On-Site Certified Advanced 208 Compliant Crash Investigation
Dynamic Science, Inc. / Case Number: DS05005
2005 Ford Escape
Colorado
April, 2005

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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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16. Abstract

This two vehicle crash occurred in April, 2005 at 1250 hours in an urban area of Colorado. The crash occurred within the confines of two intersecting roadways within an interchange area. The posted speed limit for both roadways is 56 km/h (35 mph).

The case vehicle was a 2005 Ford Escape sport utility vehicle driven by a restrained 16-year-old female traveling southbound in a left turn only lane. According to a witness, the driver of the case vehicle was stopped at the intersection prior to making a left-turn at a police estimated speed of 16 km/h (10 mph).

The other vehicle was a 1995 Toyota Previa mini-van driven by a 49-year-old restrained female traveling westbound at a police estimated speed of 48 km/h (30 mph). The Previa entered the intersection as the case vehicle was making its left turn. The right front of the Previa struck the left front of the Escape. At impact, both front air bags in the case vehicle deployed. After impact, the Escape rotated clockwise and came to rest facing west in the intersection. The Previa rotated counterclockwise and came to rest facing south in the intersection.

According to the police report, the driver of the Escape sustained evident, non-incapacitating injuries There were no injuries reported for the other two occupants in the case vehicle. According to the police report, the other driver sustained a possible injury. There were no indications of transport for the occupants in either vehicle.

Both vehicles were towed from the scene. The case vehicle was later declared a total loss.

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Dynamic Science, Inc.
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BACKGROUND

This on-site investigation focused on the performance of the Certified Advanced 208-Compliant air bag system in a 2005 Ford Escape sport utility vehicle. The multi-stage air bags were certified by the manufacturer to meet the advanced air bag requirement of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. There were a total of three occupants in the Ford Escape. The front of the Ford Escape struck the right side of a Toyota Previa in an intersection crash. According to the police report, the driver of the Escape sustained "evident, non-incapacitating" injuries. There were no injuries reported for the other two case vehicle occupants. The driver of the other vehicle sustained a possible injury. There were no indications of transport for the occupants in either vehicle.

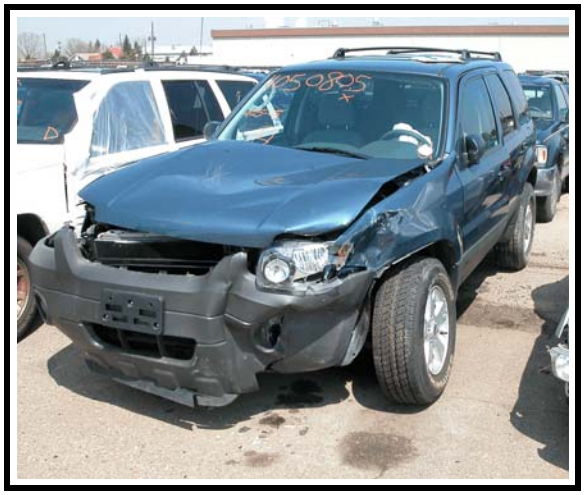


Figure 1. Front left, 2005 Ford Escape

This Advanced 208 Compliant case was identified during a review of GES police reports. The case was reported to DSI on April 28, 2005. All field activities were completed on May 3, 2005.

SUMMARY

Crash Site

This two vehicle crash occurred in April 2005 at 1250 hours in an urban area of Colorado. The crash occurred within the confines of intersecting roadways within an interchange area. The southbound roadway is an exit from a freeway and is comprised of two left turn lanes and one right turn lane. The westbound roadway is divided and is comprised of two through lanes and a left hand turn lane. The roadways were dry and free of defects. The speed limit for both roadways is 56 km/h (35 mph).

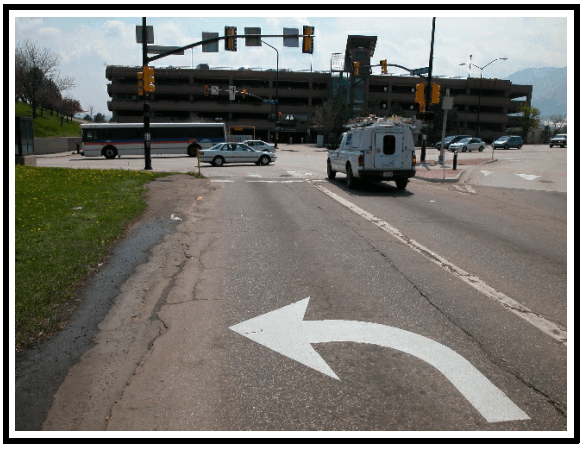


Figure 2. Approach of case vehicle to intersection (south)

At impact, both front air bags in the Escape deployed. According to the police report, the driver of the Escape sustained "evident, non-incapacitating" injuries. There were no injuries reported for the other two case vehicle occupants. There were no indications of transport.

Pre-Crash

The case vehicle was a 2005 Ford Escape sport utility vehicle driven by a restrained 16-year-old female. The front right seat was occupied by a unrestrained 15-year-old male. The rear right seat was occupied by a unrestrained 16-year-old male. The Ford Escape was traveling southbound in the far left turn lane.

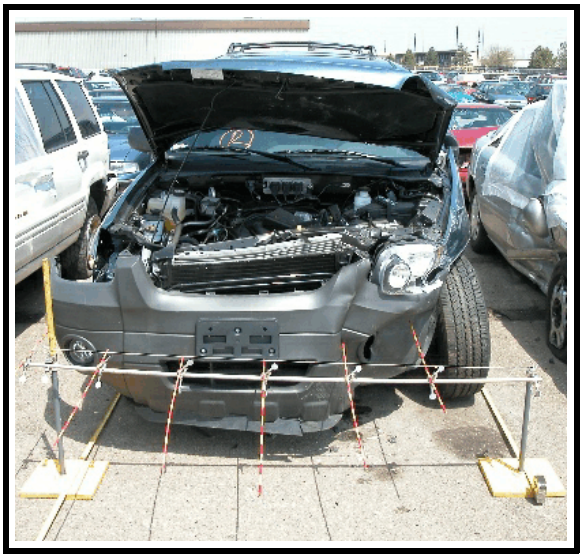
Figure 3. Approach of other vehicle to intersection (west)

The other vehicle was a 1995 Toyota Previa mini-van driven by a 49-year-old female. The Toyota was traveling westbound at a police reported speed of 48 km/h (30 mph).

According to a witness, the Ford Escape was stopped facing south at the intersection. The traffic signal for southbound traffic turned to green and the Ford Escape entered the intersection.

Crash

The driver of the Toyota Previa did not stop in time and the right front of the Previa struck the left front of the Escape (11FLEW2). At impact, both front air bags in the Escape deployed. The total velocity change as computed by the WinSmash missing vehicle algorithm was 21.6 km/h (13.4 mph). The longitudinal and lateral velocity changes were -20.3 km/h (-12.6 mph) and 7.4 km/h (4.6 mph), respectively.



The Ford Escape rotated clockwise and came to rest facing west in the intersection. The Toyota Previa rotated counterclockwise and came to rest facing south in the intersection.

Post-Crash

According to the police report, the driver of the Escape sustained “evident, non-incapacitating” injuries. There were no injuries reported for the other two case vehicle occupants. The driver of the other vehicle sustained a possible injury. There were no indications of transport for the occupants in either vehicle. Both vehicles were towed from the scene. The Ford Escape was later declared a total loss.

Vehicle Data - 2005 Ford Escape

The 2005 Ford Escape was identified by the Vehicle Identification Number (VIN): 1FMCU93135Kxxxxxx. The Ford Escape is a four-door, four wheel drive sport-utility with seating for five. The 2005 Ford Escape was equipped with a 3.0 liter 6-cylinder engine, 4 speed automatic transmission, 4-wheel anti-lock brakes, front and rear disc brakes, tilt steering wheel, AM/FM cassette stereo, and air conditioning. The Escape was equipped with front dual-stage air bags, dual front seat belt pretensioners with force limiters, and a front passenger seat position sensor. This is not a hybrid vehicle.

The odometer reading was 5,846 km (3,633 miles) at the time of the inspection.

The 2005 Ford Escape was equipped with Continental Contitrac P235/70R16 tires. The specific tire data is as follows:

Tire	Tread	Measured pressure	Manufacturer recommended cold tire pressure
LF	7 mm (9/32 in)	248 kPa (36 psi)	221 kPa (32 psi)
LR	7 mm (9/32 in)	262 kPa (38 psi)	221 kPa (32 psi)
RR	7 mm (9/32 in)	283 kPa (41 psi)	221 kPa (32 psi)
RF	7 mm (9/32 in)	255 kPa (37 psi)	221 kPa (32 psi)

The front seating positions in the 2005 Ford Escape were configured with dual cloth covered bucket seats. The seats were equipped with adjustable head restraints that were not damaged. The second row was configured as a fabric covered 60/40 split bench seat with a folding back. All three rear seat positions were equipped with adjustable head restraints that were not damaged.

VEHICLE DAMAGE

Exterior Damage - 2005 Ford Escape

The 2005 Ford Escape sustained moderate front end damage as a result of the impact with the Toyota Previa.

Damage Description:	Moderate front end damage.	
CDC:	11FLEW2	
Delta V:	Total	21.6 km/h (13.4 mph)
	Longitudinal	-20.3 km/h (-12.6 mph)
	Latitudinal	7.4 km/h (4.6 mph)
	Energy	18,002 joules (13,278 ft lbs)

Description of damage and crush profile:

The Ford Escape sustained 21.0 cm (8.3 in) of direct damage along the front bumper beginning at the left bumper corner and extending to the right. Six crush measurements were documented along the front bumper as follows: C1=20.0 cm (7.9 in), C2=10.0 cm (3.9 in), C3=0.0 cm (0.0 in), C4=0.0 cm (0.0 in), C5=0.0 cm (0.0 in), C6=0.0 cm (0.0 in).

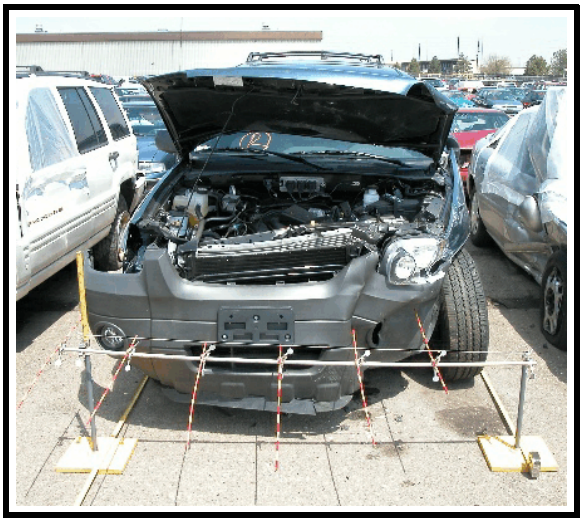


Figure 5. Front, 2005 Ford Escape

Interior Damage - 2005 Ford Escape

The 2005 Ford Escape sustained minor interior damage due to occupant contacts and normal air bag deployment related damage. There were scuffs on the right instrument panel and glove box. There were scuffs to the rear of the center console and to the right side of the front right seat back.

The contact to the seat back caused the head rest adjustment bar to push through the fabric.

There was no intrusion and no integrity loss. The side doors all remained closed and operational. The hatch was jammed shut. There was no glazing damage.

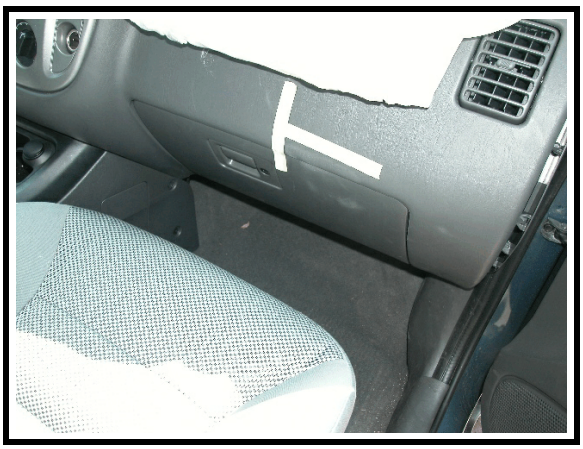


Figure 6. Contact to the right instrument panel and glove box

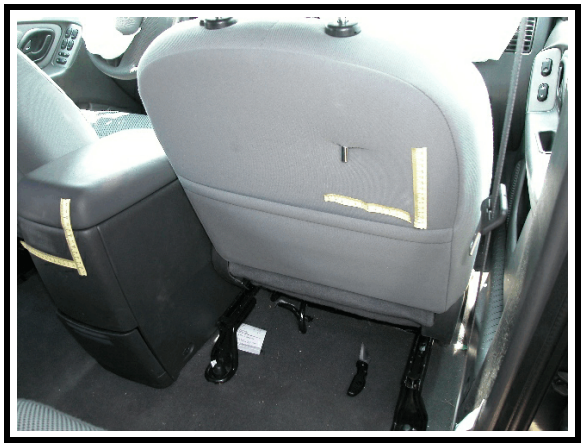


Figure 7. Contacts to right seat back and center console

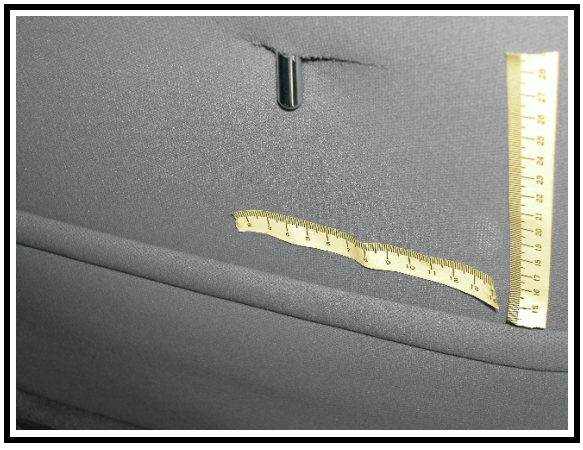


Figure 8. Closeup of contact and damage to right seat back

Manual Restraint Systems - 2005 Ford Escape

Each of the five seating positions were equipped with manual 3-point lap and shoulder belts. Both front seat belts were equipped with buckle pretensioners and load limiters, and seatbelt height adjusters that were in the full down position. The driver's safety belt was configured with a sliding latch plate and an emergency locking retractor (ELR). The remaining seat belts were configured with sliding latch plates and switchable retractors that were in the ELR mode.

The driver's buckle mounted seat belt pretensioner actuated during the crash. There was 10.0 cm (3.9 in) seat belt buckle movement/stroke.

Frontal Air Bag System - 2005 Ford Escape

The driver and right front passenger positions were equipped with dual stage front air bags and safety belt pretensioners with load limiters. The system includes a seat position sensor and a passenger air bag cutoff sensor. The driver's air bag deployed and driver's seat belt pretensioner actuated as a result of the longitudinal deceleration during impact.

Figure 9. Side view of driver's air bag

The driver's air bag was mounted in the center of the steering wheel hub. The air bag module had an H configuration. The top flap measured 15.0 cm (5.9 in) wide by 8.5 cm (3.3 in) high. The bottom flap measured 15.0 cm (5.9 in) wide by 6.0 cm (2.4 in) high. The air bag was somewhat oval in shape and measured 52.0 cm (20.5 in) high and 45.0 cm (17.7 in) wide in its deflated state. The air bag had a single internal tether. There were two circular vent ports on the back of the bag at the 3 and 9 o'clock positions.

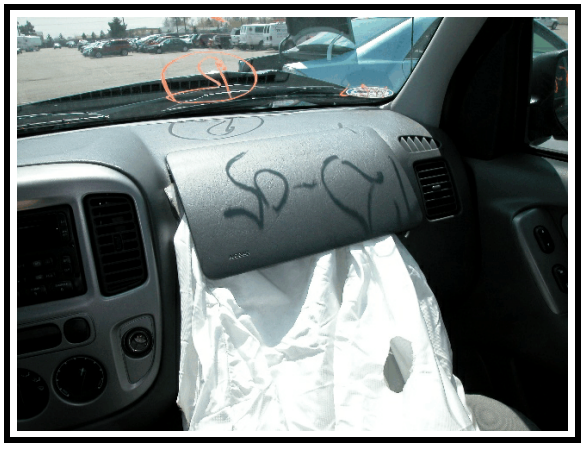


Figure 10. Front right passenger's air bag

The right front passenger air bag was a mid instrument panel mount. The module had a single forward opening cover that was rectangular in shape and measured 73.0 cm (28.7 in) wide by 33.0 cm (12.9 in) high. The air bag measured 33.0 cm (12.9 in) seam to seam laterally and was 68.0 cm (26.8 in) high. The air bag had a maximum excursion of 65.0 cm (25.6 in) in its deflated state. There were two circular vent ports on the sides of the air bag at the 3 and 9 o'clock positions. There was no damage to either air bag or to the air bag module covers.

Vehicle Data - 1995 Toyota Previa

Description:	1995 Toyota Previa minivan	
VIN:	JT3AC24S0S1xxxxxx	
Odometer:	Unknown	
Engine:	4 cylinder, 2.4 L	
Reported Defects:	None noted	
Cargo:	Unknown	
Damage Description:	PAR vehicle damage described as slight damage to the LF area, moderate damage to the hood and right fender, and extreme damage to the RF bumper corner	
CDC:	Unknown	
Delta V:	Total	19.1 km/h (11.9 mph)
	Longitudinal	-3.3 km/h (-2.1 mph)
	Latitudinal	-18.8 km/h (-11.7 mph)
	Energy	52,592 joules (38,790 ft lbs)

Occupant Demographics - 2005 Ford Escape

	Driver	Occupant 2	Occupant 3
Age/Sex:	16/Female	15/Male	16/Male
Seated Position:	Front left	Front right	Rear right
Seat Type:	Cloth covered bucket seat. Seat back reclined 25 degrees from vertical and seat adjusted between middle and forward most seat track position.	Cloth covered bucket seat. Seat back reclined 25 degrees from vertical and seat adjusted to the middle seat track position.	60/40 cloth covered split bench seat. Seat back reclined 20 degrees from vertical. Non-adjustable seat track.
Height:	Unknown	Unknown	Unknown
Weight:	Unknown	Unknown	Unknown
Occupation:	Unknown	Unknown	Unknown
Pre-existing Medical Condition:	Unknown	Unknown	Unknown
Alcohol/Drug Involvement:	Unknown	Unknown	Unknown
Driving Experience:	Presumed to be less than10 years	Not Applicable	Not Applicable
Body Posture:	Presumed to be normal, upright	Presumed to be normal, upright	Presumed to be normal, upright
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	Unknown	Unknown	Unknown
Restraint Usage:	3-point manual lap and shoulder belt available, used	3-point manual lap and shoulder belt available, not used	3-point manual lap and shoulder belt available, not used
Air bag:	Steering wheel mounted air bag, deployed	Mid instrument panel mounted air bag, deployed	None

Occupant Demographics - 1995 Toyota Previa

	Driver
Age/Sex:	49/Female
Seated Position:	Front left
Seat Type:	Bucket
Height:	Unknown
Weight:	Unknown
Occupation:	Unknown
Pre-existing Medical Condition:	Unknown
Alcohol/Drug Involvement:	Unknown
Driving Experience:	Presumed to be greater than 10 years
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt used, per police report

Occupant Injuries - 2005 Ford Escape

	Injury
Driver:	Evident, non-incapacitating, per police report
Front right occupant:	Not injured, per police report
Right rear occupant:	Not injured, per police report

Occupant Injuries - 1995 Toyota Previa

	Injury
Driver:	Possible injury, per police report

OCCUPANT KINEMATICS - 2005 Ford Escape

Driver Kinematics

The 16-year-old female driver of the case vehicle appears to have been seated in an upright posture in the cloth covered bucket seat and was restrained by the 3-point manual lap and shoulder belt. The shoulder belt anchorage was in the full down position. The head restraint was slightly above the full down position. The seat track was adjusted to between the mid and forward most position. The seat back was reclined at a 25 degree angle from the vertical and the seat bottom had a 15 degree angle from the horizontal. At impact, the driver's front air bag deployed and the left side safety belt pretensioner actuated. The female driver initiated a forward and slightly lateral trajectory towards the 11 o'clock direction of force. She loaded the safety belt and possibly engaged the deployed air bag with her face. There were no direct indications of contact. The driver sustained "evident, non-incapacitating" injuries according to the police report. There were no indications of transport. The driver was able to exit the vehicle on her own.

Front Right Occupant Kinematics

The 15-year-old front right passenger was seated forward facing in the cloth covered bucket seat. The seat was adjusted to the middle track position. The head restraint was slightly above the full down position. He was not wearing the available 3-point lap and shoulder belt. This is based on the lack of loading evidence and the non-actuation of the seat belt pretensioner. The seat back was reclined at a 25 degree angle from the vertical and the seat bottom had a 15 degree angle from the horizontal. At impact, the front right passenger's front air bag deployed. The front right passenger initiated a forward and slightly lateral trajectory towards the 11 o'clock direction of force. It appears that his right knee struck and scuffed the right instrument panel and right glove box. There were no indications of any injuries to this occupant. The occupant was able to exit the vehicle on his own.

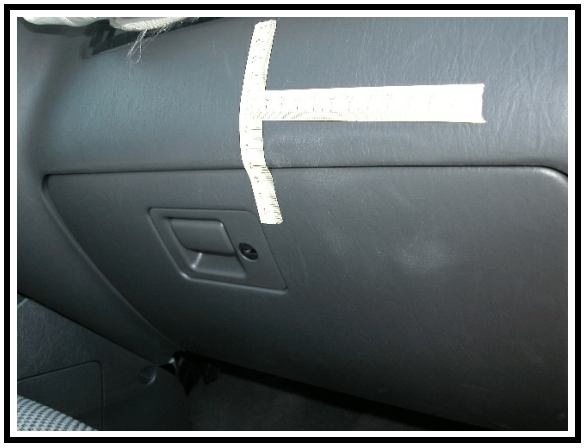


Figure 11. Closeup of contact to the right instrument panel and glove box

Right Rear Occupant Kinematics

The 16-year-old second row right seat passenger was seated forward facing on the cloth covered 60/40 split bench with folding backs. He was not wearing the available 3-point lap and shoulder

belt. This is based on the lack of seat belt loading evidence and the occupant contacts found on the back of the front right seat and the center console. The seat back was reclined at a 20 degree angle from the vertical and the seat bottom had a 15 degree angle from the horizontal. At impact, this passenger initiated a forward and slightly lateral trajectory towards the 11 o'clock direction of force. It appears that his right knee struck and scuffed the front right passenger's seat back. His left knee likely engaged and scuffed the back of the center console. There were no indications of any injuries to this occupant. The occupant was able to exit the vehicle on his own.

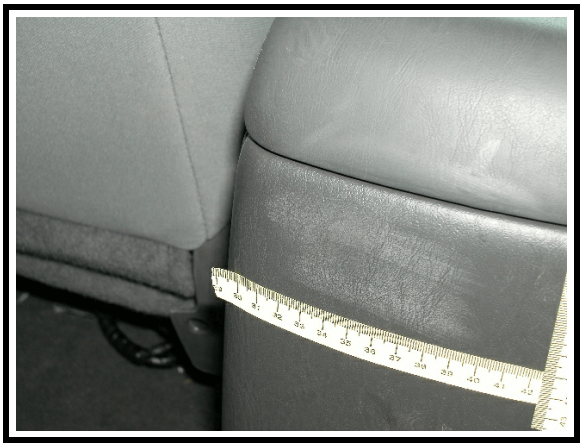


Figure 12. Closeup of contact to back of center console

Attachment 1. Scene Diagram