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REMOTE CHILD AIR BAG-RELATED FATALITY INVESTIGATION

CASE NUMBER - IN-05-012
LOCATION - Minnesota
VEHICLE - 1997 Ford Escort
CRASH DATE - October 2002

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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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Remote investigation of an air bag deployment crash involving a 1997 Ford Escort, with dual first generation air bags, that impacted a 2002 Dodge Caravan.

16. *Abstract*
This report covers a remote investigation of an air bag deployment crash that involved a 1997 Ford Escort (case vehicle) and a 2002 Dodge Grand Caravan (other vehicle). This crash is of special interest because the case vehicle's front right passenger (15-month-old female) sustained critical skull and brain injuries when the deploying front right passenger air bag impacted her infant carrier/safety seat, resulting in her death. The case vehicle's driver (27-year-old female) sustained a broken ankle and other minor injuries. There was no other occupant in the case vehicle. The case vehicle was traveling northward in the outside northbound through lane of a divided state highway, approaching a four-leg intersection, intending to pass through the intersection and continue northward. The other vehicle was traveling eastward in the eastbound through lane of the intersecting city street, intending to pass through the intersection and continue eastward. The case vehicle entered the intersection as the other vehicle was passing through. There is no evidence that either driver attempted any avoidance maneuvers. The front of the case vehicle impacted the other vehicle's right side, causing the case vehicle's driver and front right passenger air bags to deploy. The other vehicle's driver and front right passenger air bags also deployed. The two vehicles came to rest with no further impacts and both were towed due to disabling damage. The case vehicle's front right passenger was positioned in a rear-facing infant carrier/safety seat. The deploying front right passenger's air bag engaged the leading edge of the infant seat, causing the infant seat's seat back to strike the back of the child's head. The child was transported via ground ambulance to a local hospital and was declared dead approximately one hour post-crash. The case vehicle driver sustained a comminuted fracture of the right ankle and was hospitalized for three days.

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BACKGROUND

IN-05-012

This remote investigation was brought to the NHTSA's attention on March 17, 2005 by a newspaper article. This crash involved a 1997 Ford Escort (case vehicle) and a 2002 Dodge Grand Caravan (other vehicle). The crash occurred in October 2002, at 5:54 a.m., in Minnesota, and was investigated by the applicable municipal police department. This crash is of special interest because the case vehicle's front right passenger (15-month-old female, black, unknown if Hispanic) sustained critical skull and brain injuries when the deploying front right passenger air bag impacted her infant carrier/safety seat, resulting in her death. The case vehicle's driver (27-year-old female, white, unknown if Hispanic) sustained a broken ankle and other minor injuries. There was no other occupant in the case vehicle. The case vehicle was not available to be inspected and no on-scene investigation was conducted. This report is based on the police crash report, police on-scene photographs, medical treatment data for the driver and the front right passenger, the autopsy report for the front right passenger, occupant kinematic principles and this contractor's evaluation of the available evidence.

CRASH CIRCUMSTANCES

The case vehicle was traveling northward in the outside northbound through lane of a divided state highway, approaching a four-leg intersection that was controlled by overhead automatic signals, intending to pass through the intersection and continue northward. The north-south divided trafficway had two through lanes in each direction separated by a wide, depressed grass median, with left- and right-turn lanes in the intersection area, for a total of four lanes on the northbound approach to the intersection. The other vehicle was traveling eastward in the eastbound through lane of a city street, approaching the same intersection and intending to pass through the intersection and continue eastward. The east-west city street was divided by a raised concrete median in the intersection area, with left-and right-turn lanes, for a total of three lanes on the eastbound approach to the intersection. The asphalt road surface on both roadways was dry and free of defects. The weather was clear and it was dark but lighted. The speed limit was 89 km.p.h. [55 m.p.h.] for the state highway and is unknown for the city street. The case vehicle entered the intersection as the other vehicle was passing through. There is no evidence that either driver attempted any avoidance maneuvers.

Figure 1: Overview of the crash site looking north, showing the case vehicle at final rest (arrow)

Figure 2: Overview of crash site looking northeast, showing the other vehicle at final rest (arrow)

The crash occurred within the intersection. The front of the case vehicle impacted the other vehicle's right side, causing the case vehicle's driver and front right passenger air bags to deploy. The other vehicle's driver and front right passenger air bags also deployed. The case vehicle's driver apparently provided post-impact steering input, leading to the case vehicle coming to rest in the state highway's grass median just north of the intersection, heading eastward (**Figure 1**). The other vehicle rotated clockwise approximately 260 degrees as it slid northeastward. The other vehicle came to rest slightly east of the intersection, with its front wheels off the north road edge and its rear wheels in the roadway, heading a few degrees west of north (**Figure 2**).

CASE VEHICLE: 1997 FORD ESCORT LX

The case vehicle was a front wheel drive 1997 Ford Escort LX four-door, five-passenger sedan (VIN: 1FALP13P0VW------), equipped with an I4 2.0 liter gasoline engine and an automatic transmission with a console-mounted selector lever. Four-wheel anti-lock brakes were an option for this model, but it is not known if the case vehicle was so equipped. The case vehicle was equipped with manual, three-point, lap-and-shoulder safety belts for the two front bucket seats plus driver and front right passenger first generation air bags. Its specification wheelbase was 250 centimeters [98.4 inches] and its odometer reading was 190,259 kilometers [118,225 miles]. The case vehicle was towed due to disabling damage.

The case vehicle sustained direct contact damage across its entire front (**Figure 3**). The left and right bumper struts were bent and the entire bumper structure was shifted to the right, with the bumper crushed rearward against the radiator. The leading edge of the hood showed direct contact damage and the hood was crushed rearward and folded upward at the center. The leading edges of both fenders sustained direct contact and both headlamp/turn signal assemblies were shattered and broken away. The front portion of the left fender was crushed rearward with induced damage extending back to the left A-pillar (**Figure 4**). There is no visible damage on the left side rearward of the A-pillar. The right side is not visible in the available photographs. It appears that the wheelbase was unchanged and there is no visible damage to any of the wheels/tires or glazing.

Figure 3: Front of case vehicle at final rest; note, the child safety seat that was in use at the time of the crash was removed from the vehicle by first responders and is laying on the grass

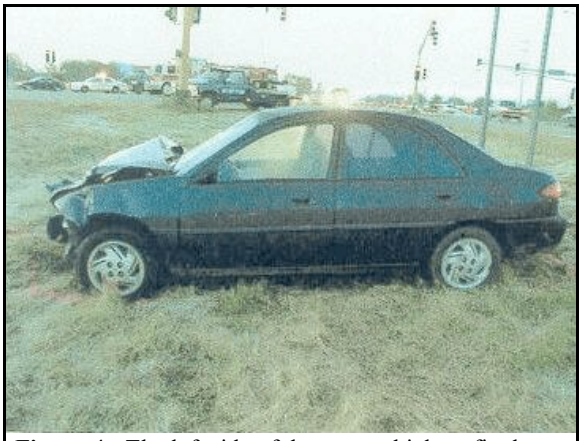


Figure 4: The left side of the case vehicle at final rest

The CDC for the case vehicle's single impact was estimated from the available photographs as **10-FDEW-2 (310 degrees)**. The WinSMASH reconstruction program, CDC-only algorithm based on the photo-estimated CDCs for the two vehicles, was used. The total, longitudinal and lateral delta-Vs for the case vehicle are, respectively: 30 km.p.h. [18.6 m.p.h.], -19.3 km.p.h. [-12.0 m.p.h.] and + 23.0 km.p.h. [+ 14.3 m.p.h.]. This is a borderline reconstruction but the results appear reasonable. This was a crash of moderate severity (24-40 km.p.h. [15-25 m.p.h.]) for the case vehicle.

The driver's air bag was mounted in the steering wheel hub and the front right passenger's air bag was mounted in the top of the instrument panel on the right. The available photographs do not show any details about the two air bags, except to confirm that they did deploy.

CASE VEHICLE'S CHILD SAFETY SEAT

The front right passenger was placed in a Maxi-Cosi "Cabrio" infant carrier/safety seat (ISS) that was intended for rear-facing use in a vehicle, but this make/model is not manufactured or sold for use in the United States. The label indicates that it is suitable for children up to weight 16 kilograms [35 pounds]. The ISS was fitted with a three-point harness system that buckled between the child's legs, with the shoulder straps threaded through the middle slots. It had a folding carrying handle but no shield (**Figure 5**). The ISS consisted of a rigid, one-piece plastic shell lined with padded fabric. The fabric was soiled, heavily worn and frayed in some places. The plastic shell was fractured and a seam was partially separated along the area where the seat cushion joins the seat back (**Figure 6**). The case vehicle driver could not recall whether the child was buckled in the harness or whether the ISS was secured by the case vehicle's safety belt system, and did know if the seat was forward or rearward facing at the time of the crash.

Figure 5: Front of infant seat, photographed where it was found (see Figure 3)

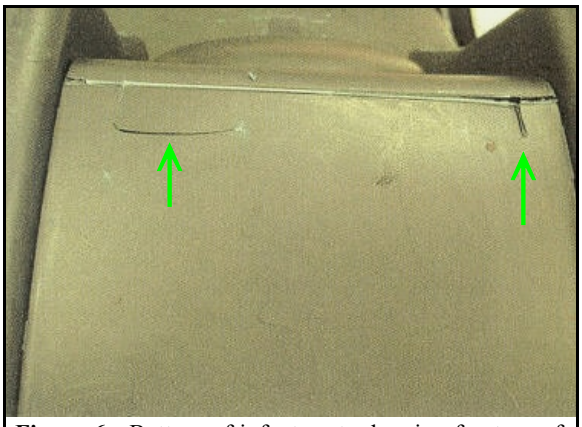


Figure 6: Bottom of infant seat, showing fracture of plastic body (left) and separation of seam (right)

There was also a second child safety seat in the back seat of the case vehicle. This was a Cosco, Inc. convertible child safety seat (CSS) with a tray shield, with further details not known. This CSS was not in use at the time of the crash and is not discussed further.

The case vehicle's front right passenger (15-month-old female, black, unknown if Hispanic, 79 centimeters, 10 kilograms [31 inches, 22 pounds]) was positioned in an infant carrier/car safety seat. It is not known whether the infant seat was secured by the vehicle's available, active, three-point, lap-and-shoulder safety belt system and it is not known whether the child was restrained by the infant seat's harness. Based on the child's injuries and the damage to the infant seat, the infant seat was in the rear-facing configuration, with the child in a rear-facing, reclined posture. The available photographs indicate that the front right bucket seat track was adjusted between the middle and forward position with the seat back incline adjusted in the upright position.

The case vehicle driver was apparently asleep and did not attempt any avoidance maneuvers prior to the impact and the child's posture did not change. The case vehicle's front impacted the right side of the other vehicle, causing the case vehicle's driver and front right passenger air bags to deploy. The infant seat and the child moved forward and leftward in response to the 10:00 o'clock direction of the impact force. The deploying front right passenger's air bag engaged the leading edge of the infant seat, causing the infant seat's seat back to strike the back of the child's head. The child sustained a comminuted fracture of the vault of the skull involving the sagittal suture and the right parietal bone, and a comminuted basilar skull fracture involving the right lambdoidal suture, the right posterior occiput and the right posterior cranial fossa. She also sustained: transtentorial herniation with right-to-left shift; massive cerebral edema with compression of the lateral ventricles; intraventricular hemorrhage; subarachnoid hemorrhage; extensive subgaleal and subperiosteal contusion over the right parieto-occipital, posterior parieto-occiptal and left occiput areas; and other injuries. Her position at final rest is not known.

CASE VEHICLE FRONT RIGHT PASSENGER'S INJURIES

The front right passenger was transported via ground ambulance to a local hospital, where she was declared dead approximately one hour post-crash.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Compression brain stem with transtentorial (uncal) {central} herniation with right-to-left shift	critical 140202.5,8	Child safety seat's back top surface {air bag-related}	Probable	Autopsy
2	Hemorrhage, subdural, 2-3 cc, bilaterally, not further specified	critical 140654.5,3	Child safety seat's back top surface {air bag-related}	Probable	Autopsy
3	Nonanatomic brain injury with loss of consciousness, unresponsive to pain, pupils fixed and dilated with traumatic cardiac and respiratory arrest	critical 160824.5,0	Child safety seat's back top surface {air bag-related}	Probable	Emergency room records

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
4	Edema, massive, with marked compression of lateral ventricles, resulting from right-to-left shift	severe 140664.4,1	Child safety seat's back top surface {air bag-related}	Probable	Autopsy
5	Hemorrhage, intraventricular, posterior left lateral ventricle	severe 140678.4,2	Child safety seat's back top surface {air bag-related}	Probable	Autopsy
6 7	Hemorrhage, subarachnoid, superior parieto-occipital lobes and right temporal lobe and left occipital lobe	serious 140684.3,1 140684.3,2	Child safety seat's back top surface {air bag-related}	Probable	Autopsy
8	Injury thoracic cavity not further specified with bilateral pneumothoraces	serious 442202.3,3	Child safety seat's back top surface {air bag-related}	Probable	Autopsy
9	Fracture, comminuted, vault involving sagittal suture and right parietal skull	serious 150404.3,1	Child safety seat's back top surface {air bag-related}	Probable	Autopsy
10	Fracture, comminuted, base involving right lambdoidal suture, right posterior occiput, and right posterior cranial fossa	serious 150200.3,8	Child safety seat's back top surface {air bag-related}	Probable	Autopsy
11	Abrasions, 4.0 x 1.0 cm (1.6 x 0.4 in) right temple area and 3.0 x 1.0 cm (1.2 x 0.4 in) right temporal occipital area	minor 190202.1,1	Child safety seat's back top surface {air bag-related}	Probable	Autopsy
12	Contusion {hemorrhage}, extensive, subgaleal and subperiosteal on right parieto-occipital area, posterior parieto-occipital, and left occiput area	minor 190402.1,6	Child safety seat's back top surface {air bag-related}	Probable	Autopsy
13	Contusion {discoloration} over right temporal occipital area just superior to helix of ear extending obliquely	minor 190402.1,1	Child safety seat's back top surface {air bag-related}	Probable	Autopsy
14	Contusion {ecchymosis} about nose, not further specified	minor 290402.1,4	Child safety seat's right side surface	Possible	Emergency room records

The case vehicle's driver (27-year-old female, white, unknown if Hispanic, height unknown, 100 kilograms [220 pounds]) was police-reported as restrained by her available, active, three-point, lap-and-shoulder safety belt system. The available photographs indicate that her bucket seat track was adjusted between the middle and forward position with the seat back incline adjusted in a slightly reclined position. She had at least one hand on the steering wheel and her right foot was operating the accelerator pedal.

The driver was apparently asleep and did not attempt any avoidance actions prior to the crash. The case vehicle's front impacted the other vehicle's right side, causing the case vehicle's driver and front right passenger air bags to deploy. The driver moved forward and leftward in response to the 10:00 o'clock direction of the impact force. Her knees impacted the knee bolster on either side of the steering column and she sustained contusions on both knees and a laceration on the right knee. Her right foot loaded against the floor or foot controls and she suffered abrasions and a bimalleolar fracture in the right ankle. Her abdomen contacted the steering wheel rim and she sustained superficial lacerations to the right of her umbilicus. It appears that she provided some post-impact steering input because the case vehicle's final rest position (in the median) was to the west of the point of impact, while the principles of crash dynamics indicate that, given the direction of travel for the two vehicles and the impact configuration, final rest is expected to be to the east of the point of impact. Her posture at final rest is not known.

CASE VEHICLE DRIVER'S INJURIES

The case vehicle driver was transported via ambulance to a local hospital, where she was admitted for three days.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Nonanatomic brain injury without loss of consciousness but amnesia to event	moderate 160410.2,0	Air bag, driver's	Probable	Emergency room records
2	Fracture, bimalleolar, right ankle with comminution lateral malleolus–not repairable, and displacement medial malleolus but repairable	serious 851614.3,1	Floor, foot controls	Probable	Emergency room records
3	Laceration {scratches}, superficial, mid-anterior abdomen, right of umbilicus	minor 590602.1,8	Steering wheel rim	Probable	Emergency room records
4	Contusion, large, 8 cm (3.1 in) left medial knee	minor 890402.1,2	Knee bolster, driver's, left of steering column	Probable	Emergency room records

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
5	Contusion right knee, not further specified	minor 890402.1,1	Knee bolster, driver's, right of steering column	Probable	Emergency room records
6	Laceration, 4-5 cm (~ 2 in), right lateral knee	minor 890602.1,1	Knee bolster, driver's, right of steering column	Probable	Emergency room records
7	Abrasions, small, right ankle	minor 890202.1,1	Floor, foot controls	Probable	Emergency room records

OTHER VEHICLE: 2002 DODGE GRAND CARAVAN

The other vehicle was a front wheel drive 2002 Dodge Grand Caravan Sport four-door, seven-passenger minivan (VIN: 2B4GP44R72R------), equipped with a V6 3.3 liter gasoline engine and an automatic transmission with a column-mounted selector lever. Four-wheel anti-lock brakes were standard for this model. Its specification wheelbase was 303 centimeters [119.3 inches] and its odometer reading was 22,414 kilometers [13,928 miles]. The Caravan was towed due to disabling damage.

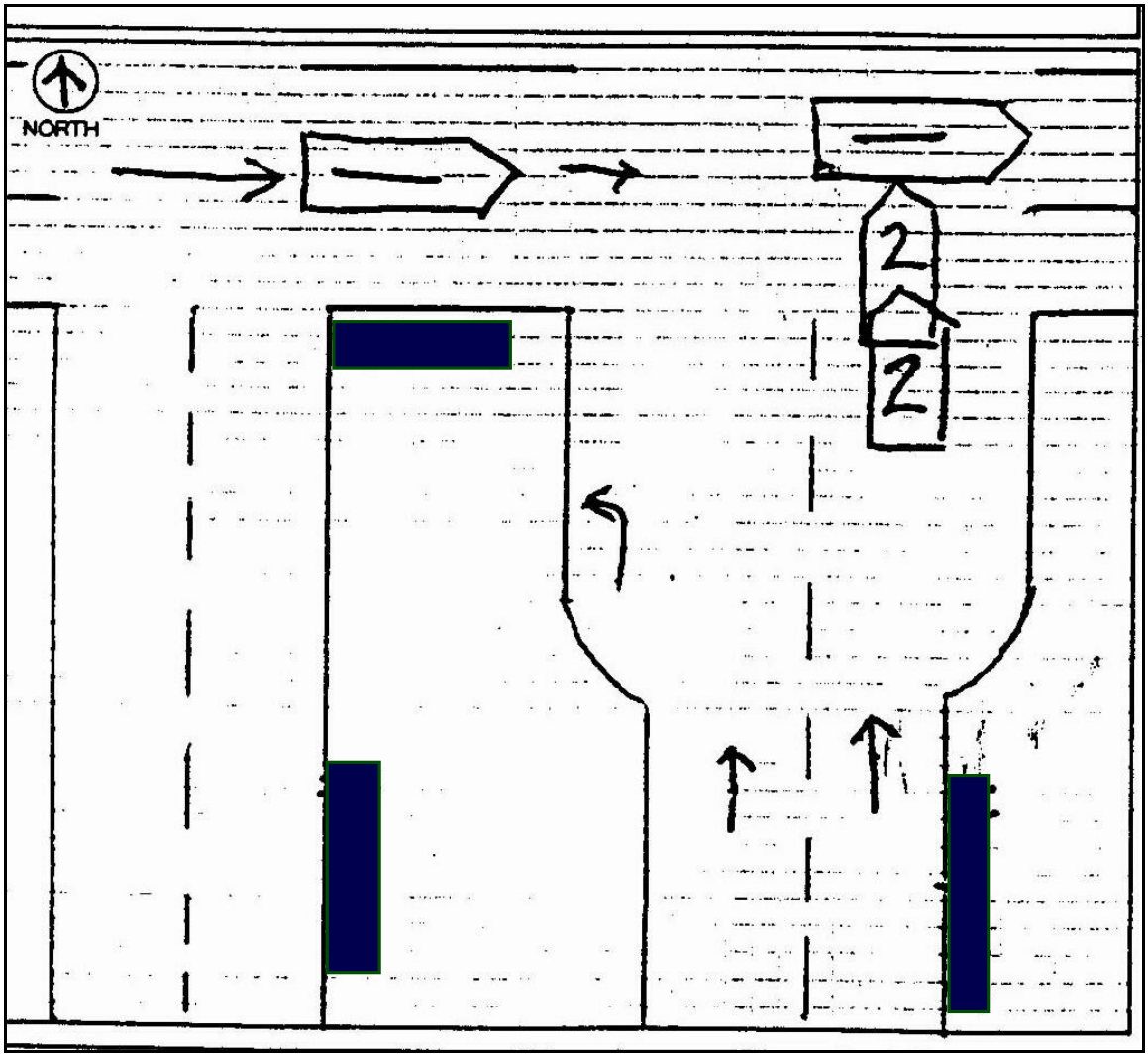
The Caravan sustained direct contact damage along its right side, extending from the B-pillar rearward to the trailing edge of the rear wheel well. The lower half of the sliding door was crushed inward, and this caused the upper half of the door to flex outward (**Figure 7**). The body panel around the right rear wheel well was crushed inward and the right rear wheel/tire assembly was broken off (**Figure 8**). The left rear and right front tires were separated from their rims and deflated, with the left front tire showing no visible damage. The plastic rear bumper cover was displaced and the both tail lamp/turn signal assemblies were entirely absent. The right rearmost window's glazing was disintegrated and all other glazing was undamaged.

Figure 7: Caravan's back and right side at final rest; note, top of sliding door flexed outward

The CDC for the Caravan's single impact was estimated from the available photographs as **01-RZEW-3 (40 degrees)**. The WinSMASH reconstruction program, CDC-only algorithm based on the photo-estimated CDCs for the two vehicles, was used. The total, longitudinal and lateral delta-Vs for the Caravan are, respectively: 18.0 km.p.h. [11.2 m.p.h.], -13.8 km.p.h. [-8.6 m.p.h.] and -11.6 km.p.h. [-7.2 m.p.h.]. This is a borderline reconstruction and these results appear somewhat low. This was a crash of low severity (14-23 km.p.h. [9-14 m.p.h.]) for the Caravan.

Figure 8: Rear and middle portions of Caravan's right side at final rest

It is not known whether the Caravan's driver (44-year-old male) was restrained by his available, active, three-point, lap-and-shoulder safety belt system. The driver sustained police-reported "C" (possible) injuries and was not transported by ambulance to a hospital. His treatment status and specific injuries, if any, are not known.



Scene diagram copied from police crash report. The case vehicle is V2 in this diagram.