the tree, heading east (Figure 5). The tree was not displaced due to the impact.

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 medical center. The Ford was towed from the crash scene due to damage.

CASE VEHICLE

The 2007 Ford Focus XZ4 SE was a front wheel drive, 4-door, sedan (VIN: 1FAFP34N07W-----) that was manufactured in October, 2006. The vehicle was equipped with a 2.0L, 4-cylinder engine and an automatic transmission. Four wheel anti-lock brakes were optional but this vehicle was not so equipped. 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, seat back-mounted side impact air bags, and side curtain air bags that protected the front and second row outboard seating positions. The second row was equipped with a bench seat with folding backs, lap-and-shoulder belts, and Lower Anchors and Tethers for Children (LATCH) in the outboard seating positions. The vehicle was



Figure 3: Ford's frontal damage



Figure 4: Approach to impact with tree (arrow)



Figure 5: Police on-scene photo showing Ford's final rest position

equipped with an electronic odometer and the mileage at the time of inspection could not be determined due to the lack of power to the vehicle. The specified wheelbase was 261 cm (102.9 in).

CASE VEHICLE DAMAGE

Exterior Damage: The damage from the tree impact involved the Ford's front plane (**Figure 3**). The bumper, bumper fascia, hood, and grille were directly damaged. The direct damage began 25 cm (10 in) right of the front right bumper corner and extended 27 cm (10.6 in) to the left along the front bumper. The maximum residual crush was 95 cm (37.4 in) and occurred at C₃ (**Figure 5**). The table below shows the vehicle'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	1	27	95	38	42	64	95	94	92	36	-15	0
in		10.6	37.4	15.0	16.5	25.2	37.4	37.0	36.2	14.2	-5.9	0.0

Direct damage was also present on the right quarter panel and back of the right rear door. However, the direction of the sheet metal displacement was from the back to the front. There were also black transfers and scratches that angled upward approximately 10 degrees. The nature of this damage was not consistent with the off-road dynamics of the vehicle. A small portion of the damage is visible on the right rear door, near the door handle, in one of the police on-scene photographs (**Figure 5**), which was taken prior to the removal of the vehicle from the tree. While the evidence indicates that the damage occurred prior to the tree impact, it could not be determined if it was related to this crash.

The vehicle's impact with the tree reduced the left side wheelbase 19 cm (7.5 in) while the right side wheelbase was reduced 4 cm (1.6 in). The indirect damage involved the hood, front bumper, both fenders, both headlamp and turn signal assemblies, the windshield, the left roof side rail, and left front door.

Damage Classification: The Ford's Collision Deformation Classification was **12-FZEN-5** (0 degrees) for the front impact to the tree. The Barrier algorithm of the WinSMASH program calculated the vehicle's total Delta V as 84.0 km/h (52 mph). The longitudinal and lateral velocity changes were -84 km/h (-52 mph) and 0 km/h, respectively.

The vehicle manufacturer's recommended tire size was P195/60R15 and the Ford 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	Flat	Flat	221	32	4	5	None, but grass in bead	No	Yes
LR	Flat	Flat	221	32	8	10	Cut sidewall and grass in bead	No	Yes
RR	172	25	221	32	6	8	None	No	No
RF	207	30	221	32	7	9	None	No	No

Vehicle Interior: The Ford's windshield was holed due to loading by the driver's head (**Figure 6**). Hair and tissue deposits were found on the glass and edges of the hole. Hair and tissue deposits were also present on the right sunvisor hinge and windshield header due to contact by the driver's head. The lower left instrument panel and left portion of the lower center instrument panel were deformed due to contact by the driver's left and right knees, respectively (**Figure 7**). The steering assembly was deformed as a result of loading by the driver's chest. The steering wheel rim was completely collapsed (**Figure 8**) with the upper half sustaining the primary deformation of 14 cm (5.5 in). The energy absorbing steering column was compressed approximately 10 cm (4 in) and displaced to the left 5 cm (2 in). There was also a significant blood deposit on the front portion of the right front door and upper right instrument panel, which indicated the probable final rest position of the driver within the vehicle.



Figure 6: Windshield holed by the driver's head

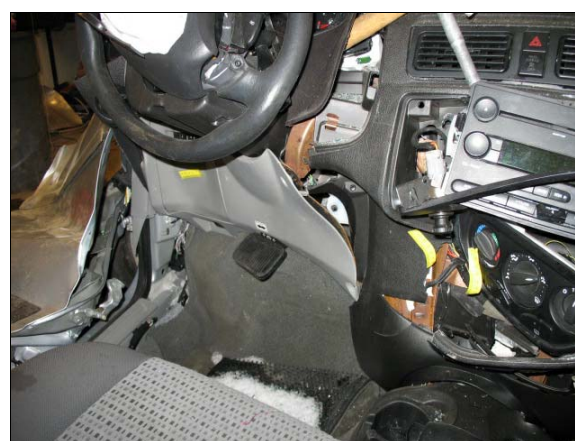


Figure 7: Knee bolster and instrument panel damage due to driver contact

The vehicle's right front and left front doors were jammed shut while the right rear and left rear doors remained closed and operational. All of the window glazing was either closed or fixed. The windshield was cracked and in place due to impact forces, as well as holed due to occupant contact. The left front and left rear window glazing was disintegrated due to impact forces.

The vehicle sustained four passenger compartment intrusions. The intrusions into the driver's occupant space involved the toe pan, center instrument panel, and left instrument panel, which intruded longitudinally 27 cm (10.6 in), 20 cm (7.8 in), and 11 cm (4.3 in), respectively.

AUTOMATIC RESTRAINT SYSTEM

The Ford 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 and front right passenger buckle-mounted pretensioners, seat belt usage sensors, driver seat position sensor, and a front right passenger weight sensor. The frontal air bag sensors were located on the left and right upper 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 15 cm (5.9 in) in width at the top, 18 cm (7.1 in) at the bottom, and 5 cm (2 in) in height. The bottom flap was 18 cm (7.1 in) in width at the top, 6 cm (2.4 in) in width at the bottom, and 8 cm (3.1 in) in height. The cover flaps opened at the designated tear points and there was no damage to the deployed air bag. The deployed air bag (**Figure 9**) was round with a diameter of 58 cm (22.8 in) and was designed with two tethers and six small vent ports. The vent ports were located on the back of the air bag in groups of 3, at the 3 and 9 clock positions (**Figure 10**). There were two blood stains on the left middle portion of the air bag. Lighter blood smears were noted on the lower right portion of the air bag. The blood stains were probably related to the extrication of the driver when he was removed from the vehicle through the left front door.

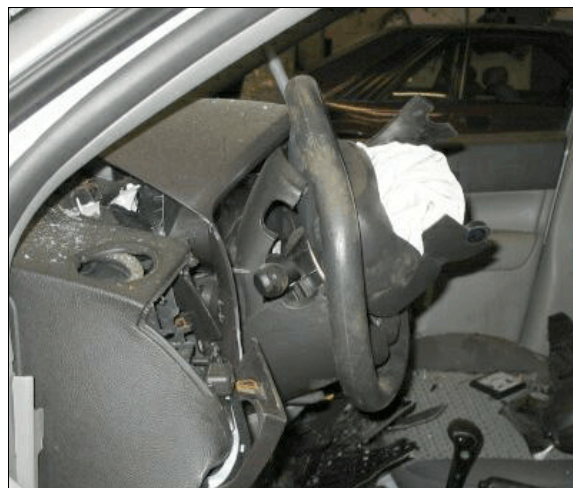


Figure 8: Left side view of deformation of the steering assembly

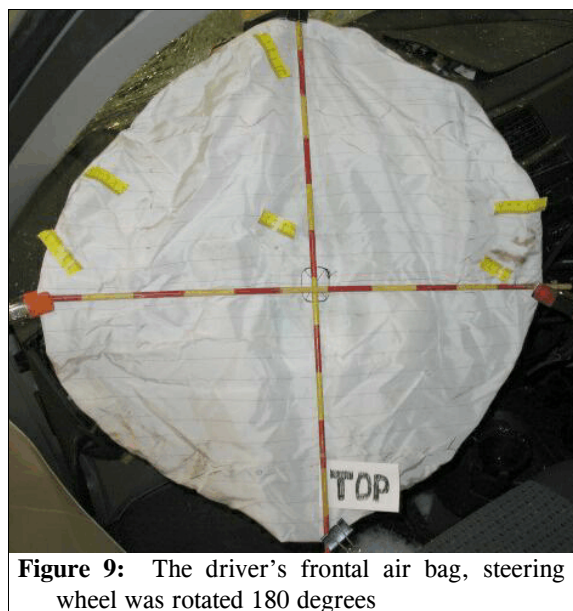


Figure 9: The driver's frontal air bag, steering wheel was rotated 180 degrees

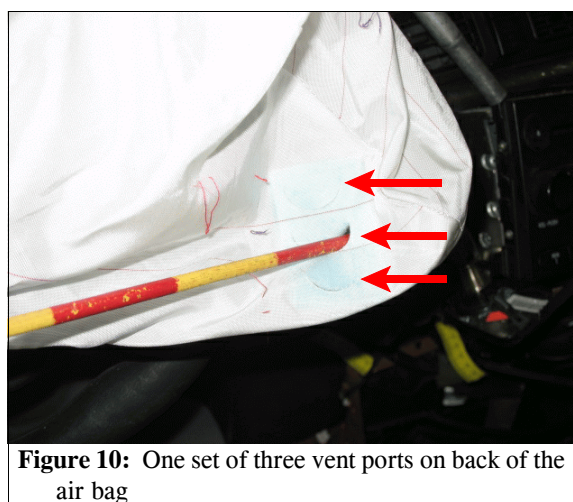


Figure 10: One set of three vent ports on back of the air bag

The front right passenger air bag was located in the top of the right instrument panel. The deployment of this air bag was suppressed because there was no front right passenger seated in the vehicle at the time of the crash as determined by the seat weight sensor.

The vehicle's seat back-mounted side impact air bags were located within the outboard side of the driver and front right seat backs. The side curtain air bags were located within the roof rails over both front and rear doors. The side impact sensors were located within the front doors and lower B-pillars. These air bags did not deploy because the vehicle did not sustain a lateral deceleration of sufficient magnitude during the crash to deploy them.

MANUAL RESTRAINT SYSTEM

The Ford was equipped with lap-and-shoulder belts in all 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 middle 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 buckle-mounted pretensioners. The second row seat belts consisted of continuous loop belt webbing, switchable ELR/ALRs, sliding latch plates, and fixed upper anchors.

The inspection of the driver's seat belt assembly revealed some historical usage marks on the latch plate, but there was no evidence of occupant loading. There was also no evidence that the pretensioner actuated during the crash. The evidence indicated that the driver was not restrained in this crash. The police crash report also indicated that the driver was not restrained and the driver confirmed this during the interview. The remaining seat positions were unoccupied.

CASE VEHICLE DRIVER KINEMATICS

The Ford's driver [28-year-old, male; 180 cm and 97 kg (71 in, 215 lbs)] was leaning forward and to the right, reaching down for a compact disc. The seat track was adjusted between the middle and full rear positions and the seat back was reclined to a 15 degree angle from vertical. The head restraint was adjusted to an upper position. The top of the head restraint was positioned 23 cm (9 in) above the top of the seat back. The tilt steering column was adjusted between the center and full down positions.

When the Ford impacted the tree, the unrestrained driver was displaced forward opposite the 12 o'clock direction of force. His chest loaded the deployed air bag, which he rode down and loaded the steering wheel. The driver's left knee loaded the left lower instrument panel and the right knee loaded the left portion of the center lower instrument panel. He continued forward and over the steering wheel and his face loaded the windshield and his right forearm loaded the center instrument panel. The interaction with the steering wheel caused a grade III spleen laceration, contused left adrenal gland, and contusion of the inferior mesenteric and iliac arteries. The contact with the left portion of the center lower instrument panel caused a comminuted fracture of the right femur, a laceration of the right posterior cruciate ligament, and a large osteochondral defect in the

medial femoral condyle with associated right knee joint effusion. The contact with the windshield caused a nonanatomic brain injury with loss of consciousness and multiple avulsions, lacerations and abrasions on the driver's head and face. The driver also sustained a comminuted fracture of the right ulna due to loading the center instrument panel. The emergency responders found the driver laying on his right side across the front right seat cushion with his head resting on the right front door and his feet on the driver's side near the floor.

CASE VEHICLE DRIVER INJURIES

The driver was transported from the crash scene by ambulance to a medical center where he was admitted for treatment of his injuries and hospitalized for eight days. Upon his release from the hospital, he was transferred directly to a rehabilitation facility where he spent an additional 11 days. 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	Nonanatomic brain injury with prior loss of consciousness, improving mental status, no memory of event, GCS=12	moderate 160606.2,0	Front left windshield's glazing	Certain	Hospitalization records
2 3	Laceration, grade III, spleen, not further specified, with small parasplenic hematoma	serious 544224.3,2 moderate 544299.2,2	Steering wheel hub and/or spokes and rim	Certain	Hospitalization records
4	Contusion {hematoma} left adrenal gland	minor 540210.1,2	Steering wheel hub and/or spokes and rim	Certain	Hospitalization records
5	Contusion {hematoma}, non-flow-limiting, intramural ¹ , inferior mesenteric artery	serious 521402.3,9	Steering wheel hub and/or spokes and rim	Certain	Hospitalization records
6	Contusion {hematoma}, non-flow-limiting, intramural ¹ , right common iliac artery	serious 520602.3,1	Steering wheel hub and/or spokes and rim	Certain	Hospitalization records
7	Fracture, comminuted, proximal third right femoral diaphysis with moderate fragment displacement	serious 851814.3,1	Center lower instrument panel, left portion {Indirect injury}	Certain	Hospitalization records
8	Fracture, comminuted, transverse, right ulna near right elbow	serious 753204.3,1	Center instrument panel	Probable	Hospitalization records

¹ The following term is defined in DORLAND'S ILLUSTRATED MEDICAL DICTIONARY as follows:
intramural (in"tra-mu'ral): within the wall of an organ.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
9	Laceration {tear}, partial thickness, right posterior cruciate ligament	moderate 840404.2,1	Center lower instrument panel, left portion	Certain	Hospitalization records
10	Defect, large, 3.2 x 2.3 cm (1.3 x 0.9 in) osteochondral, with underlying lucency ² in medial femoral condyle with moderate to large right knee joint effusion	serious 850802.1,1	Center lower instrument panel, left portion	Certain	Hospitalization records
11	Contusion {hematoma} posterior scalp, not further specified	minor 190402.1,6	Right front door panel, front upper quadrant	Possible	Hospitalization records
12 13	Avulsion and extensive laceration to middle frontal area at apex of scalp involving right parietal and temporal areas	moderate 190604.2,1 190804.2,1	Front left windshield's glazing	Certain	Hospitalization records
14	Avulsion right eyebrow exposing muscle	minor 290802.1,7	Front left windshield's glazing	Certain	Hospitalization records
15	Lacerations upper and lower right eyelids, full length upper	minor 297602.1,1	Front left windshield's glazing	Certain	Hospitalization records
16	Abrasions, several, right cheek, not further specified	minor 290202.1,1	Front left windshield's glazing	Certain	Hospitalization records
17	Lacerations, multiple, right face, not further specified	minor 290602.1,1	Front left windshield's glazing	Certain	Hospitalization records
18	Abrasions right side chest, not further specified	minor 490202.1,1	Air bag, driver's	Probable	EMS treatment record
19	Abrasions upper central abdomen, not further specified	minor 590202.1,7	Air bag, driver's	Probable	EMS treatment record
20	Contusion {hematoma} right thigh, not further specified	minor 890402.1,1	Center lower instrument panel, left portion {Indirect injury}	Probable	Hospitalization records
21	Abrasions left knee, not further specified	minor 890202.1,2	Left lower instrument panel	Certain	Hospitalization records
22	Abrasions, superficial, right leg, not further specified	minor 890202.1,1	Center lower instrument panel, left portion	Probable	Emergency room records
23	Sprain left ankle, not further specified	minor 890202.1,1	Floor, including toe pan	Probable	Interviewee (same person)

² The following term is defined in DORLAND'S ILLUSTRATED MEDICAL DICTIONARY as follows:
translucent (trans-loo'sent): transmitting light, but diffusing it so that objects beyond are not clearly distinguished.

