On scene Investigation / Vehicle to Object
Dynamic Science, Inc. / Case Number: DS04019
2005 Ford Escape
Colorado
July, 2004

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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 on-site investigation focused on the performance of the Certified Advanced 208-Compliant air bag system in a 2005 Ford Escape XLT 4x4 sport utility vehicle. This two-vehicle crash occurred in July 2004 at 1539 hours in the state of Colorado. The crash occurred on a curved portion of a three-lane interstate roadway. The Ford Escape lost control on an interstate highway and struck a concrete barrier on the right side of the roadway. The impact resulted in sufficient longitudinal deceleration of the Escape to command the deployment of the frontal air bag system and actuation of the driver's seat belt pretensioner. The vehicle rotated out from the initial wall impact and was subsequently struck by a 1999 Freightliner tractor pulling a single trailer. The restrained 48-year-old male driver of the Escape appears to have sustained a minor facial injury. The driver of Freightliner did not report any injuries.

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**Dynamic Science, Inc.**
**Crash Investigation**
**Case Number: DS04019**

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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 XLT 4x4 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. The driver of the Ford Escape lost control of the vehicle on an interstate highway and struck a concrete barrier on the right side of the roadway. The impact resulted in sufficient longitudinal deceleration of the Escape to command the deployment of the frontal air bag system and actuation of the driver's seat belt pretensioner. The vehicle rotated out from the initial wall impact and was subsequently struck by a 1999 Freightliner tractor pulling a single trailer. The restrained 48-year-old male driver of the Escape may have sustained a minor facial injury, but did not report any injuries. The driver of Freightliner did not report any injuries.

**Figure 1**. Front left, Ford Escape

This case was identified by NHTSA during a review of GES reports. The case was faxed to DSI with instructions to locate the vehicle on August 6, 2004. Since the time of the crash the vehicle had been moved to a repair facility, declared a total loss, moved to a salvage facility, and then sold to a private party. DSI was able to locate the private party on August 26, 2004. Field work was completed on August 30, 2004.

## SUMMARY

### Crash Site

This is a two-vehicle crash that occurred in July 2004 at 1539 hours in the state of Colorado. The crash occurred on a curved portion of a three-lane interstate roadway. The concrete roadway had a downward grade. The left shoulder was dirt covered. The right shoulder was paved. Next to the paved shoulder was a concrete barrier. The weather was clear and dry. The speed limit is 89 km/h (55 mph).

**Figure 2**. Overview of travel paths and impact areas–east

**Pre-Crash**

The case vehicle was a 2005 Ford Escape XLT 4x4 sport utility driven by a 48-year-old male (183 cm/72 in, 91 kg/200 lbs). The case vehicle was part of a national rental fleet. 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 2005 Ford Escape was traveling eastbound in the left hand lane of the left hand curve.

The other vehicle was a 1999 Freightliner FLC120 6x4 cab behind engine truck tractor (VIN: 1FUYDSEB5Xxxxxx) hauling a 14.3 m (47.0 ft) flat bed trailer. The total length of the truck/trailer combination was 20.4 m (67.0 ft). The gross vehicle weight rating was 36,288 kg (80,000 lbs).

The Freightliner was traveling in the right hand lane.

**Crash**

The Escape apparently drifted off the road on the left side for approximately 32.6 m (107.0 ft). The driver over corrected to the right and the vehicle went into a clockwise rotation. The Escape went across all three lanes of travel and struck a concrete barrier with its front end (CDC=11FDEW1). It appears that the front air bags in the Escape deployed at this time. The Escape continued its clockwise rotation and struck the barrier again with its rear end (CDC=04BYES1) approximately 15.5 m (51.0 ft) further east. At or near this point, the front of the Escape came into the right hand travel lane where it was then struck by the front of the Freightliner (CDC=Unknown).

As a result of the front impact with the barrier and the overlapping damage from the impact with the other vehicle, the case vehicle sustained 147.0 cm (57.8 in) of direct damage along the front bumper beginning at the left bumper corner and extending to the right. The maximum crush was 27.0 cm (10.6 in) and located at C2. The total velocity change[1] as computed by the WinSmash barrier algorithm was 24.1 km (15.0 mph). The longitudinal and lateral velocity changes were -22.7 km (-14.1 mph) and 8.3 km/h (5.1 mph), respectively. The results should be considered borderline because the level of damage caused by the impact with the other vehicle is not entirely clear.

**Post-Crash**

There were no reported injuries by any parties in the crash.

The Ford Escape sustained moderate front and rear damage and was towed from the scene. The police report indicated that the Freightliner sustained minor contact damage to the front right corner and was driven from the scene.

[1]Calculated using stiffness values from NCAP test 4952.

**VEHICLE DATA -2005 Ford Escape XLT 4x4 sport utility vehicle**

The 2005 Ford Escape XLT 4x4 sport utility vehicle was identified by its Vehicle Identification Number (VIN): 1FMYU93105KAxxxxxx) . The Ford Escape is a four-door, four wheel drive sport-utility with seating for five. It was equipped with a 3.0 liter 6-cylinder end, 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 odometer reading at the time of the vehicle inspection was 15,753 km (9,789 miles).

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

| Tire | Tread | Pressure | Recommended cold pressure |
|---|---|---|---|
| LF | 8 mm (10/32 in) | 193 kPa (28 psi) | 220 kPa (32 psi) |
| LR | 8 mm (10/32 in) | 234 kPa (34 psi) | 220 kPa (32 psi) |
| RF | 8 mm (10/32 in) | Flat | 220 kPa (32 psi) |
| RR | 8 mm (10/32 in) | 255 kPa (37 psi) | 220 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

| | | |
|---|---|---|
| Damage Description: | The Ford escape sustained moderate front end damage from the impacts with the barrier and the tractor trailer. There was minor sideswiping damage to the back right corner. The vehicle was towed from the scene due to damage and was later declared a total loss. The front right tire was flattened. The rear hatch was jammed shut. | |
| CDC: | Impact 1: 11FDEW1<br>Impact 2: 04BYES1<br>Impact 3: Unknown | |
| Delta V (Impact 1): | Total | 24.1 km/h (15.0 mph) |
| | Longitudinal | -22.7 km/h (-14.1 mph) |
| | Latitudinal | 8.3 km/h (5.1 mph) |
| | Energy | 47,600 joules<br>(35,107 ft-lbs) |

**Figure 3**. Front right, Ford Escape


**Figure 4**. Rear left corner, Ford Escape.

As a result of the front impact with the barrier and the overlapping damage from the impact with the other vehicle, the case vehicle sustained 147.0 cm (57.8 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=9.0 cm (3.5 in), C2=27.0 cm (10.6 in), C3=17.0 cm (6.7 in), C4=13.0 cm (5.1 in), C5=11.0 cm (4.3 in), C6=7.0 cm (2.8 in).

**Interior Damage - 2005 Ford Escape**

The 2005 Ford Escape did not sustain any significant interior damage except normal expected air bag deployment related damage. 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.

**MANUAL RESTRAINT SYSTEMS - 2005 Ford Escape**

The 2005 Ford Escape was configured with manual 3-point lap and shoulder belts for each of the five seating positions. Both front seat belts were equipped with buckle pretensioners and load limiters, and seatbelt height adjusters that were in the full up 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 emergency locking retractor (ELR) mode.

The driver's buckle mounted seat belt pretensioner actuated during the barrier crash. There was 6.0 cm (2.4 in) of stroke. There were loading marks found on the shoulder harness from the D ring. These measured 13.0 cm (5.1 in) in length and were located 103.0 cm (40.6 in) from the stop button. The front right passenger's pretensioner did not actuate.

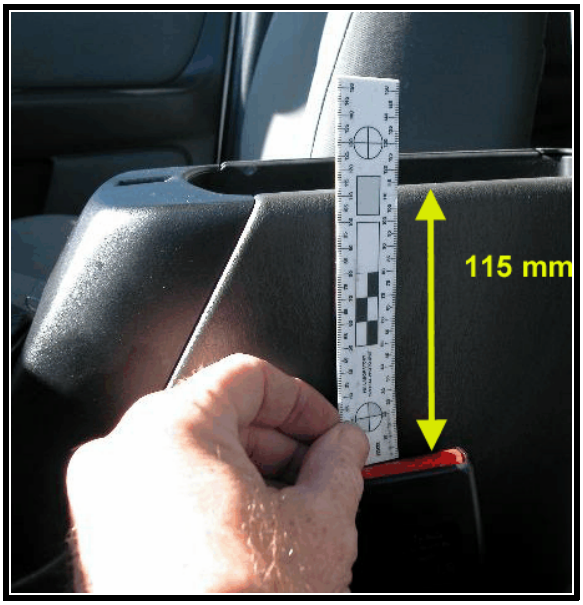


**Figure 5**. Driver's side buckle retractor position. Pretensioner actuated.


**Figure 6**. Front right passenger buckle retractor position. Pretensioner not actuated.

**FRONTAL AIR BAG SYSTEM - 2005 Ford Escape**

The 2005 Ford Escape was equipped with dual stage frontal air bags and safety belt pretensioners with load limiters for the driver and front right passenger positions. The system includes a seat position senor 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 of the Ford during the impact with the concrete wall.

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 13.5 cm (5.3 in) at the tear point by 7.5 cm (2.9 in) high. The bottom flap measured 13.5 cm (5.3 in) wide at the tear point by 5.5 cm (2.2 in) high. The air bag was circular in shape and measured 52.0 cm (20.5 in) in its deflated state. The air bag had a single internal tether. There were two circular vent ports on the back of the back at the 3 and 9 o'clock positions. Both vent ports were scorched along the edges. There was a single skin transfer/blood contact found in the lower right quadrant. The stain tested positive for blood. The front right passenger's air bag was a mid instrument mount and did not deploy.

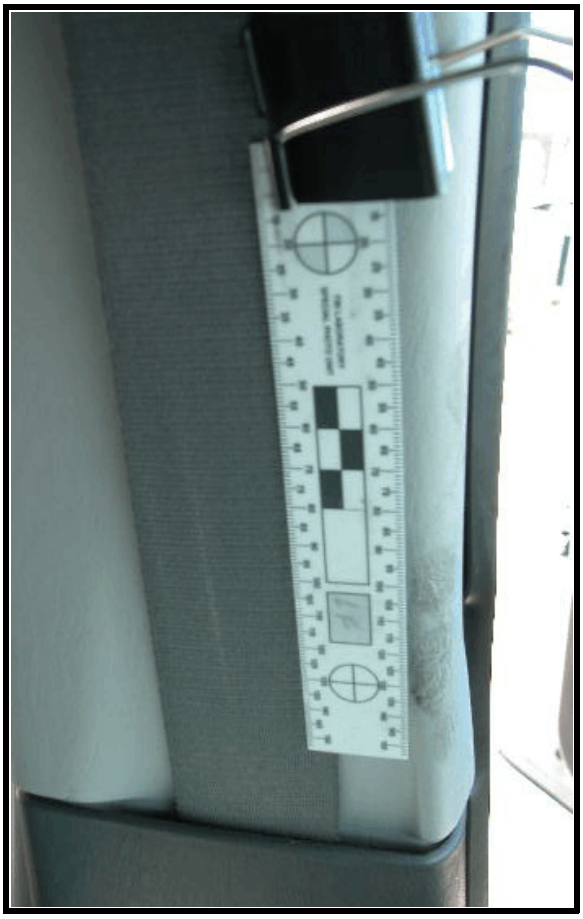

**Figure 7**. Loading to driver's seat belt webbing

**Figure 8**. Driver's air bag. Contact to right lower quadrant.

**Figure 9**. Driver's air bag. Scorched vent ports and top module cover.

**VEHICLE DATA - 1999 Freightliner FLC120 6x4 cab behind engine truck tractor**

| | | |
|---|---|---|
| Description: | 1999 Freightliner FLC120 6x4 cab behind engine truck tractor hauling a trailer. The gross vehicle weight rating was 36,288 kg (80,000 lbs). | |
| VIN: | 1FUYDSEB5Xxxxxxx | |
| Odometer: | Unknown | |
| Engine: | 774 CID, 6 cylinder, diesel | |
| Reported Defects: | None noted | |
| Cargo: | Truck hauling a 14.3 m (47 ft) flat bed trailer. The total length of the truck/trailer combination was 20.4 m (67 ft). Unknown if loaded or unloaded. | |
| Damage Description: | Police indicate some minor contact damage to the front right corner. Vehicle was driven from the scene. | |
| TDC: | Unknown | |
| Delta V: | Total | Unknown |
| | Longitudinal | Unknown |
| | Latitudinal | Unknown |
| | Energy | Unknown |

**Figure 10**. Exemplar views of 1999 Freightliner FLC120 tractor

**OCCUPANT DEMOGRAPHICS - 2005 Ford Escape**

| | Driver |
|---|---|
| Age/Sex: | 48/Male |
| Seated Position: | Front left |
| Seat Type: | Fabric covered bucket seat. Seat adjusted to rear most track position. Seat back angle of 64 degrees, seat bottom angle of 7 degrees. |
| Height: | 183 cm (72 in) |
| Weight: | 91 kg (200 lbs) |
| Occupation: | Unknown |
| Pre-existing Medical Condition: | None noted |
| Alcohol/Drug Involvement: | None |
| Driving Experience: | Greater than 20 years |
| Body Posture: | Normal, upright |
| Hand Position: | Unknown. Driver actively steering. |
| Foot Position: | Right foot on brake, left on floor |
| Restraint Usage: | Lap and shoulder belt available, used. |
| Air bag: | Driver's air bag available, deployed |

**OCCUPANT DEMOGRAPHICS - 1999 Freightliner**

| | |
|---|---|
| Age/Sex: | 54/Male |
| Seated Position: | Front left |
| Seat Type: | Unknown |
| Height: | Unknown |
| Weight: | Unknown |
| Occupation: | Truck driver |
| Pre-existing Medical Condition: | None noted |
| Alcohol/Drug Involvement: | None |
| Driving Experience: | Unknown |
| Body Posture: | Presumed to be upright, normal |
| Hand Position: | Unknown |
| Foot Position: | Unknown |
| Restraint Usage: | Unknown restraint used, per police report |

**OCCUPANT INJURIES - 2005 Ford Escape**

Driver injuries: Injuries based on the location and presence of blood and tissue on the driver's air bag.

| Injury | OIC Code | Injury Mechanism | Confidence Level |
|---|---|---|---|
| Possible facial injury | NA | Air bag | Possible |

**OCCUPANT INJURIES - 1999 Freightliner**

| Injury | OIC Code | Injury Mechanism | Confidence Level |
|---|---|---|---|
| Not injured | | | |

**OCCUPANT KINEMATICS - 2005 Ford Escape**

**Driver Kinematics**

The 48-year-old male driver was seated in an upright posture in the cloth covered bucket seat and was restrained by the 3-point manual lap and shoulder belt. The seat track was adjusted to the rear most position. The seat back was reclined at a 64 degree angle and the seat bottom had a 7 degree angle. The driver was wearing glasses with plastic lenses and frame. At impact, the driver's front air bag deployed and the left side safety belt pretensioner actuated. The male driver initiated a forward and slightly lateral trajectory towards the 11 o'clock direction of force. He loaded the safety belt and engaged the deployed air bag with his face. There was skin transfer and blood[2] found on the right lower quadrant of the air bag face. The actual location of the contact at the time of the crash was likely more towards the top due to the driver's attempt to steer out of rotation. After the initial impact, the vehicle rotated clockwise and the driver pitched to left both due to rotation and the subsequent impact to the barrier with the left rear corner of the vehicle. The driver remained essentially upright and held in place by the pretensioner seat belt. There was a final impact with the front of the Ford with the front right of the Freightliner, but this appears to have been relatively minor. The police indicated that the driver of the Ford was uninjured and he was able to exit the vehicle under his own power.

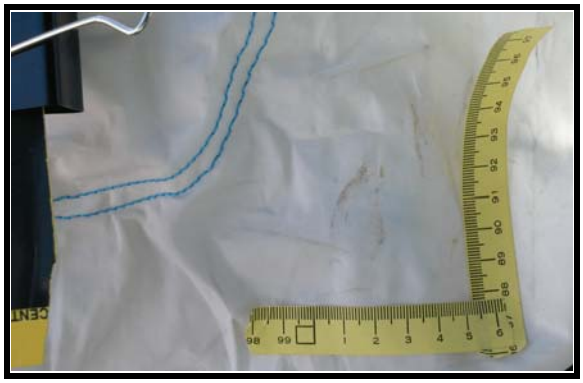

**Figure 11**. Skin/blood contact to face of driver's air bag

[2]Tested positive for blood using Hemident presumptive blood reagent kit.

**Attachment 1. Scene Diagram**