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ON-SITE POTENTIAL SAFETY-RELATED DEFECT INVESTIGATION

CASE NUMBER - IN07035
LOCATION - INDIANA
VEHICLE - 1993 FORD E350 SUPER CLUB WAGON
CRASH DATE - October 2007

Submitted:

February 13, 2008
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Contract Number: DTNH22-07-C-00044

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
National Center for Statistics and Analysis
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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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16. *Abstract*

This report covers an on-site potential safety-related defect investigation involving a 1993 Ford E350 Super Club Wagon, which ran-off-road and rolled over. This crash is of special interest because the Ford reportedly sustained a tread separation and blow-out of the left rear tire resulting in roadway departure into the median and a subsequent rollover. The Ford E350 was traveling south in the inside southbound lane of an interstate highway. A witness that was traveling behind the Ford indicated that the left rear wheel began to vibrate rapidly and she then saw what she thought was the left rear tire blow out. The Ford then began to rotate counterclockwise and entered the median with the passenger side leading and began to rollover. The Ford rolled over through the median and across the northbound travel lanes and came to final rest on its passenger side facing east on the outside shoulder of the northbound travel lanes. No tire marks indicative of a flat tire were found on the roadway. Tire marks and abrasions were found in the Ford's left rear wheel well that indicated the left rear tire tread had separated from the tire carcass as the Ford was traveling down the roadway and slapped against the inside of the wheel well. Based on the police scene measurements, the separated tire tread was found on the west shoulder of the southbound lanes approximately 54 meters (177 feet) north of the area of the road departure. Inspection of the left rear tire showed that the tire tread had separated from the tire carcass in one piece.

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IN07035

BACKGROUND IN07035

This crash was brought to the National Highway Traffic Safety Administration's (NHTSA's) Special Crash Investigation attention on or about October 21, 2007 by NHTSA's Office of Defects Investigation. This crash involved a 15-passenger 1993 Ford E350 Super Club Wagon XL 4x2. This crash is of special interest because the Ford sustained a tread separation of the left rear tire and ran off the road into a median and rolled over. In addition, five passengers sustained fatal injuries in the crash. This crash occurred in October, 2007 at 4:35 p.m., in Indiana and was investigated by the Indiana State Police. This contractor inspected the scene, vehicle and the left rear tire on October 30, 2007 and interviewed a witness on February 7, 2007. This report is based on the police crash report, inspections of the scene, vehicle and the left rear tire, an interview with a witness, and this contractor's evaluation of the evidence.

SUMMARY

The Ford E350 was traveling south in the inside southbound lane of a four-lane, divided interstate highway. A witness that was traveling behind the Ford indicated that the left rear wheel begin to vibrate rapidly. The witness indicated she saw what she thought was the left rear tire blow out and dust fly out from the left rear wheel well. She further indicated that the Ford's brake lights illuminated at that time. The Ford then began to rotate counterclockwise and entered the median with the passenger side leading and began to rollover. The Ford rolled over through the median and across the northbound travel lanes and came to final rest on its passenger side facing east on the outside shoulder of the northbound travel lanes. An undetermined number of the Ford's 16 passengers were ejected from the vehicle during the rollover. The evidence indicated that the ejections occurred through the side windows. Inspection of the Ford revealed that all the doors were jammed closed, and the side glazing in all the windows as well as the backlights disintegrated during the rollover. No tire marks indicative of a flat tire were found on the roadway during the scene inspection. Tire marks and abrasions were found within the Ford's left rear wheel well that indicated the left rear tire tread had separated from the tire carcass as the Ford was traveling down the roadway and slapped against the inside of the wheel well. Based on the police scene measurements, the separated tire tread was found on the west shoulder of the southbound lanes approximately 54 meters (177 feet) north of the area of the road departure. Inspection of the left rear tire showed that the tire tread had separated from the tire carcass in one piece.

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which the Ford was traveling was a four-lane, divided, interstate highway, traversing in a north-south direction. The trafficway was divided by a grass median and each travel direction had two bituminous travel lanes with bituminous shoulders. Each travel lane was 3.5 meters (11.5 feet) in width. Each outside shoulder was 3.3 meters (10.8 feet) in width. The inside shoulder of the northbound lanes was 1.3 meters (4.3 feet) in width. The inside shoulder of the southbound lanes was 1.5 meters (4.9 feet) in width. The grass median was 15.5 meters (50.8 feet) in width. The Ford's approach to the crash location was uncontrolled, and the speed limit was 113 km.p.h. (70 m.p.h.). At the time of the crash, the light condition was daylight, the atmospheric condition was clear, and the roadway pavement was dry and level.

Traffic density was moderate and the site of the crash was rural. See the Crash Diagram at the end of this report.

Pre-Crash: The Ford was traveling south in the inside southbound lane (**Figure 1**). Based on an interview with a witness, who was traveling directly behind the Ford, the Ford's driver and the witness were in the process of passing a tractor semi-trailer. The witness stated that she had been behind the Ford for 8 to 16 kilometers (5 to 10 miles). She stated that her vehicle and the Ford were traveling approximately 122 to 124 km.p.h. (76 to 77 m.p.h.) as they were closing on the tractor semi-trailer. She said they had passed several other vehicles prior to attempting to pass the tractor semi-trailer.

Crash: Based on the interview with the witness and the police reported witness statement, the witness saw the Ford's left rear wheel begin to vibrate rapidly. The witness indicated she then saw what she thought was the left rear tire blow out and dust fly out from the left rear wheel well. The witness stated that she did not see the tread come off the left rear tire. However, the separated left rear tire tread was found by police on the outside shoulder of the southbound lanes approximately 54 meters (177 feet) north of the area of road departure. The witness indicated she also saw the Ford's brake lights illuminate when the left rear wheel began vibrating. The witness stated that the van then swerved left and right. The Ford then immediately began to rotate counterclockwise and entered the median with the passenger side leading and began to rollover. This contractor's scene inspection revealed three striated tire marks in the inside southbound lane (**Figure 1**) leading to two furrows in the median at the location where the Ford entered the median (**Figure 2**). A striated tire mark is indicative of a tire that is rotating and also slipping sideways and is the signature of a yaw mark. The darkest yaw marks were associated with the Ford's right front and right rear tires, which created the furrows as

Figure 1: Approach of Ford southbound in inside lane; right arrow shows Ford's right rear yaw mark, left arrow shows right front yaw mark

Figure 2: Ford's yaw marks departing inside shoulder of southbound lanes into median, yaw marks from right to left are right rear, left rear and right front

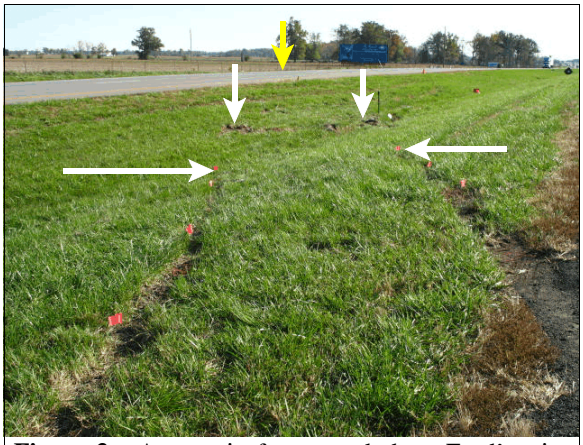


Figure 3: Arrows in foreground show Ford's trip point, middle arrows show first ground impact, arrow in background shows area of final rest on outside shoulder of northbound lanes

the Ford entered the median (**Figure 2** above). The roadway was devoid of marks indicative of a flat tire, such as an irregular tire mark containing broad intermittent transfers. As the Ford approached the bottom of the median (**Figure 3** above), it tripped and rolled over, passenger side leading, along a diagonal path through the median. The Ford then entered the northbound lanes, landed on its passenger side and slid to the outside shoulder of the northbound lanes facing east (**Figure 4**). Based on the scene evidence, the Ford rolled over across a total distance of approximately 48 meters (157 feet). An undetermined number of the Ford's 16 passengers were ejected from the vehicle during the rollover. The police crash report indicated that the ejection/entrapment status of 10 of the passengers was unknown. The police measurements located the final rest position of 2 ejected passengers, and the police crash report indicated that the third row left passenger was partially ejected. The evidence indicated that the ejections occurred through the side windows. The inspection of the Ford revealed that all the doors were jammed closed due to damage, and the side glazing in all the windows as well as the backlights was broken out during the rollover. This contractor was not able to determine the specific number of times the Ford rolled over. However, based on the damage to the Ford and the rollover distance, this contractor estimated that the Ford rolled over 17 quarter turns (i.e., four and one quarter rolls).

Figure 4: View northwest to Ford's location of final rest on outside shoulder of northbound lanes (left arrow); center arrow shows area of scratches and gouges on inside shoulder, right arrow shows area where Ford departed southbound lanes and entered median

Figure 5: News photo of Ford's final rest position on outside shoulder of northbound lanes

Post-Crash: The Ford came to final rest on its passenger side facing east with the back portion of the vehicle on the outside shoulder of the northbound lanes and the front portion of the vehicle on the grass (**Figures 4** and **5**). Rescue personnel cut all the driver side pillars as well as the inside window frames of the back doors and bent the roof structure over to the passenger side in order to extricate the remaining passengers. The total number of passenger's that were ejected and their final rest locations are not known. There was insufficient information contained in the police crash report to make this determination and there was no scene evidence regarding the rest positions of any ejected occupants.

The 1993 Ford E350 was a rear wheel drive, 15 passenger van (VIN: IFBJS31H6PH-----) equipped with a 5.8L, V8 engine and automatic transmission. The Ford was also equipped with a driver air bag, four wheel anti-lock brakes, driver and front right passenger bucket seats, lap-and-shoulder safety belts and three, 3-passenger bench seats and one, 4-passenger bench seat located in the back seating row.

Figure 6: Overview of damage to Ford's top and left side; vertical scale in tenths of meter

CASE VEHICLE DAMAGE

Exterior Damage: The entirety of the Ford sustained direct and induced damage as a result of the rollover. The top, left side and right side sustained the primary contact direct damage, with the top plane sustaining the most severe damage (**Figures 6** and **7**). There was no direct damage to the front or back planes of the Ford indicating that the rollover was side-to-side. The direct damage on the top plane began 51 centimeters (20.1 inches) forward of the left front axle and extended 511 centimeters (201.2 inches) rearward along the top plane. The full width of the roof also sustained direct damage, which was measured as 165 centimeters (65 inches). The maximum residual lateral crush occurred at the left A-pillar (**Figure 8**) and was determined to be approximately 46 centimeters (18 inches). The maximum residual vertical crush occurred to the roof side rail over the driver's seat. Due to alteration of the roof crush when rescue personnel cut the driver's side pillars and bent the roof to the passenger side, a specific vertical crush value could not be measured. The Ford's left and right side wheelbase dimensions were unchanged due to the crash.

Figure 7: Overview of damage to Ford's passenger side

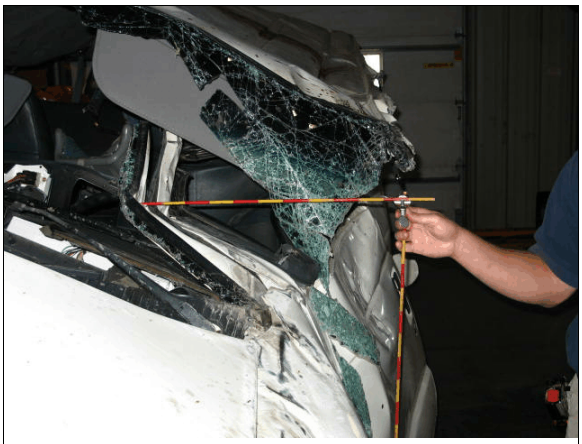


Figure 8: Lateral crush of left "A"-pillar, each increment is 5 centimeters (2 inches)

Inspection of the left rear wheel well revealed evidence that the left rear tire tread had separated from the tire carcass as the Ford was traveling down the roadway and slapped against the inside of the wheel well. Numerous black marks and abrasions were observed on the inside of the wheel well (**Figure 9**). The heaviest area of interaction was on the bottom of the wheel well directly above the left rear axle (**Figure 10**).

Vehicle Interior: It was only possible to conduct a visual inspection of the Ford's interior and obtain photographs through the windows. The Ford was under a police impound order and the tow facility representative instructed this contractor that the Ford could not be touched or manipulated. The observations indicated that the Ford had sustained numerous intrusions into all of the seat rows by the roof, roof side rail, adjacent window frames and pillars. The most severe intrusion appeared to be the lateral displacement of the left A-pillar into the driver's occupant space. The A-pillar was determined to have intruded approximately 46 centimeters (18 inches).

Figure 9: Black tire tread marks and abrasions on inside of Ford's left rear wheel well

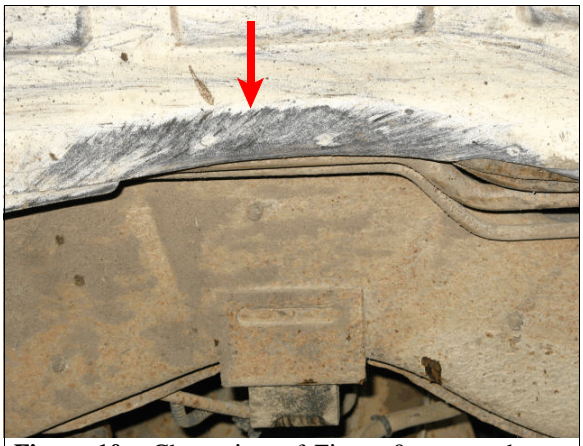


Figure 10: Close view of Figure 9; arrow shows heavy black marks and abrasions from left rear tire tread

Damage Classification: The Ford's Collision Deformation Classification (CDC) was determined to be **00-TDDO-4**. Based on the extent of damage to the Ford, the rollover severity was determined to be severe. The Ford was towed due to damage.

LEFT REAR TIRE DAMAGE AND CASE VEHICLE'S TIRES

The inspection of the left rear tire took place at the state police post where it had been impounded. The Tire Identification Number (TIN) side of the tire (i.e., outboard side) was numbered with the clock sectors 12, 3, 6, and 9 (**Figure 11**). The 12 o'clock position was placed at the TIN. The same numbers were also written on the other side of the tire opposite each corresponding o'clock position (**Figure 12**) to identify reference points for comparing areas on one side of the tire to the other side. The tire was identified as a Liberator All Terrain (**Figure 12** below), size LT245/75R16. The TIN was DOT BF11N9JJ4601 (**Figure 13**). The information on the tire sidewall indicated that the load range was E and the tread was composed of two polyester plies and two steel plies. The sidewall was designed with two polyester plies. The tire tread was totally separated from the tire carcass. The tread was in a single piece (**Figure 14**) and its length was measured as 244 centimeters (96.1 inches). The tread depth was measured as 9 millimeters (11/32 inch) at the center of the tread and 7 millimeters (9/32 inch) at the outside of

Figure 11: Overview of the outboard side of Ford's left rear tire

the tread. The tire carcass had a tear in it that was 78 centimeters (30.7) in length (**Figure 15**) as measured around the circumference of the tire. One end of the tear was located near the edge of the tread on the inboard side 16 centimeters (6.3 inches) to the right of 6 o'clock and extended diagonally across the carcass to the edge of the tread on the outboard side. Neither sidewall of the tire was heavily abraded or damaged (**Figures 11** and **12**) indicating that the tire was not flat while rolling on the roadway. The rim flange on the outboard side had a dent 17 centimeters (6.7 inches) in length located at the approximate 10 o'clock position (**Figures 11** and **16**). The dent on the flange was formed by a force directed toward the center of rotation of the wheel. There were abrasions on the edge of the flange and a wheel weight in this area. A second rim flange dent, also on the outboard side, was located at the 3 o'clock position (**Figures 11** and **17**). It was 13 centimeters (5.1 inches) in length and bituminous material was imbedded in the outside of the flange in this area. This dent was formed by a force directed parallel to the axle. The rim on the inboard side was not deformed and the tire sidewall was not damaged (**Figure 12**).

Figure 12: Overview of inboard side of left rear tire; o'clock positions correspond to same numbers on other side of tire

Figure 13: Ford's left rear tire Tire Identification Number

Figure 14: Overview of tread from Ford's left rear tire

Figure 15: Tear in carcass of Ford's left rear tire

Figure 16: Dent in rim flange on outboard side of Ford's left rear wheel, dent formed by force directed toward center of rotation

Figure 17: Dent in rim flange on outboard side of Ford's left rear wheel with bituminous jammed in flange; dent formed by force directed parallel to axle

The Ford's recommended tire size was: LT245/75R16. All of the tires on the Ford were of the recommended size. The left front tire was a Firestone Steeltex Radial. Its TIN was DOT VN11BAC4101. The right front tire was a Goodyear Wrangler A/T. Its TIN was DOT MD1152WV358. The right rear tire was a Uniroyal Liberator A/T. Its TIN was DOT AN11C6TU1807. As indicated above the left rear tire was a Liberator (not a Uniroyal) All Terrain. Its TIN was DOT BF11N9JJ4601. A summary of the Ford's tire data is shown in the table below.

Tire	*Measured Pressure*		*Recommended Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kPa	psi	kPa	psi	milli-meters	32nd of an inch			
LF	496	72	379	55	8	10	None	No	No
RF	241	35	379	55	6	8	Grass in bead	No	No
LR	Flat	Flat	552	80	9	11	Rim dented and abraded, tread separated, carcass torn	No	Yes
RR	248	36	552	80	11	14	Grass in bead	No	No

AUTOMATIC RESTRAINT SYSTEM

The Ford was equipped with a driver air bag housed within the steering wheel hub. The air bag module had been cut out of that location. Based on the appearance of the steering wheel hub, it appeared the air bag module had been removed following the crash.

The police crash report indicated that there were 16 occupants in the Ford. The report indicated that there were 5 fatalities. The remaining 11 occupants were injured. The police crash report also indicated that multiple occupants were ejected and at least one occupant was partially ejected. Body fluid, body tissue and hair on the exterior of the Ford indicated that some of the ejected occupants had been rolled upon by the vehicle (**Figures 18**, **19**, **20** and **21**). The table on the following page shows the known information for each occupant based on the police crash report.

Figure 18: Top and left side of Ford showing overview of locations shown in **Figures 19** and **20**

Figure 19: Right arrow shows large deposit of hair and blood on roof behind left front door; left arrow shows blood smear on roof above left front door

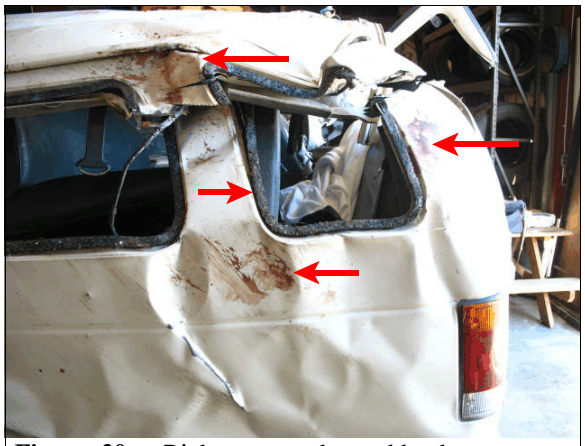
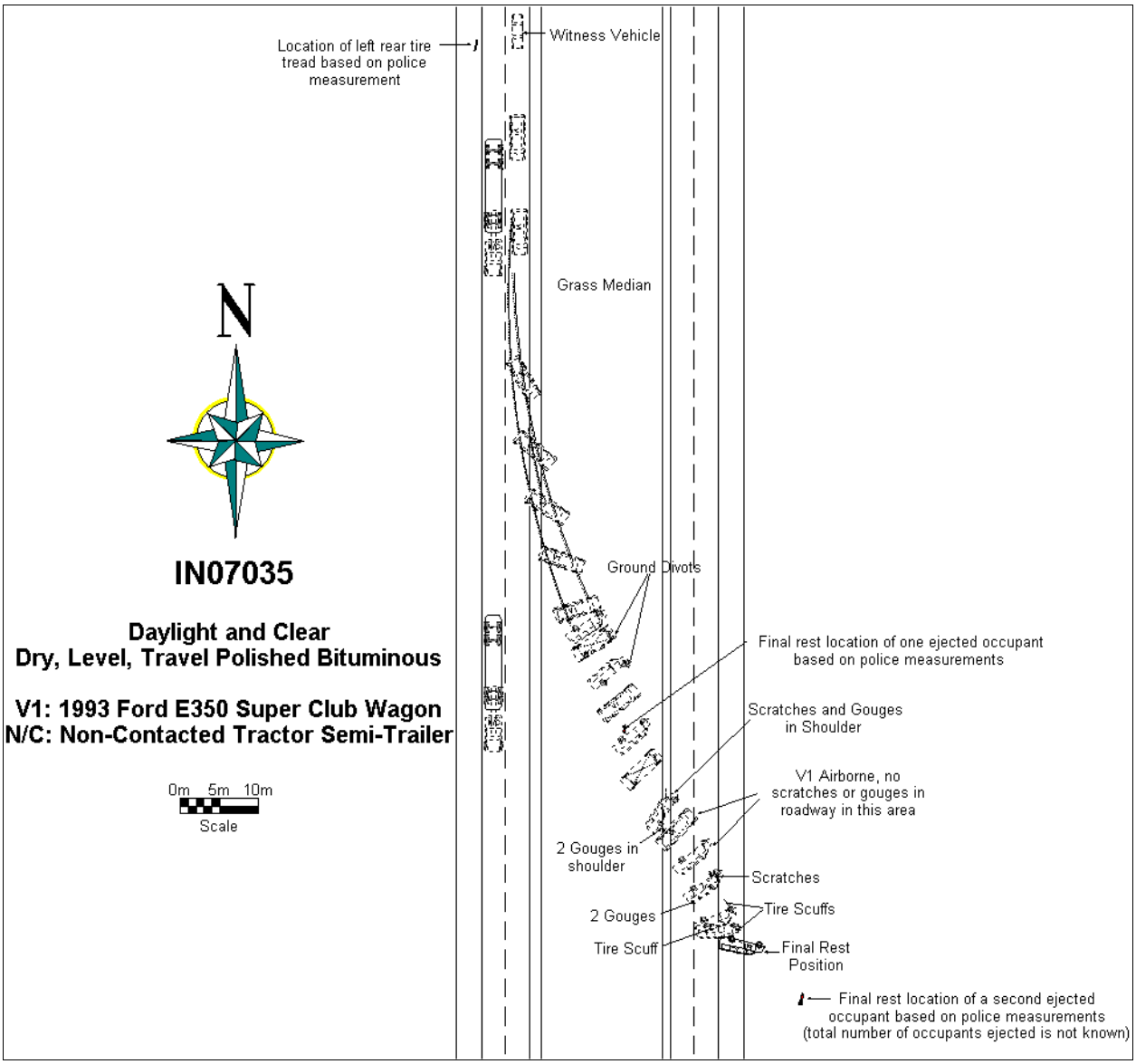


Figure 20: Right arrow shows blood smear on window frame and side of vehicle; left arrows show blood, hair, and tissue on window frame and side of vehicle

Figure 21: Pointer shows hair deposit on side of vehicle below right side window adjacent to seat rows 3 and 4; arrow shows blood and hair deposit on window frame; vertical scale in 10th of meter

Occupant position	Age	Sex	Police-reported injury descriptor	Police-Reported Ejection/ Entrap-ment	Police-Reported Restraint Use	EMS Transport Status
11	39	M	Fatal	Trapped	Yes, L/S	Yes, unknown if treated
13	34	M	B-Injury	Trapped	Yes, L/S	Yes, unknown if hospitalized
21	39	F	Fatal	Trapped	Yes, L/S	Unknown, not listed
Unk	9	M	B-Injury	Unk	Unk	Yes, unknown if hospitalized
Unk	7	F	A-Injury	Unk	Unk	Unknown, not listed
33	5	M	A-Injury	Unk	Unk	Unknown, not listed
Unk	3	F	A-Injury	Unk	Unk	Unknown, not listed
Unk	1	M	A-Injury	Unk	Unk	Unknown, not listed
23	9	M	B-Injury	Unk	Unk	Unknown, not listed
32	13	M	A-Injury	Unk	Unk	Unknown, not listed
Unk	4	M	A-Injury	Unk	Unk	Unknown, not listed
Unk	7	F	A-Injury	Unk	Unk	Unknown, not listed
Unk	32	F	A-Injury	Trapped	Unk	Unknown, not listed
31	16	M	Fatal	Partially ejected	Unk	Unknown, not listed
Unk	11	M	Fatal	Unk	Unk	Unknown, not listed
22	1	M	Fatal	Ejected	Unk	Unknown, not listed


Location of left rear tire tread based on police measurement
Witness Vehicle
Grass Median
N
IN07035
Daylight and Clear
Dry, Level, Travel Polished Bituminous
V1: 1993 Ford E350 Super Club Wagon
N/C: Non-Contacted Tractor Semi-Trailer
0m 5m 10m
Scale
Ground Divots
Final rest location of one ejected occupant based on police measurements
Scratches and Gouges in Shoulder
V1 Airborne, no scratches or gouges in roadway in this area
2 Gouges in shoulder
Scratches
Tire Scuffs
2 Gouges
Tire Scuff
Final Rest Position
Final rest location of a second ejected occupant based on police measurements (total number of occupants ejected is not known)