INDIANA UNIVERSITY
TRANSPORTATION RESEARCH CENTER
School of Public and Environmental Affairs
222West Second Street
Bloomington, Indiana 47403-1501
(812) 855-3908 Fax: (812) 855-3537

REMOTE ADVANCED OCCUPANT PROTECTION SYSTEM INVESTIGATION

CASE NUMBER - IN-03-029
LOCATION - Texas
VEHICLE - 2001 FORD ESCAPE
CRASH DATE - June 2001

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. *Supplementary Notes*
Remote air bag deployment investigation involving a 2001 Ford Escape, equipped with redesigned frontal air bags, that impacted a 1994 International straight truck

16. *Abstract*
This report covers a remote investigation of a crash involving a 2001 Ford Escape SUV (case vehicle) and a 1994 International straight truck (other vehicle). This crash is of special interest because the case vehicle's unrestrained front right passenger (4-year-old male) sustained critical head injuries, resulting in his death. The unrestrained driver (24-year-old female) sustained minor injuries and there was no other occupant. The case vehicle was traveling east in the eastbound lane of a two-lane, undivided county road and was approaching an intersection at a hill crest, intending to continue east. The International truck had been traveling west in the westbound lane of the same roadway and was in the process of making a left turn at the intersection, intending to travel south. It was daylight, the weather was clear and the asphalt road surface was dry and free of defects. The case vehicle's driver observed the threat ahead, steered slightly left and braked with lockup. The front right area of the case vehicle impacted right rear dual wheel assembly and flat bed cargo deck of the International straight truck, causing the case vehicle's driver and front right passenger air bags to deploy. The case vehicle rotated clockwise and penetrated beneath the straight truck's cargo deck, sustaining direct contact on the windshield and right A-pillar. The case vehicle rotated approximately 230 degrees clockwise while sliding in a northeasterly direction and came to rest heading northwest in the westbound lane, a short distance west of the point of impact. The International truck completed its turn and was brought to a controlled stop in the southbound lane of the intersecting roadway. The front right passenger moved forward in response to the braking deceleration and then rightward as the case vehicle rotated against the intruding right A-pillar. He sustained a comminuted fracture of the right temporal bone extending into the occipital bone, bilateral subarachnoid and subdural hemorrhages, intraventricular hemorrhage, and numerous contusions and abrasions.

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BACKGROUND

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This remote investigation was brought to the NHTSA's attention in June 2003 by a review of the 2001 Fatality Analysis Reporting System (FARS) data. This crash involved a 2001 Ford Escape XLS sport utility vehicle (case vehicle) and a 1994 International 4700 straight truck (other vehicle). The crash occurred in June 2001, at 11:30 a.m., in Texas, and was investigated by the applicable state police. This crash is of special interest because the case vehicle was equipped with multiple advanced occupant protection system (AOPS) features and the case vehicle's unrestrained front right passenger (4-year-old male, white, unknown if Hispanic) sustained critical head injuries, resulting in his death. The unrestrained driver (24-year-old female, white, unknown if Hispanic) sustained minor injuries and there was no other occupant. This report is based on the police crash report, police on-scene photographs, medical treatment and autopsy records, and this contractor's evaluation of the available evidence.

CRASH CIRCUMSTANCES

The case vehicle was traveling east in the eastbound lane of a two-lane, undivided county road and was approaching a Tee intersection at the top of a hill crest, intending to continue east. The International truck had been traveling west in the westbound lane of the same roadway and was in the process of making a left turn at the Tee intersection, intending to travel south into a residential subdivision. It was daylight, the weather was clear, the asphalt road surface was dry and free of defects, and the speed limit was 72 km.p.h. [45 m.p.h.]. The roadway was straight and the terrain was hilly, with the case vehicle's approach being an uphill grade such that the hill crest and intersection were not visible for on-coming eastbound traffic. The police report notes that there was a caution sign for eastbound traffic warning of an intersection ahead. The case vehicle's driver observed the threat ahead, steered slightly left and braked with lockup, depositing approximately 30.5 meters [100 feet] of skid marks, in an attempt to avoid the crash. The crash occurred in the eastbound lane, within the intersection.

Figure 1: Lookback along case vehicle's eastbound approach (looking west), with case vehicle at final rest (right foreground) (case photo #02)

The front right area of the case vehicle impacted right rear dual wheel assembly and flat bed cargo deck of the International straight truck, causing the case vehicle's driver and front right passenger air bags to deploy. The case vehicle rotated clockwise and penetrated beneath the straight truck's cargo deck, sustaining direct contact on the windshield and right A-pillar. The case vehicle rotated approximately 230 degrees clockwise while sliding in a northeasterly direction and came to rest heading northwest in the westbound lane, a short distance west of the point of impact. The International truck completed its turn and was brought to a controlled stop in the southbound lane of the intersecting roadway.

The case vehicle was a 2001 Ford Escape XLS rear wheel drive, four-door, five passenger sport utility vehicle (VIN: 1FMYU01101K------), equipped with a 3.0 liter V6 gasoline engine and an automatic transmission with a column-mounted selector lever. The case vehicle was equipped with multiple advanced occupant protection system (AOPS) features, including redesigned frontal air bags and safety belt pretensioners for the two front seat positions, seat belt sensors and an Event Data Recorder (the EDR was not available for this report). Seat back-mounted side air bags and four wheel anti-lock brakes were options for this model, but the case vehicle was not so equipped. Its wheelbase was 262 centimeters [103.2 inches]. The odometer reading is not known. The case vehicle was towed due to disabling damage.

Figure 2: Case vehicle's right side (case photo #07)

Figure 3: Case vehicle's front and left side (case photo #06)

The right third of the case vehicle's front impacted the straight truck's right rear dual wheel assembly, causing heavy crush to the bumper, grille, right fender, hood and into the engine compartment (**Figures 2** and **3**). As the case vehicle rotated clockwise, it penetrated beneath the rear overhang of the straight truck's cargo deck, with the windshield and right A-pillar sustaining direct contact (**Figures 3** and **4**). The case vehicle's right front wheel assembly was displaced rearward, the right A-pillar was deformed and the roof was buckled in the area over the right front door. The windshield was shattered across its entire width, the right front door window glazing was disintegrated, and there was no other glazing damage. The right front tire was restricted and deflated, with no other damage to the wheels/tires.

Figure 4: Case vehicle's right A-pillar; note, dent from other vehicle' s cargo deck (case photo #09)

The CDC was estimated from the available photographs as **12-FZAW-6 (0)**. This collision is out of scope for the WinSMASH reconstruction program (heavy truck impact), but the barrier equivalent speed (BES) was calculated. Based on the WinSMASH barrier algorithm with CDC-only, the BES was 49 km.p.h. [30.4 m.p.h.]. This result seems slightly high but reasonable. This was a crash of high severity (greater than 40 km.p.h. [25 m.p.h.]) for the case vehicle.

The case vehicle was equipped with driver and front right passenger redesigned frontal air bags. Both air bags deployed as a result of the collision events.

The driver's air bag was located in the steering wheel hub, with the module cover flaps in an unknown configuration. The air bag's size and shape are not known, it is not known if it had any tether(s) or vent port(s) and it is not possible to discern any evidence of occupant contact. The available photos confirm that the air bag did deploy, but there is otherwise no information.

The front right passenger's air bag was located in the top of the right instrument panel, with a single cover flap. The air bag's size and shape are not known, it is not known if it had any tether(s) or vent port(s), and it is not possible to discern any evidence of occupant contact. The available photos confirm that the air bag did deploy, but there is otherwise no information.

CASE VEHICLE FRONT RIGHT PASSENGER'S KINEMATICS

The case vehicle's front right passenger (4-year-old male, white, unknown if Hispanic, 104 centimeters, 16 kilograms [41 inches, 35 pounds]) was not using the available, active, three-point, lap-and-shoulder, safety belt system. His safety belt system was equipped with a buckle pretensioner, but because the belt was not in use, the pretensioner did not actuate. His seat adjustments and seated posture are not known.

The case vehicle driver observed the threat ahead, steered slightly to the left and braked with lockup. The front right passenger moved forward and slightly to the right in response to these avoidance maneuvers. The case vehicle's front right area impacted the other vehicle's right rear dual wheel assembly, causing the case vehicle's driver and front right passenger air bags to deploy. The out-of-position child probably encountered the right side of the deploying air bag with the right side of his face and torso and he sustained abrasions and contusions on his face, chin, right upper chest and right shoulder. His left arm and both legs flailed, contacting the air bag, and he sustained abrasions and contusions on his left arm and both thighs. The child contacted the upper right A-pillar, which was being crushed rearward as the case vehicle penetrated under the other vehicle's cargo deck. His contact with the right upper A-pillar resulted in: a comminuted fracture of the right temporal bone, extending into the occipital bone; subdural and subarachnoid hemorrhages in both hemispheres of the cerebrum; intraventricular hemorrhage; a laceration and subgaleal hemorrhage over the right temporoparietal area; and contusions on the right side of his face and chest. The case vehicle was rotating clockwise as the air bag deflated and the child loaded against the intruding right instrument panel, sustaining contusions on his right flank and right forearm. As the case vehicle rotated to final rest, he rebounded slightly to the right. His position at final rest is not known.

The front right passenger was transported to a hospital via ambulance. He was pronounced dead approximately ninety minutes after the crash.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Hemorrhages, subdural, involving both sides of cerebrum	critical 140654.5,3	Right A-pillar	Probable	Autopsy
2 3	Hemorrhages, subarachnoid, involving both sides of cerebrum	serious 140684.3,1 140684.3,2	Right A-pillar	Probable	Autopsy
4	Hemorrhage, intraventricular, not further specified	severe 140678.4,9	Right A-pillar	Possible	Autopsy
5	Fracture, comminuted, right temporal bone, extending to occipital bone	serious 150404.3,1	Right A-pillar	Probable	Autopsy
6	Hemorrhage, subgaleal, right temporoparietal area	minor 190402.1,1	Right A-pillar	Probable	Autopsy
7	Laceration, 1.9 cm (0.75 in), right side of head	minor 190602.1,1	Right A-pillar	Probable	Autopsy
8	Abrasion bridge of nose	minor 290202.1,4	Air bag, front right passenger's	Probable	Autopsy
9 10	Abrasion, brush-burn, right side of face and chin	minor 290202.1,1 290202.1,8	Air bag, front right passenger's	Probable	Autopsy
11	Contusion right face, not further specified	minor 290402.1,1	Right A-pillar	Probable	Autopsy
12	Abrasions right chest, extending to abdomen	minor 490202.1,1	Air bag, front right passenger's	Possible	Autopsy
13	Contusion right chest, not further specified	minor 490402.1,1	Right A-pillar	Possible	Autopsy
14	Contusion right lumbar area (i.e., flank)	minor 590402.1,1	Right instrument panel and below	Possible	Autopsy
15	Contusion, brush-burn, right shoulder	minor 790402.1,1	Air bag, front right passenger's	Probable	Autopsy
16 17	Abrasion and contusion, left forearm near cubital area	minor 790202.1,2 790402.1,2	Air bag, front right passenger's	Possible	Autopsy
18	Contusion right forearm near wrist	minor 790402.1,1	Right instrument panel and below	Possible	Autopsy

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
19	Contusion both thighs, not further specified	minor 890402.1,3	Air bag, front right passenger's	Possible	Autopsy
20 21	Abrasion and contusion right knee, not further specified	minor 890202.1,1 890402.1,1	Knee bolster, front right passenger's	Possible	Autopsy
22	Contusion right foot, not further specified	minor 890402.1,1	Right instrument panel and below	Possible	Autopsy

CASE VEHICLE DRIVER'S KINEMATICS

The case vehicle's driver (24-year-old female, white, unknown if Hispanic, height and weight unknown, two months pregnant) was not restrained by the available, active, three-point, lap-and-shoulder, safety belt system. Her safety belt system was equipped with a buckle pretensioner, but because the safety belt system was not in use the pretensioner did not actuate. Her seat adjustments and seated posture are not known.

The case vehicle driver observed the threat ahead, steered slightly to the left and braked with lockup. She moved forward and slightly to the right in response to these avoidance maneuvers. The case vehicle's front right area impacted the other vehicle's right rear dual wheel assembly, causing the case vehicle's driver and front right passenger air bags to deploy. She pitched forward and her chest struck the deployed air bag, causing unknown blunt chest trauma. Her head struck the windshield, causing abrasions, lacerations and an avulsion on her forehead. Her right thigh struck the knee bolster, causing a contusion immediately proximal to the knee. She probably rebounded into the driver's seat as the vehicle rotated clockwise. Her position at final rest is not known.

CASE VEHICLE DRIVER'S INJURIES

The driver was transported by ambulance to a hospital. She sustained minor soft tissue injuries and was treated and released.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Abrasions, superficial, mid-forehead	minor 290202.1,7	Windshield glazing	Certain	Emergency room records
2	Laceration, large, across forehead, not further specified	minor 290600,1,7	Windshield glazing	Certain	Emergency room records

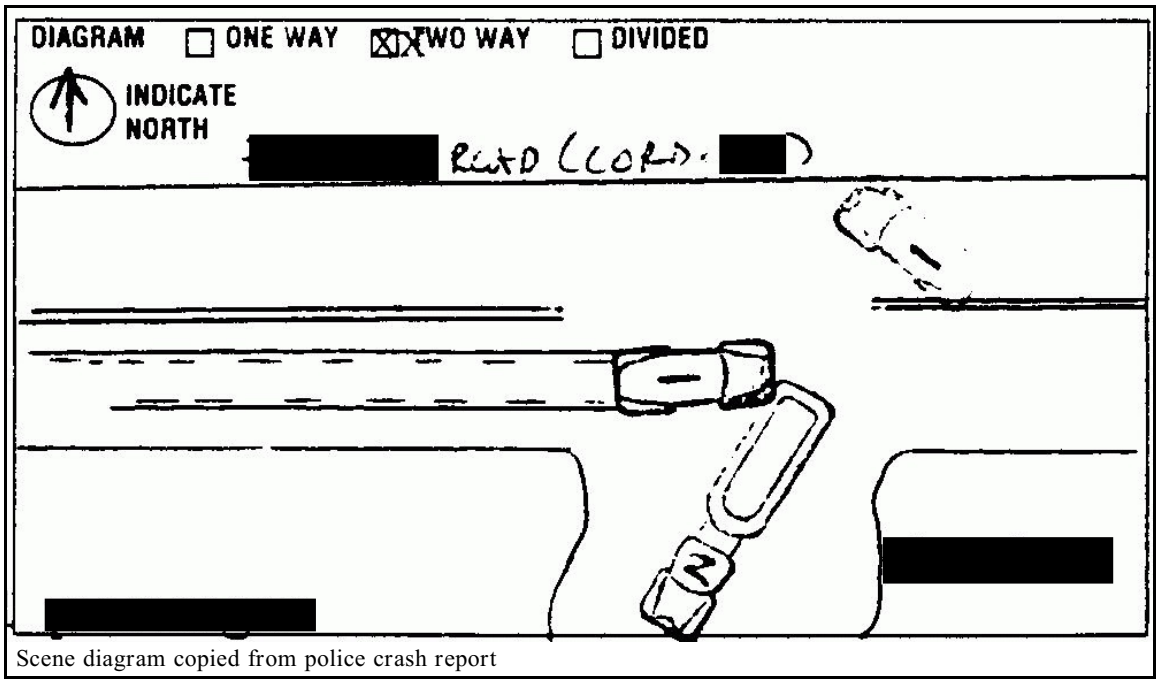
Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
3	Avulsion mid-forehead, not further specified	minor 290800.1,7	Windshield glazing	Certain	Emergency room records
4	Blunt chest trauma, mild, right lateral chest wall	unknown 415099.7,1	Air bag, driver's	Probable	Emergency room records
5	Contusion above right knee	minor 890402.1,1	Knee bolster, driver's	Probable	Emergency room records

OTHER VEHICLE: 1994 INTERNATIONAL 4700 STRAIGHT TRUCK

The other vehicle was a 1994 International 4700 flatbed straight truck (VIN: 1HTSCACN6RH------), equipped with air brakes and with a GVWR rating of 11,794 - 14,969 kilograms [26,001 - 33,000 pounds]. Further details are not known. The truck was towed due to disabling damage to the right rear dual wheel assembly.

Figure 5: Right side of other vehicle, where it was brought to a stop after the impact; note, right rear tire is deflated, other damage not visible (the truck was loaded with building supplies and was off-loaded prior to being towed) (case photo #05)

According to the police crash report, the International's driver (24-year-old male) was restrained by his available, active, three-point, lap-and-shoulder, safety belt system. The driver was not transported by ambulance to the hospital, and he did not sustain any injuries as a result of this crash.



Scene diagram copied from police crash report