Certified Advanced 208-Compliant Vehicle Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: 2004-75-046G
2004 Ford F150 pickup
Colorado
April, 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.

Technical Report Documentation Page

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16. Abstract

This remote investigation focused on the Certified Advanced 208-Compliant (CAC) air bag system in a 2004 Ford F150. The case vehicle was being driven by a restrained 29-year-old male. The case vehicle was traveling northbound in the left hand turn lane and was attempting to make a left turn to go west. The case vehicle was struck in the right side by a 2000 Chevrolet Suburban that was traveling southbound. The Ford F150 was then pushed laterally in a southwest direction until the left side of the F150 struck the front of a stopped Ford Explorer. The Ford Explorer was then pushed into a stopped Toyota Camry. The driver of the Ford F150 sustained a minor knee injury. All four vehicles came to rest in the western leg of the intersection. The Ford F150, the Ford Explorer, and the Suburban were towed from the scene. The Camry sustained moderate damage to the front end but was driven from the scene.

This CAC Vehicle Investigation was identified by the local National Automobile Sampling System (NASS) Primary Sampling Unit (PSU). A CAC vehicle is certified by the manufacturer to be compliant to the Advanced Air Bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The case was reported to DSI on May 6, 2004 This was an SCI/NASS combination case.

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Certified Advanced 208 Compliant, air bag deployment, minor injury	

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Dynamic Science, Inc.
Crash Investigation
Case Number: 2004-75-046G

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BACKGROUND

Description

Figure 1. Case vehicle, 2004 Ford F150

This remote investigation focused on the Certified Advanced 208-Compliant (CAC) air bag system in a 2004 Ford F150. A CAC vehicle is certified by the manufacturer to be compliant to the Advanced Air Bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The case vehicle was being driven by a restrained 29-year-old male. The case vehicle was traveling northbound in the left hand turn lane and was attempting to make a left turn to go west. The case vehicle was struck in the right side by a 2000 Chevrolet Suburban that was traveling southbound. The Ford F150 was then pushed laterally in a southwest direction until the left side of the F150 struck the front of a stopped Ford Explorer. The Ford Explorer was then pushed into a stopped Toyota Camry. The driver of the Ford F150 sustained a minor knee injury. All four vehicles came to rest in the western leg of the intersection. The Ford F150, the Ford Explorer, and the Suburban were towed from the scene. The Camry sustained moderate damage to the front end but was driven from the scene.

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SUMMARY

Crash Site

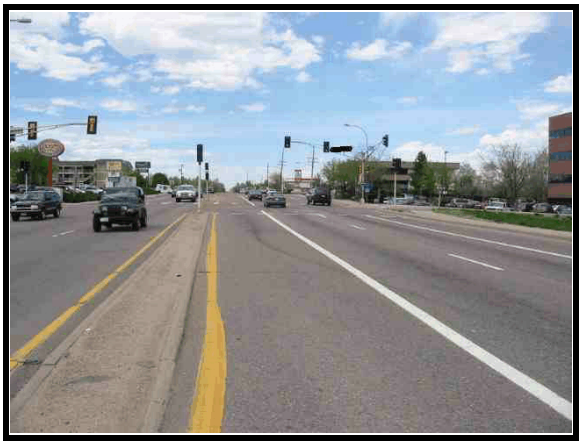


Figure 2. Approach for case vehicle, north (2004 Ford F150)

This was a four vehicle collision. The crash occurred in April, 2004 at 1522 hours in the state of Colorado. The crash occurred within the confines of a four-leg intersection. The northern leg of the intersection is comprised of three southbound travel lanes, a westbound turn lane, and three northbound travel lanes. The southern leg of the intersection is comprised of three northbound travel lanes, a westbound turn lane, and three southbound travel lanes. The north and southbound travel lanes are separated by raised curb medians. The western leg of the intersection is comprised of a single westbound travel lane and two eastbound travel lanes. All the roadways

were dry and level. The speed limit for north and southbound travel was 56 km/h (35 mph).

Pre-Crash

The case vehicle is a 2004 Ford F150 Heritage 4x4 regular cab pickup (VIN: 2FTRF18W54Cxxxxxx). The case vehicle was being driven by a restrained 29-year-old male (183 cm/72 in, 91 kg/201 lbs). The case vehicle was traveling northbound in the left hand turn lane and was attempting to make a left turn to go west.

Figure 3. Overview of eastbound trafficway

The first other vehicle is a 2000 Chevrolet Suburban 4x4 four-door sport utility vehicle (VIN: 3GNFK16T1YGxxxxxx). This vehicle was being driven by a lap and shoulder belt restrained 43-year-old female (173 cm/68 in, 59 kg/130 lbs). The Suburban was traveling southbound in the middle lane approaching the intersection.

Figure 4. Approach to area of impact, south

The second other vehicle is a 2002 Ford Explorer XLT 4x4 four-door sport utility vehicle (VIN: 1FMZU73K42Zxxxxxx). This vehicle was being driven by a 53-year-old female (163 cm/64 in, 63 kg/139 lbs). The Explorer was stopped at the intersection facing east.

The third other vehicle is a 1997 Toyota Camry four-door sedan (VIN: JT2BG22K1V0xxxxxx). This vehicle was being driven by a 60-year-old male. The Camry was stopped behind the Explorer facing east.

Crash

Prior to impact, the driver of the Ford F150 began making a left turn, intending to travel west. The driver of the southbound Suburban was unable to stop in time and struck the right side of the Ford F150 (02RZEW2). There was 118.0 cm (46.4 in) of direct contact that began 100.0 cm (39.4 in) forward. The maximum crush was located at C2 and measured 17.0 cm (6.7 in). The total velocity change as computed by the WinSmash program was 10.0 km/h (6.2 mph)[1]. The longitudinal and lateral components were -3.4 km/h (-2.1 mph) and -9.4 km/h (-5.8 mph), respectively. The impact was moderate and resulted in the deployment of the frontal air bag system in the Ford F150. The EDR-reported longitudinal delta V was estimated to be -6.9 km/h (-3.7 mph)[2], 55 milliseconds into the crash.

[1]WinSmash run added by SCI, borderline recontruction

[2]Visual estimate based on delta V trace

The Ford F150 was then pushed laterally in a southwest direction until the left side (10LZEW3) of the F150 struck the front of the stopped Ford Explorer (11FLEE6). There was 212.0 cm (83.5 in) of direct contact to the Ford F150 that began 12.0 cm (4.7 in) forward the rear axle and extended forward. The maximum crush was located at C3 and measured 21.0 cm (8.3 in). The total velocity change as computed by the WinSmash program was 10.0 km/h (6.2 mph). The longitudinal and lateral components were -5.0 km/h (-3.1 mph) and 8.7 km/h (5.4 mph), respectively.

Figure 5. Case vehicle, 2004 Ford F150, left side impact

The Ford F150 rotated counterclockwise and there was a second impact between the Ford and the Suburban.

The Explorer was pushed rearward (06BZEW1) and into the front of the stopped Camry (12FYEW1).

All four vehicles came to rest in the western leg of the intersection. The Ford F150, the Ford Explorer, and the Suburban were towed from the scene. The Camry sustained moderate damage to the front end but was driven from the scene.

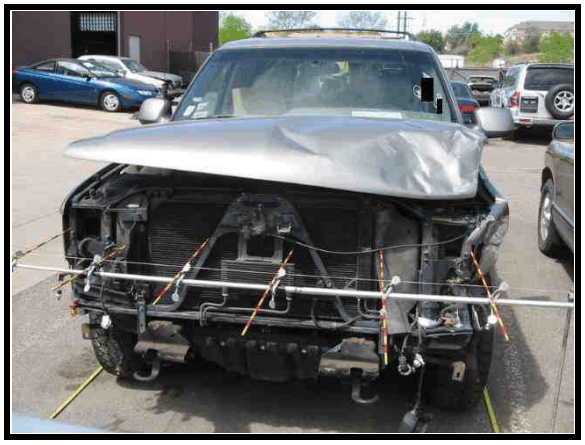


Figure 6. 2000 Chevrolet Suburban (impact to right side of case vehicle, 1st impact)

Post-Crash

The driver of the Ford F150 sustained a minor contusion to the right shin. The driver of the Suburban reported pain in her right foot. The driver of the Explorer complained of neck pain. The driver of the Camry did not report any injuries. No one was transported or sought treatment later.

The Ford F150 was equipped with an electronic data recorder (EDR). The EDR was harvested and sent to the SCI office. It was then sent to the Ford Motor Company for interpretation. A summary of the downloaded data can be found in the Frontal Air Bag System section. Acceleration and delta V traces can be found in Attachment 2 of this document.

VEHICLE DATA -2004 Ford F150 Heritage 4x4 regular cab pickup

The 2004 Ford F150 was equipped with an automatic transmission, 4-wheel drive, 4-wheel anti-lock brakes, air conditioning, power steering, and cloth upholstery

VIN:	2FTRF18W54Cxxxxxx
Odometer:	4,918 km (3,056 miles), per interview
Engine:	4.6 liter, 8 cylinder
Reported Defects:	None
Cargo:	16 kg (35 lbs), toolbox, per interview

The 2004 Ford F150 pickup was equipped with BF Goodrich P235/70R16 tires. The specific tire data is as follows:

Tire	Tread	Pressure	Recommended pressure
LF	11 mm (0.43 in)	290 kPa (42 psi)	241 kPa (35 psi)
LR	11 mm (0.43 in)	290 kPa (42 psi)	241 kPa (35 psi)
RF	11 mm (0.43 in)	290 kPa (42 psi)	241 kPa (35 psi)
RR	10 mm (0.39 in)	290 kPa (42 psi)	241 kPa (35 psi)

The front seating positions in the 2004 Ford F150 pickup were comprised of a single, three person bench seat with a folding back. There two outboard positions were equipped with integral head restraints that did not sustain any damage. The seat was adjusted to the rear most track position.

VEHICLE DAMAGE

Exterior Damage - 2004 Ford F150 pickup

Damage Description:	Moderate left and right side damage–mainly to the truck bed	
CDC:	Impact 1: 02RZEW2 Impact 2: 10LZEW3	
Delta V (impact 1)[3]:	Total	10.0 km/h (6.2 mph)
	Longitudinal	-3.4 km/h (-2.1 mph)
	Latitudinal	-9.4 km/h (-5.8 mph)
	Energy	6,398 joules (4,719 ft lbs)
Delta V (impact 2)[3]:	Total	10.0 km/h (6.2 mph)
	Longitudinal	-5.0 km/h (- 3.1 mph)
	Latitudinal	8.7 km/h (5.4 mph)
	Energy	11,084 joules (8,185 ft-lbs)

Figure 7. Right side, Ford F150

Figure 8. Rear left, Ford F150

[3]SCI addition, borderline reconstruction

Interior Damage - 2004 Ford F150 pickup

Interior damage to the Ford pickup was generally limited to normal damage associated with front air bag deployments. There was a burn mark found on the right side of the air bag–near the module/air bag attachment.

MANUAL RESTRAINT SYSTEMS - 2004 Ford F150 pickup

The Ford F150 was equipped with manual lap and shoulder belts with sliding latch plates for both outboard seat positions. The lap and shoulder belts were equipped with retractor type pretensioners that did actuate during the crash. The middle seat was equipped with a manual lap belt.

FRONTAL AIR BAG SYSTEM - 2004 Ford F150 pickup

The 2004 Ford F150 Heritage was equipped with the Ford Personal Safety System that includes dual stage driver and a front right passenger air bags, energy management safety seat belt systems with pretensioners, belt buckle usage switches, a front right passenger weight sensor, and a driver's seat track position switch. The passenger's air bag includes an air bag cutoff switch that was in the ON position prior to impact. Side air bags were not available.

Figure 9. Passenger air bag

The driver was seated in the bench seat facing forward. The seat had been adjusted to the rear most track position. The driver was wearing the available lap and shoulder belt. The anchorage adjuster for the shoulder belt was in the full up position. The seat belt was equipped with a pretensioner that did actuate.

Both front air bags deployed during the crash. It is believed that the air bags deployed during the first impact.

Figure 10. Driver's and front right passenger's air bag

The driver's air bag was mounted in the steering wheel. The module cover had an H-configuration. The top flap measured 20.0 cm (7.9 in) wide by 13.0 cm (5.1 in) high. The bottom flap measured 20.0 cm (7.9 in) high by 9.0 cm (3.5 in) wide. The air bag was generally circular in shape and measured 53.0 cm (20.9 in) vertically and 57.0 cm (22.4 in) horizontally. The air bag was equipped with two vent ports (11 and 1 o'clock positions) and two central internal tethers. There was no damage or contacts noted to either the air bag or the module covers. There was a burn mark found on the right side of the air bag–near the module/air bag attachment.

The front right passenger air bag was a mid instrument panel mount. There was a single module flap that was rectangular in shape and measured 41.0 cm (16.1 in) wide by 18.0 cm (7.1 in) high. The air bag was generally rectangular in shape and measured 70.0 cm (27.6 in) vertically and 63.0 cm (24.8 in) horizontally. There were no tethers or vent ports. There was no damage or contacts noted to either the air bag or the module cover.

Figure 11. Burn to right side of driver's air bag

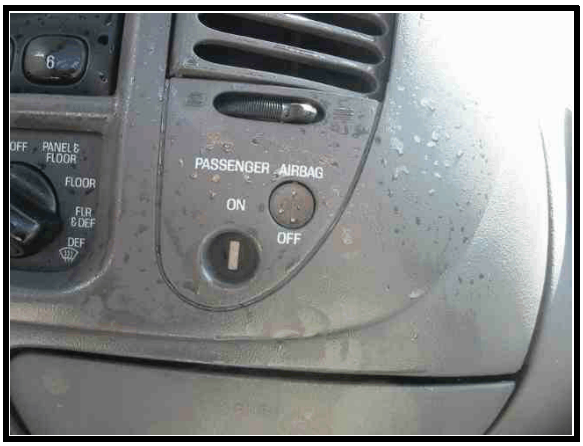


Figure 12. Passenger air bag cut off switch set to "ON" position

Summary of EDR readout[4]

- The EDR-reported longitudinal delta V was estimated to be -6.9 km/h (-3.7 mph), 55 milliseconds into the crash.
- There was a flash code 19 (Crash memory full status code) present when the restraint control module was powered on at Autoliv.
- The restraint control module issued a command to deploy the front airbags and pretensioners. The fire time was 54 ms after algorithm wakeup. The safing sensor closed 1 ms after the microcontroller's deploy decision.
- The passenger front airbag was enabled at the time of the event.
- There were no faults present at the time of the event.
- There were no internal faults recorded.
- The historical faults are listed on the following page.

[4]Field Report included as Attachment 3

HISTORICAL FAULTS (Faults are listed in the order in which they were detected)							
Pad lap short to ignition							
1	Key-ons with the fault present						
	Fault cleared						
Deployment occurrence							
15	Key-ons with the fault present						
0	Key-ons since fault has not been present						
PAFAB high resistance							
12	Key-ons with the fault present						
2	Key-ons since fault has not been present						
DRPT high resistance							
12	Key-ons with the fault present						
2	Key-ons since fault has not been present						
PAPT high resistance							
12	Key-ons with the fault present						
2	Key-ons since fault has not been present						
PAFAB low leak							
1	Key-ons with the fault present						
13	Key-ons since fault has not been present						
DRFAB high resistance							
11	Key-ons with the fault present						
2	Key-ons since fault has not been present						
Mismatched vehicle ID - Caused by Autoliv's incorrect loadbox setup							
2	Key-ons with the fault present						
0	Key-ons since fault has not been present						

VEHICLE DATA - 2000 Chevrolet Suburban

Description:	2000 Chevrolet Suburban 4x4 sport utility vehicle	
VIN:	3GNFK16T1YGxxxxxx	
Odometer:	153,149 km (95,165 miles), per repair facility	
Engine:	5.3L 8 cylinder	
Reported Defects:	None	
Cargo:	None, per inspection	
Damage Description:	Moderate front end damage. Damage to bumper, hood, and left front fender.	
CDC:	Impact 1: 11FYEW1 Impact 2: Unknown	
Delta V (impact 1)[5]:	Total	9.0 km/h (5.6 mph)
	Longitudinal	-8.5 km/h (-5.3 mph)
	Latitudinal	3.1 km/h (1.9 mph)
	Energy	12,294 joules (9,068 ft lbs)

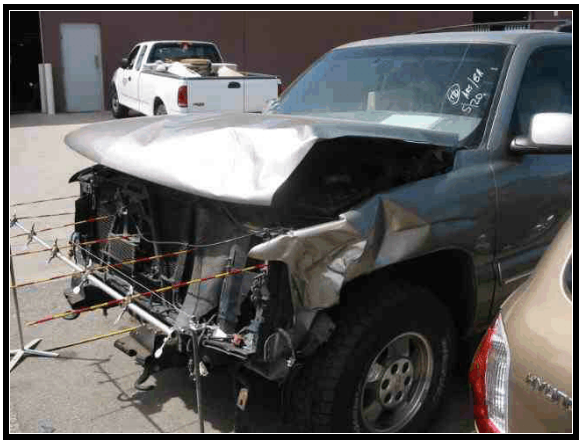


Figure 14. Front left, Chevrolet Suburban

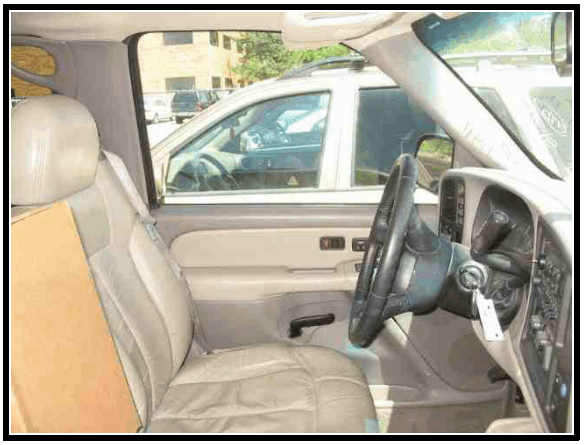


Figure 15. Interior view, Chevrolet Suburban

[5]SCI addition

VEHICLE DATA - 2002 Ford Explorer

Description:	2002 Ford Explorer 4x2	
VIN:	1FMZU73K42Zxxxxxx	
Odometer:	26,459 km (16,440 miles)	
Engine:	4.0L (245 CID) 6 cylinder	
Reported Defects:	None	
Cargo:	3 kg (7 lbs), bookcase/sleeping bag	
Damage Description:	Minor front and rear end damage.	
CDC:	Impact 1: 11FLEE6 (impact with Ford pickup) Impact 2: 06BZEW1 (impact with Toyota Camry)	
Delta V:	Total	Unknown
	Longitudinal	Unknown
	Latitudinal	Unknown
	Energy	Unknown

Figure 16. Front left, Ford Explorer

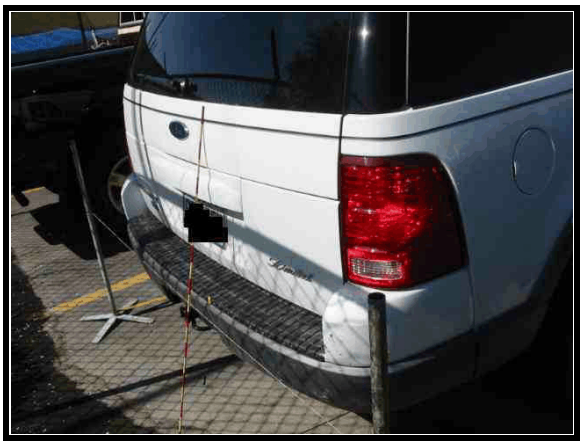


Figure 17. Back right, Ford Explorer

VEHICLE DATA - 1997 Toyota Camry

Description:	1997 Toyota Camry	
VIN:	JT2BG22K1V0xxxxxx	
Odometer:	Unknown	
Engine:	2.2L 4 cylinder	
Reported Defects:	None	
Cargo:	None	
Damage Description:	Moderate front end damage. Damage to bumper, bumper fascia, hood, and radiator support.	
CDC:	12FYEW1 (impact with Ford Explorer)	
Delta V:	Total	Unknown
	Longitudinal	Unknown
	Latitudinal	Unknown
	Energy	Unknown

Figure 18. Bumper fascia, Toyota Camry

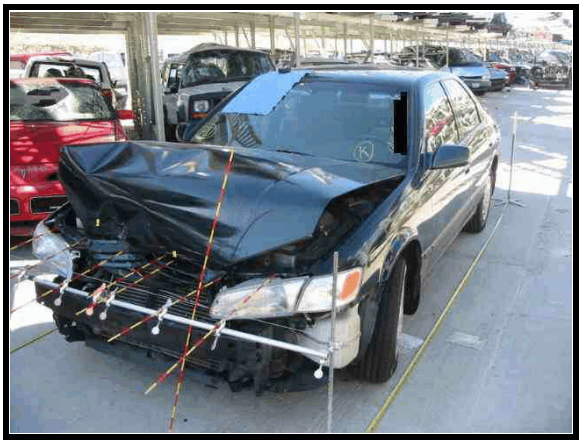


Figure 19. Front left, Toyota Camry

OCCUPANT DEMOGRAPHICS - 2004 Ford F150 pickup

	Driver
Age/Sex:	29/Male
Seated Position:	Front left
Seat Type:	Fabric covered bench seat
Height:	183 cm (72 in)
Weight:	91 kg (201 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	Unknown
Body Posture:	Normal, upright
Hand Position:	Unknown
Foot Position:	Right foot on accelerator, left on floorboard
Restraint Usage:	Lap and shoulder belt available, used
Air bag:	Steering wheel mounted air bag, deployed

OCCUPANT DEMOGRAPHICS - 2000 Chevrolet Suburban

	Driver
Age/Sex:	43/Female
Seated Position:	Front left
Seat Type:	Bucket seat. Seat adjusted to middle track position. Seat back slightly reclined.
Height:	173 cm (68 in)
Weight:	59 kg (130 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	Unknown
Body Posture:	Normal, upright
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt available, used

OCCUPANT DEMOGRAPHICS - 2002 Ford Explorer

	Driver
Age/Sex:	53/Female
Seated Position:	Front left
Seat Type:	Bucket seat. Seat adjusted to middle track position. Seat back slightly reclined.
Height:	163 cm (64 in)
Weight:	63 kg (139 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	Unknown
Body Posture:	Normal, upright
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt available, used

OCCUPANT DEMOGRAPHICS - 1997 Toyota Camry

	Driver
Age/Sex:	60[6]/Male
Seated Position:	Front left
Seat Type:	Unknown
Height:	Unknown
Weight:	Unknown
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	Unknown
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt used, per police report

[6]Age added by SCI, obtained from police report

OCCUPANT INJURIES -2004 Ford F150 pickup

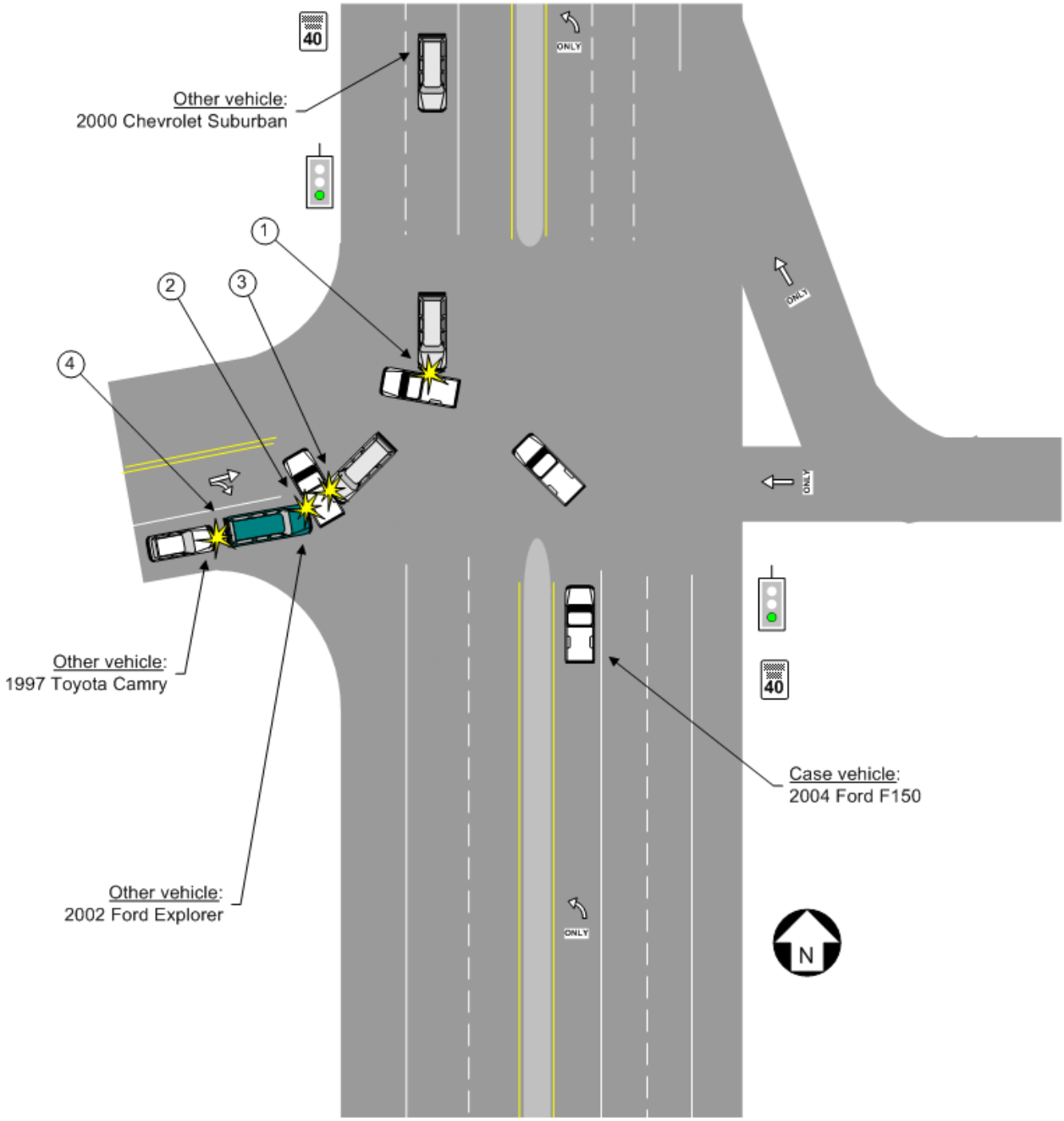
Driver: Injuries obtained from driver interview.

Injury	OIC Code	Injury Mechanism	Confidence Level
Contusion, right knee	890402.1,1	Knee bolster	Certain

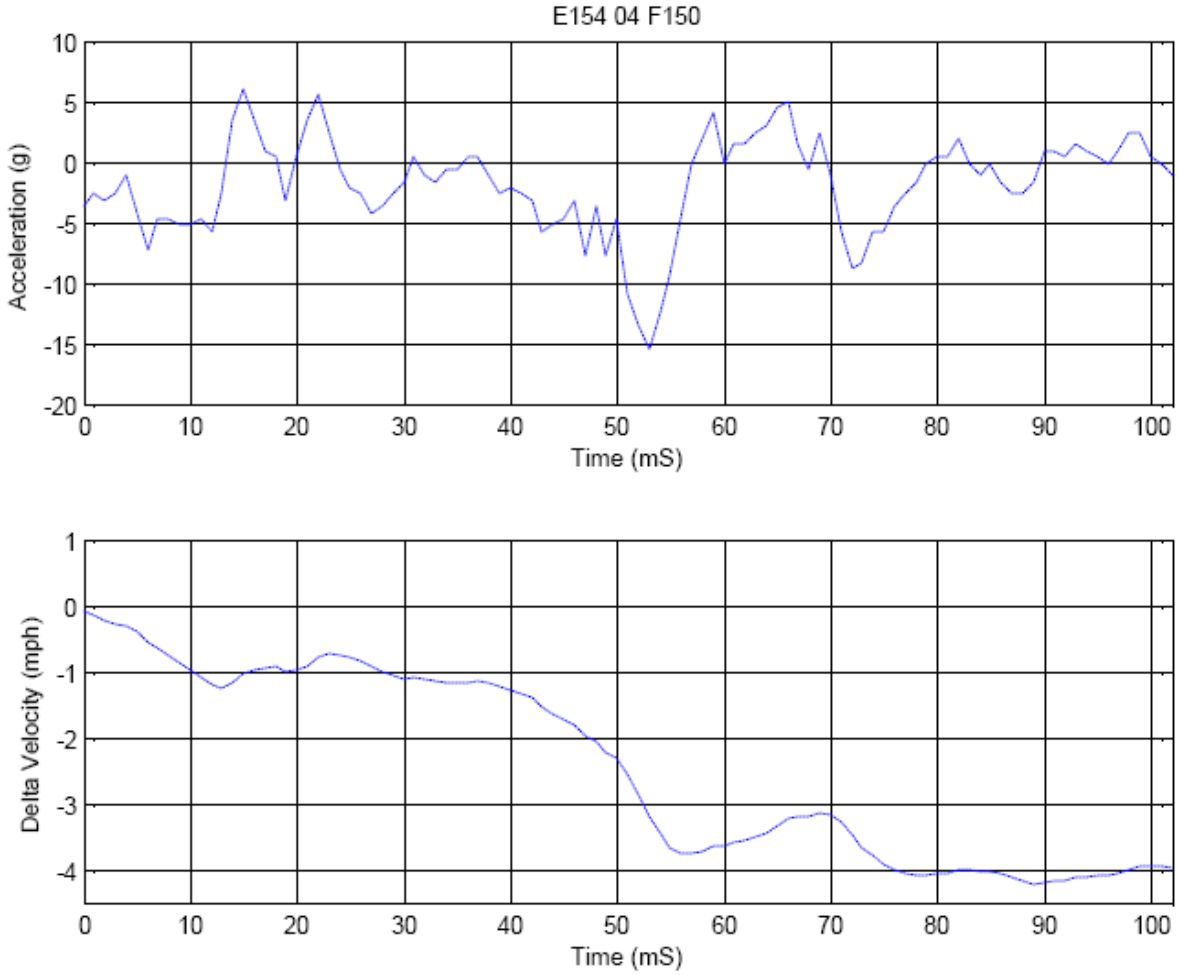
OCCUPANT KINEMATICS - 2004 Ford F150 pickup

The 29-year-old male driver (183 cm/72 in, 91 kg/201 lbs) of the Ford F150 was sitting in a normal, upright fashion on the fabric covered bench seat. The seat had been adjusted to the rear most track position. The driver was wearing the available lap and shoulder belt. The shoulder belt anchorage was in the full up position. The driver was in the process of making a left hand turn. His right foot was on the accelerator, his left on the floorboard. The driver was actively steering through the left hand turn. At impact, both frontal air bags deployed and the seat belt pretensioners actuated. The driver initiated a trajectory to the front and right side in response to the 2 o'clock direction of force. He contacted the deployed driver's air bag but did not sustain any related injuries. His right knee contacted the lower instrument panel resulting in a minor contusion. He rebounded back into the seat and the restraint system mitigated additional occupant movement in the vehicle as the Ford F150 was pushed into a clockwise rotation. The left side of the Ford F150 then struck the front of the Ford Explorer. The driver responded to the 10 o'clock direction of force by moving to the left. He likely engaged the left interior of the vehicle but did not leave any contact evidence nor did he sustain any related injury. There was a second impact between the case vehicle and the Chevrolet Suburban, but this appeared to be minor and there would have been little occupant movement. The driver exited the vehicle on his own. The police indicated that he was uninjured. He did not seek any medical attention.

Attachment 1. Scene Diagram



Attachment 2. Acceleration and delta V traces for Ford F150



Attachment 3. Ford Field Report

REPORT INFORMATION	
ID #	E154
REPORT DATE	05/26/04
VEHICLE INFORMATION	
MODEL YEAR	04
NAME	F150
CODE	PN96
VIN	2FTRF18W54CAxxxxxx
MILEAGE	Data not supplied
IDENTIFICATION	20043-75-046
RESTRAINT CONTROL MODULE	
TYPE	RCM4XP
PART#	1L3A-14B321-AD
SERIAL #	202609xxxxxx
BUILD DATE	February 11, 2004
CUSTOMER CONTACT	
NAME	<deleted>
COMPANY	<deleted>
POSITION	Field Investigations
PHONE	<deleted>
EMAIL	<deleted>
AEA CONTACT	
NAME	<deleted>
POSITION	Field Investigations Engineer
PHONE	<deleted>
EMAIL	<deleted>
ADDITIONAL INFORMATION	

ALLEGED EVENT DESCRIPTION

Data not supplied.

ALLEGED DAMAGE DESCRIPTION

Data not supplied.

INVESTIGATION RESULTS

1. There was a flash code 19 (Crash memory full status code) present when the restraint control module was
   powered on at Autoliv.
2. The restraint control module issued a command to deploy the front airbags and pretensioners. The
   fire tim

REPORT ID#	E154
HISTORICAL FAULTS (Faults are listed in the	
Pad lap short to ignition	
1	Key-ons with the fault present
	Fault cleared
Deployment occurrence	
15	Key-ons with the fault present
0	Key-ons since fault has not been present
PAFAB high resistance	
12	Key-ons with the fault present
2	Key-ons since fault has not been present
DRPT high resistance	
12	Key-ons with the fault present
2	Key-ons since fault has not been present
PAPT high resistance	
12	Key-ons with the fault present
2	Key-ons since fault has not been present
PAFAB low leak	
1	Key-ons with the fault present
13	Key-ons since fault has not been present
DRFAB high resistance	
11	Key-ons with the fault present
2	Key-ons since fault has not been present
Mismatched vehicle ID - Caused by Autoliv's i	
2	Key-ons with the fault present
0	Key-ons since fault has not been present