CRASH DATA RESEARCH CENTER

Calspan Corporation
Buffalo, NY 14225

CALSPAN ON-SITE OFFICE OF DEFECTS INVESTIGATION ROLLOVER CRASH INVESTIGATION

SCI CASE NO. – CA08052

VEHICLE – 2007 FORD ESCAPE XLT

LOCATION – MASSACHUSETTS

CRASH DATE – OCTOBER 2008

Contract No. DTNH22-07-C-00043

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
Washington, D.C. 20590

DISCLAIMER

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no responsibility for the contents or use thereof.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points are 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 STANDARD TITLE PAGE

1. Report No. CA08052	*2. Government Accession No.*	*3. Recipient's Catalog No.*	
4. Title and Subtitle Calspan On-Site Office of Defects Investigation Rollover Crash Investigation Vehicle: 2007 Ford Escape Location: State of New York		*5. Report Date*: June 2009 *6. Performing Organization Code*	
7. Author(s) Crash Data Research Center		*8. Performing Organization Report No.*	
9. Performing Organization Name and Address Crash Data Research Center Calspan Corporation P.O. Box 400 Buffalo, New York 14225		*10. Work Unit No.* C00500.0000.0113 *11. Contract or Grant No.* DTNH22-07-C-00043	
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Washington, D.C. 20590		*13. Type of Report and Period Covered* Technical Report Crash Date: October 2008 *14. Sponsoring Agency Code*	
15. Supplementary Note This on-site investigation focused on the rollover crash that involved a 2007 Ford Escape XLT sport utility vehicle.			
16. Abstract This on-site investigation focused on the rollover crash that involved a 2007 Ford Escape XLT sport utility vehicle. The Ford was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system, an indirect Tire Pressure Monitoring System (TPMS), all-wheel drive, and a sunroof. The Escape was not equipped with the optional inflatable side curtain air bags with rollover sensing. Electronic Stability Control was not available on this vehicle. The manufacturer of this vehicle has certified that the 2007 Ford Escape meets the advanced air bag portion of Federal Motor Vehicle Safety Standard No. 208. The Escape was involved in a single vehicle on-road rollover crash that resulted in fatal injuries to the restrained 29-year old female driver. She expired from a massive head injury that resulted from a partial ejection of the head through the left front door window opening.			
17. Key Words Rollover crash Tire Valve Stems		*18. Distribution Statement* General Public	
19. Security Classif. (of this report) Unclassified	*20. Security Classif. (of this page)* Unclassified	*21. No. of Pages* 12	*22. Price*

TABLE OF CONTENTS

BACKGROUND **1**

SUMMARY **2**

CRASH SITE 2
VEHICLE DATA 2
2007 FORD ESCAPE 2
VEHICLE HISTORY 3
CRASH SEQUENCE 4
PRE-CRASH 4
CRASH 5
POST-CRASH 5
VEHICLE DAMAGE 5
EXTERIOR 5
INTERIOR 7
TIRE - WHEEL - VALVE STEM DATA / DAMAGE 7
FRONTAL AIR BAG SYSTEM 10
MANUAL SAFETY BELT SYSTEMS 10
DRIVER DEMOGRAPHICS/DATA 11
DRIVER INJURY 11
DRIVER KINEMATICS 11

CALSPAN ON-SITE OFFICE OF DEFECTS INVESTIGATION
ROLLOVER CRASH INVESTIGATION
SCI CASE NO. – CA08052
VEHICLE – 2007 FORD ESCAPE XLT
LOCATION – MASSACHUSETTS
CRASH DATE – OCTOBER 2008

BACKGROUND

Figure 1. Overall view of the Ford Escape.

This on-site investigation focused on the rollover crash that involved a 2007 Ford Escape XLT sport utility vehicle. The Ford was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system, an indirect Tire Pressure Monitoring System (TPMS), all-wheel drive, and a sunroof. The Escape was not equipped with the optional inflatable side curtain air bags with rollover sensing. Electronic Stability Control was not available on this vehicle. The manufacturer of this vehicle has certified that the 2007 Ford Escape meets the advanced air bag portion of Federal Motor Vehicle Safety Standard No. 208. The Escape was involved in a single vehicle on-road rollover crash that resulted in fatal injuries to the restrained 29-year old female driver. She expired from a massive head injury that resulted from a partial ejection of the head through the left front door window opening.

A family member of the deceased driver submitted an on-line Vehicle Owner's Questionnaire (VOQ) through NHTSA's Auto Safety Hotline on November 15, 2008. This notification alerted NHTSA's Office of Defects Investigation (ODI) of a potential tire inflation/wheel issue. The VOQ was forwarded to the Calspan Special Crash Investigations (SCI) team on November 17, 2008 for an on-site investigation. The SCI team immediately contacted the family member to gain further information relating to the crash and the possible disposition of the vehicle. Additional follow-up was conducted with the investigating police agency and the insurance company. The vehicle was subsequently located at a regional insurance salvage yard and was available for SCI inspection. The on-site aspect of this investigation occurred on Monday, November 24, 2008 and involved the inspection and documentation of the vehicle and the crash site, and an interview with the investigating police officer. Additional telephone follow-up was conducted with the reporting family member. This person provided service invoices of recent tire and wheel repairs to the Escape. The family member; however, declined to authorized the release of the driver's autopsy report to the SCI team.

SUMMARY

Crash Site

Figure 2. Look-back view of the Ford's pre-crash trajectory.

The crash occurred on a divided interstate roadway during nighttime hours. At the time of the crash, the conditions were clear, dry and dark. The roadway was not illuminated. The driver of the Ford Escape was traveling in an easterly direction. The eastbound lanes consisted of three travel lanes that were surfaced with asphalt and posted with a 105 km/h (65 mph) speed limit. A thire-beam median barrier separated the east and west bound lanes. The travel lanes were 3.7 m (12') in width and were bordered by asphalt surfaced shoulders with curbs located at the outboard aspect of the shoulders. Rumble strips were cut into the inboard shoulder. The travel lanes were delineated by broken white lane lines with solid lines marking the edges of the inboard and outboard travel lanes. On the distant approach to the crash site, the eastbound lanes curved to the left with an uphill grade. In the vicinity of the crash site, the lanes transitioned to a straight segment with a slight positive grade of less than two-percent. **Figure 2** is a look-back view of the Ford's trajectory to the crash site. The Crash Schematic is attached as **Figure 16**, Page 12 of this report.

Vehicle Data

2007 Ford Escape

Figure 3. Image of an exemplar 2007 Ford Escape.

The case vehicle in this crash was a 2007 Ford Escape XLT sport utility vehicle. An exemplar vehicle is depicted in **Figure 3**. The Escape was manufactured in October 2006 and was identified by Vehicle Identification Number (VIN) 1FMYU93107K (production number deleted). The odometer reading at the time of the crash is unknown. The Escape was powered by a 3.0 liter, V-6 gasoline engine linked to a four-speed automatic transmission with a console mounted shifter. The vehicle was equipped with a roof rack and a power sunroof. The service brakes were power-assisted four-wheel disc with anti-lock. Electronic brake force distribution was standard. Electronic Stability Control was not available on this vehicle. The Escape was equipped with OEM five-spoke alloy wheels with P235/70R16 Continental ContiTrac tires. The vehicle manufacturer recommended cold tire pressure for this vehicle was 205 kPa (30 PSI). The Escape was also equipped with an indirect Tire Pressure Monitoring System (TPMS) that was standard equipment. The specific tire data at the time of the SCI inspection was as follows:

Position	Measured Tire Pressure	Measured Tread Depth	Tire/Wheel Damage
LF	Flat and de-beaded	5 mm (6/32”)	Outer bead of alloy wheel abraded circumferentially, 5 cm cut to outer sidewall of tire
LR	Flat and de-beaded	9 mm (11/32”)	15x3 cm dent to outer bead of alloy wheel at the valve stem location, 6x3 cm gouge in sidewall
RF	Flat and de-beaded	5 mm (6/32”)	Alloy wheel fractured, 40 percent (2-spokes) of wheel separated, remaining outer bead abraded by road surface
RR	Flat and de-beaded	9 mm (11/32”)	Outer bead of alloy wheel abraded circumferentially with asphalt embedded into bead

The interior of the Ford Escape was equipped with Certified Advanced 208-Compliant frontal air bags for the driver and front right passenger positions. All five seating positions were equipped with three-point lap and shoulder safety belt systems with front buckle pretensioners. The Escape was not equipped with the optional seat back mounted side impact air bag system or the inflatable side curtain air bags with rollover sensing. The front bucket seats were equipped with reclining seat backs and adjustable head restraints. Both front head restraints were adjusted 6 cm (2.5”) above the seat backs. The second row seat was a split bench (60/40 left side wide) with forward folding seat cushions and seat backs. The three rear seat positions were equipped with adjustable head restraints that were adjusted 9 cm (3.5”) above the seat backs.

Vehicle History

The driver purchased the 2007 Ford Escape as a new vehicle. Routine service was performed on the Escape during the first year of ownership. On Saturday, August 9, 2008, the driver reported to her father that the right front tire was loosing air and that the vehicle had a vibration in the front. The father drove the Escape to a local chain tire retailer/service center and informed the service manager of the vehicle complaint. The Escape was inspected and a crack was discovered in the right front wheel. The risks of driving the vehicle in that condition were explained to the father and he agreed to leave the vehicle at the service center for several days as a new replacement wheel was ordered for the Ford. In addition to the wheel, the Escape was diagnosed with worn rear brakes. New rear disc brake pads, rotors, and an oil and filter change were also performed during this service interval. The recorded odometer reading at this service interval was 60,820 km (37,793 miles). The new wheel was installed with the installation of a new valve stem, reinstallation of the TPMS sensor and band clamp, and tire/wheel balancing. In addition, a four-wheel alignment was performed. The repair order was completed on Wednesday, August 13, 2008.

The driver/owner of the Ford Escape complained to her sister that the vehicle had another vibration in the front wheels and returned it to the same tire dealer noted above on September 3, 2008. The service technician diagnosed the problem as a loose TPMS wheel sensor in the left front due to a faulty sensor band strap. The band strap was replaced at a recorded odometer reading of 62,808 km (39,028 miles). Following this repair, the driver stated to her sister that the Escape drove like it did when new. It should be noted that an aftermarket band strap was installed on the right front wheel, the wheel that was replaced during the August service. There was no mention of this strap on the service invoice; therefore it is possible that the right front band strap was replaced during the September work order.

Crash Sequence

Pre-Crash

The driver was traveling in an easterly direction on the inboard lane of the divided interstate roadway at a witness estimated speed of 130-145 km/h (80-90 mph). On the distant approach to the impending crash site, the interstate was curved to the left for eastbound traffic with a positive grade that exceeded two percent. The road transitioned to a straight segment with a slight positive grade of less than two percent. As the driver passed the off-ramp, she attempted an aggressive lane change maneuver to the right, crossing the center lane onto the outboard travel lane. The witness noted that she was not passing slower moving traffic, just changing lanes.

As the Escape entered the outboard travel lane, the driver applied a rapid counterclockwise (CCW) steering input in an attempt to maintain directional control of the vehicle. This CCW input loaded the right side tires. The right front tire rolled under the alloy wheel and probably experienced a loss of air pressure. The alloy wheel subsequently gouged the asphalt road surface, originating in the center of the outboard travel lane and arced in a CCW direction at the outboard edge line **(Figure 4)**. As this point the vehicle was in a slight CCW yaw.

The right rear tire rolled under the alloy wheel, causing the wheel to gouge the asphalt shoulder, terminating at the edge line **(Figure 5)**. These wheel gouges tripped the Escape into a lateral right side leading rollover event.

Figure 4. Right front wheel gouge mark.

Figure 5. Right rear wheel gouge mark.

Crash

The vehicle overturned to its right as it traversed the eastbound travel lanes **(Figure 6)**. The left roof side rail area impacted the pavement between the second and third quarter turns resulting in lateral and downward deflection of the roof. The left side glazing disintegrated. The restrained driver responded laterally to her left. Her head was partially ejected through the window opening and was crushed between the asphalt road surface and the left side rail of the vehicle. Body fluid and strands of hair evidenced the contact area on the vehicle.

Figure 6. Rollover trajectory of the Ford Escape.

The Escape continued to overturn across the travel lanes for an estimated distance of 19 m (62'). Based on the lateral and longitudinal abrasion patterns on the vehicle, the initial pre-crash speed, and the travel distance, it was determined that the Escape completed eight-quarter turns. The vehicle came to rest on its wheels facing in a northwesterly direction.

Post-Crash

The first responders arrived on scene and determined that the driver was deceased at the scene of the crash. Her body was unbuckled from the safety belt system and removed through the left front door. The Escape was towed from the crash site and transferred to an insurance salvage facility where it was held for this SCI investigation.

Vehicle Damage

Exterior

The exterior of the Ford escape sustained severe damage to the roof that was associated to the rollover event. The direct contact damage consisted of road surface abrasions that extended the full length and width of the vehicle **(Figure 7)**. The abrasions were primarily laterally oriented across the leading edge of the hood, the roof side rails, the windshield header and the backlight header area at both D-pillars. The left aspect of the front bumper fascia was abraded with several small areas abraded full-thickness. The left corner of the bumper beam was crushed 5 cm (2").

The left front fender exhibited vertically oriented road abrasions the full length and height of the component. The left outside mirror separated from the door mount. The left front upper window frame was displaced laterally to the right and was heavily abraded. On the door skin below the beltline were vertically oriented abrasions. A longitudinally oriented abrasion pattern was located on the mid left doors at the B-pillar area. Scattered abrasions were noted to the left quarter panel. The fuel filler door was crushed and displaced forward.

The top aspect of the rear lift gate was heavily abraded at the D-pillar locations. The lift gate remained closed during the rollover. The right quarter panel was abraded and dented

at the wheel opening flare and at the side rail and C-pillar locations. Longitudinally oriented abrasions were located on the mid right door panels at the B-pillar areas. The right outside mirror was fractured and separated from the door. The right front fender was crushed laterally and heavily abraded at the forward half. The aft aspect of the fender was abraded longitudinally. The abrasions extended onto the leading aspect of the right front door.

Maximum roof crush was 33 cm (12.9”) located at the mid aspect of the windshield header. This area of the roof buckled from lateral displacement of the left roof side rail. The left side rail was crushed downward approximately 20 cm (8”) and displaced laterally right 25 cm (10”) at the left A-pillar area **(Figure 8)**. The Collision Deformation Classification (CDC) for this rollover is 00-TDDO-4.

All four doors remained closed during the crash. At the time of the SCI inspection, the left front door was closed and unlocked. This door opened and re-latched without difficulty. The left rear and right side doors were locked. These doors were manually unlocked, opened and re-latched as all four side doors remained operational post-crash. The rear lift gate was locked and appeared to be operational. The locking mechanism for this lift gate was electric with no key lock or manual release lever.

The laminated windshield was 100 percent fractured and was not holed. The laminate tore post-crash along both A-pillars and the header, allowing the windshield to sag inward onto the top of the instrument panel. The sunroof was in the closed position pre-crash and disintegrated during the rollover event. The interior cover door for the sunroof was retracted into the headliner pre-crash.

The glazing in the left doors was closed pre-crash and disintegrated during the rollover. The fixed rear quarter windows also disintegrated. The backlight glazing was closed and disintegrated during the crash. The glazing for the right doors was closed and remained intact during the rollover. The front door glazing was AS-2 tempered glass while the rear door, quarter window, backlight, and sunroof were OEM deep tint AS-3 glazing.

The Escape was equipped with a roof rack as standard equipment. At the time of the inspection, the lateral load bars were separated from the rack and were not with the vehicle. The roof rack rails did not contribute to the deformation of the roof.

Figure 7. Front left oblique view of the Ford Escape.

Figure 8. Roof crush, vertical land lateral.

Interior

The interior of the Escape was significantly reduced in size by the vertical displacement of the roof and lateral displacement of the left roof side rail. There were no visible driver contact points within the interior; however, the interior surfaces were heavily stained by body fluid spatter as the driver rebounded laterally right during the later stages of the rollover. Maximum roof crush was located at the front header and was 33 cm (12.9”), resulting in a matching intrusion value into the front center of the vehicle. The lateral extent of intrusion was located at the left roof side rail and was approximately 27 cm (10.5”). The combination of lateral displacement of the roof side rail and the left front door window frame with the disintegration of the left door glazing created an ejection portal for the restrained driver’s head during the third-quarter turn of the rollover.

The intrusions into the passenger compartment are identified in the following table:

Position	Component	Magnitude	Direction
Front Left	Roof headliner	37 cm (14.5”)	Vertical
Front Left	Windshield header/roof	28 cm (11”)	Vertical
Front Left	Left roof side rail	20 cm (8”)	Vertical
Front Left	Left roof side rail	27 cm (10.5”)	Lateral
Front Left	Left door window frame	14 cm (5.5”)	Lateral
Front Left	Left upper B-pillar	13 cm (5”)	Lateral
Front Left	Left door window frame	8 cm (3”)	Vertical
Front Center	Windshield header/roof	33 cm (12.9”)	Vertical
Front Right	Windshield header/roof	15 cm (6”)	Vertical
Rear Left	Roof/headliner	29 cm (11.5”)	Vertical
Rear Left	Left roof side rail	15 cm (6”)	Lateral
Rear Center	Roof/headliner	15 cm (6”)	Vertical

Tire - Wheel - Valve Stem Data / Damage

The tires and wheels of the Ford Escape remained in the crash-damaged state at the time of the SCI inspection that occurred six-weeks after the crash.

The Escape was equipped with matching OEM Continental ContiTrac sport utility tires. All four tires were coded with the same DOT Number that contained eight characters. The numbers were readily visible on the outer aspect of the sidewalls and were as follows: A308 46KW. The tires were sized at P235/70R16 with a load and speed rating of 104T. The tires were embossed with a Treadwear Rating of 520, a Temperature Rating of B and a Traction Rating of A. Maximum inflation pressure was 300 kPa (44 PSI). All four tires displayed uniform tread wear. The front tires ranged from 5-6 mm (6-7/32”) while the rears were consistent at 9 mm (11/32”).

The Escape was equipped with OEM alloy five-spoke alloy wheels. These wheels were standard equipment on the XLT trim package. As previously noted in the ***Vehicle History*** section of this report, the right front alloy wheel was replaced on or about August

13, 2008 due to a crack in the original wheel. This replacement wheel was an OEM replacement and an exact match to the original wheel.
The Escape was equipped with an indirect TPMS that utilized a remote sensor that was band mounted to the inner wheel at the outer bead flange. These bands were stainless steel straps that were approximately 13 mm (0.5”) in width. The sensors were positioned 180 degrees opposite of the tire valves.

The alloy wheels were equipped with rubber tire valves. The replacement of the right front wheel required the installation of a new tire valve, thus this valve would not have matched the OEM valves in the other three wheels. The right front wheel was fractured during the crash and the separated section of this wheel contained the valve. This section was not recovered during the SCI investigation.

The OEM tire valves in the left front and rear wheels were presumed to have been manufactured by Topseal. These valve stems were closely inspected for signs of cracking during the SCI investigation. None of the valves appeared to have cracks. The SCI investigator proceeded to remove the valves from the alloy wheels. All four tires were flat and de-beaded from the wheels, thus the inner bulb of the valve was visible on the inside surface of the wheel. A silicone lubricant was applied to both surfaces of the stems at the wheel bore. A valve stem installation tool was threaded onto the stem and slight pressure was applied to stretch the stem away from the wheel to check for further cracking. None was visible. A small pry tool was used to push the bulb of the stem outward through the wheel bore as a slight pulling force was applied to the valve stem tool. All three valve stems were removed from the vehicle without difficulty and without further damage to the valves **(Figure 9)**. This removal process facilitated a close and thorough inspection of the valve stems.

The identification numbers on the bottom of the stems **(Figure 10)** were as follows:

Position	Valve Identification
LF	06 TR414 111
LR	06 TR414 141
RR	06 TR414 017

Figure 9. Removed LF valve stem.

Figure 10. Close-up view of the LF tire valve identification.

The left front tire was de-beaded. A 5 cm (2") vertically oriented cut was noted to the mid point of the outer sidewall of the tire, located nearly 180 degrees opposite of the tire valve. The sidewall of the tire was scuffed in this area from probable contact with the asphalt road surface during the rollover.

The left front alloy wheel was abraded 360 degrees circumferentially about the outer bead flange. A band of asphalt was embedded into the outer bead flange of the wheel and was 11 cm (4.5") in length. This asphalt was embedded immediately clockwise (CW) of the tire valve **(Figure 11)**.

Figure 11. Left front tire and wheel.

Figure 12. Fractured (replaced) right front alloy wheel and tire.

The right front tire was de-beaded with a 3 cm (1") vertical cut located near the bead of the tire. The sidewall was scuffed and abraded from contact with the asphalt road surface.

The right front alloy wheel was the replacement wheel. The wheel fractured from impact with the road surface during the rollover **(Figure 12)**. The wheel fractured below the horizontal centerline with fracture lines extending through inner wheel, both bead flanges, and two spokes immediately outboard of the hub. The fractured section separated from the vehicle and was not recovered during the SCI investigation. A small area of circumferential bead abrasion was located on the wheel above the fracture line. The remaining face of the wheel was not damaged.

The left rear tire was de-beaded. A superficial gouge that measured 6x3 cm (2.5x1") was located on the mid aspect or the outer sidewall approximately 120 degrees CW of the tire valve. This gouge was not full thickness.

The outer bead flange of the left rear alloy wheel was deformed at the area of the tire valve **(Figure 13)**. The dent was 15 cm (6") in length and approximately 3 cm (1") in depth. Subtle cracking of the wheel at the inner bead flange resulted from this deformation. The outer bead flange was abraded 360 degrees circumferentially with asphalt embedded into the flange nearly opposite of the valve.

Figure 13. Left rear tire and wheel.

Figure 14. Right rear tire and wheel.

The right rear axle was deformed by the tire/wheel impact with the road surface during the rollover event. This resulted in severe camber to the axle position with the bottom aspect of the wheel cambered inward. The outer bead flange was abraded 360 degrees circumferentially with a 13 cm (5") area of asphalt embedded into the bead flange in the area of the tire valve **(Figure 14)**. This probably occurred during the pre-crash counterclockwise yaw of the Escape as asphalt fragments were spattered onto the stem.

The right rear tire was de-beaded and no visible damage was noted to the tire. Scuffing on the sidewall of the tire appeared to have occurred from moving the vehicle on the coarse stone at the salvage facility.

Frontal Air Bag System

The 2007 Ford Escape was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system for the driver and front right passenger positions. The manufacturer of this vehicle has certified that the Ford Escape meets the advanced air bag portion of Federal Motor Vehicle Safety Standard No. 208. The CAC system consisted of dual stage frontal air bags, seat track positioning sensors, safety belt buckle switches, and a front right occupant presence system with a center instrument panel mounted Passenger Air Bag Status indicator lamp. In addition to the air bags, the Escape was equipped with front safety belt buckle pretensioners. The CAC system was monitored and controlled by a Restraints Control Module (RCM) that was located on the center tunnel forward of the shift lever. A remote frontal crash sensor was located at the mid point of the upper radiator support panel. This vehicle platform was not supported for download by the Bosch Crash Data Retrieval Tool, Version 3.0. The CAC air bag system did not deploy in this rollover crash.

Manual Safety Belt Systems

The Ford Escape was equipped with manual safety belt systems for the five designated seating positions. All systems consisted of continuous loop webbing with sliding latch plates. The driver's belt system retracted onto an Emergency Locking Retractor (ELR) while the other belt system utilized switchable ELR and Automatic Locking Retractors (ALR). Pretensioners were incorporated into the front buckle systems that were mounted to the inboard aspect of the seat frames. The pretensioners did not actuate during the rollover crash.

The driver was restrained by the three-point lap and shoulder belt system. Loading evidence on the belt system was masked by body fluid that stained the belt system. Post-crash, the first responders unbuckled the latch plate and the belt retracted into the B-pillar mounted retractor. There was no damage noted to the belt webbing or hardware.

Driver Demographics/Data

Age/Sex:	29-year old/Female
Height:	165 cm (65”)
Weight:	61 kg (135 lb)
Safety Belt Use:	Three-point lap and shoulder belt system
Usage Source:	Vehicle inspection, observations of first responders
Eyewear:	None
Ejection:	Partial, head through left front door window opening
Medical Treatment:	None, pronounced deceased at the scene of the crash

Driver Injury

Injury	Injury Severity (AIS 90/UpDate 98)	Injury Source
Crushing injury of the head	Maximum (113000.6,0)	Captured between the pavement surface and the left roof side rail during the rollover

Source – Investigating police officer

Driver Kinematics

The 29-year old female driver of the Ford Escape was seated in a mid track position with the seatback reclined approximately 22 degrees aft of vertical. The head restraint was adjusted 6 cm (2.5”) above the seat back. She was restrained by the manual safety belt system with the adjustable D-ring set to the full-up position. All door glazing and the sunroof were closed. The interior sunroof cover was in the open (retracted) position.

The driver responded to the non-horizontal rollover crash forces by moving laterally about the interior of the vehicle. During the third-quarter turn, the driver’s head moved left with respect to the vehicle as the left roof side rail was deflected laterally right, disintegrating the left front door glazing. The driver’s head was partially ejected through the left front door window opening and was crushed between the roof side rail and the asphalt road surface **(Figure 15)**. The safety belt system restrained the driver’s body and prevented full ejection from the vehicle.

Figure 15. Lateral crush to the greenhouse area that created an ejection portal for the driver’s head.

As the vehicle continued to roll in a side-over-side configuration, the driver's body was dispalced to the right as evidenced by body fluid spatters about the interior surfaces of the vehicle's front and second row.

The vehicle came to rest upright with the driver's body restrained in the driver's position of the vehicle. Emergency responders determined the driver was deceased at the scene of the crash due to the massive head injury. They opened the left front door and unbuckled the safety belt system and removed the body from the vehicle. The body was transported to the Medical Examiner's Office for autopsy. The reporting family member declined authorization to the SCI team for the release of the autopsy report.

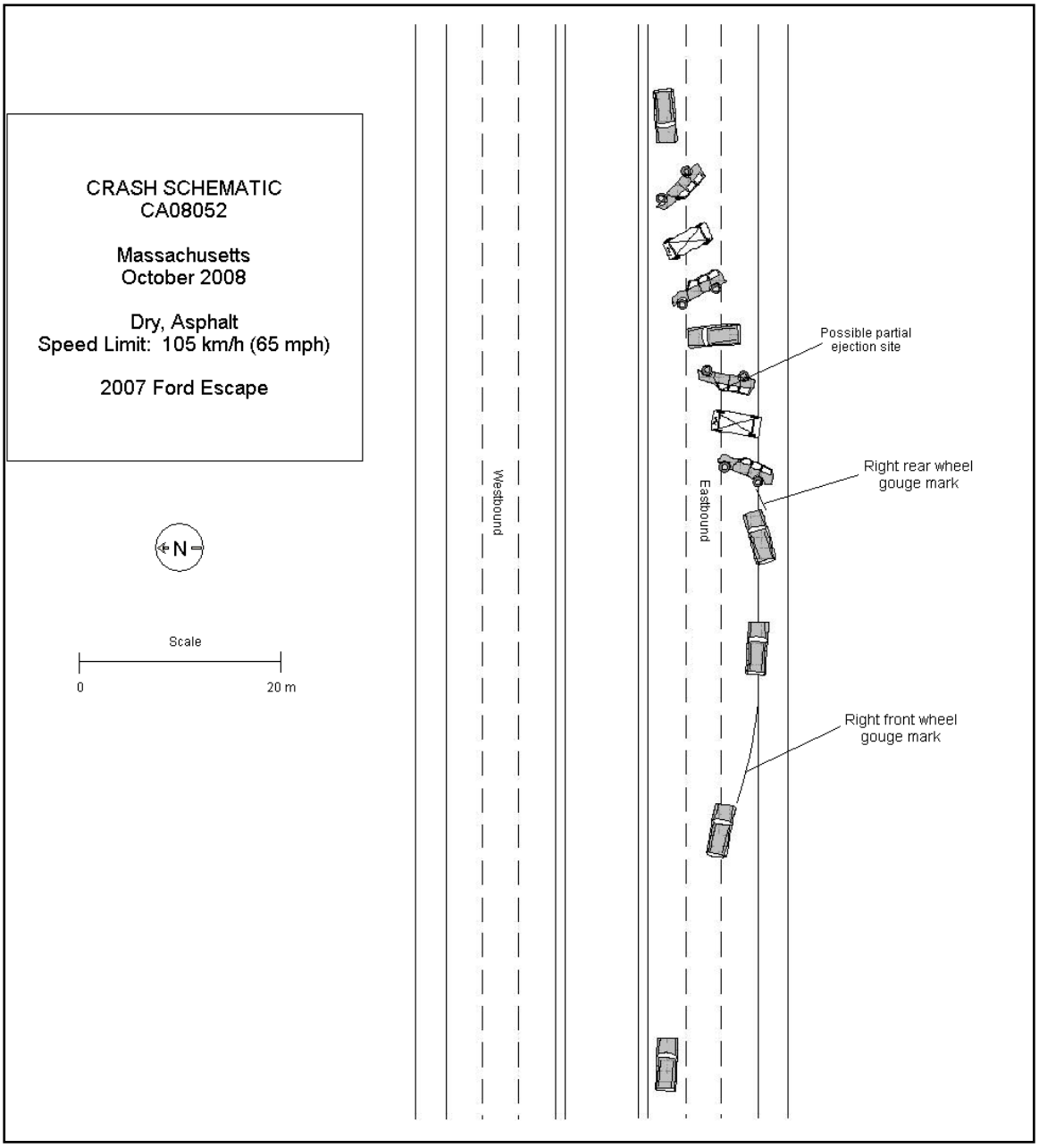

Figure 16. Crash Schematic.