

On-scene Investigation / Vehicle to Vehicle  
Dynamic Science, Inc. / Case Number: DS02004  
2002 Jaguar X type 3.0  
California  
February, 2002

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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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<p>16. Abstract</p> <p>The crash occurred on a curved three-lane divided state route in February, 2002 at 0142 hours. It was dark at the time of the crash and there were no streetlights available. The roadway was dry and free of any defects. The speed limit is 105 km/h (65 mph).</p> <p>The case vehicle, a 2002 Jaguar X-type 3.0 four-door sedan driven by a 55-year-old male, was traveling northbound in the first lane from the right. The other vehicle, a 1988 Honda Civic four-door driven by a restrained 27-year-old male, was traveling in the same direction and in front of the case vehicle. This vehicle was traveling substantially slower than the case vehicle. The vehicle was occupied by two additional persons. The front right seat was occupied by a restrained 53-year-old female (mother of driver). The rear left seat was occupied by a 19-year-old female (sister of driver).</p> <p>The driver of the other vehicle slowed/braked for some unknown reason. The front of the case vehicle struck the rear of the Honda. The Honda was pushed into a clockwise rotation. The front of this vehicle struck a concrete wall on the right side of the roadway. The vehicle continued rotating until it came to rest in the middle travel lane facing east. The case vehicle came to rest approximately north of the impact area facing north on the right hand shoulder. The driver of the case vehicle sustained a fractured sternum and rib contusions. He fled the scene to the east.</p> <p>As a result of the initial vehicle to vehicle impact, the Honda vehicle caught on fire. Police officers traveling in the opposite direction stopped their vehicle, jumped the median barrier, and attempted to put out the fire using their fire extinguishers. The driver of the case vehicle was initially knocked unconscious by the impact. He was removed from the vehicle by a police officer. The front right occupant was able to exit the vehicle on her own. Despite efforts by a number of persons, the rear seat occupant could not be extricated. She remained trapped inside the vehicle and died from smoke inhalation and thermal burns.</p>			
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**Dynamic Science, Inc.**  
**Accident Investigation**  
**Case Number: DS02004**

**TABLE OF CONTENTS**

Background .....	1
Description .....	1
Investigation Type .....	1
Crash Location .....	1
Crash Date .....	1
Notification Date .....	1
Field Work Completed .....	1
Summary .....	1
Scene Diagram .....	4
Collision Measurement Table .....	5
Detailed Information .....	6
Vehicles .....	6
Safety Systems Discussion .....	7
Air Bag Control Module Activities .....	8
Occupants .....	11
Injuries and Injury Mechanisms .....	13
Occupant Kinematics .....	14

**BACKGROUND:**

**Description:** This Advanced Occupant Protection System (AOPS) case was generated in response to a request from a state police agency. The request was to assist in downloading any available data from the Adaptive Restraints Module (ARM)—the air bag control module. DSI was assigned the case on February 21, 2002. DSI conducted the vehicles and scene inspections on February 28, 2002. Attending the inspection of the case vehicle was several members of the major accident investigation team, as well as state transportation employees who were working as part of the team. During the inspection, the ARM was removed. It was first booked into evidence and then transferred to DSI. It was later sent to the Ford Motor Company to determine if any data could be downloaded. Ford refused to download the data without the written permission of the owner. The ARM was later returned to evidence.

**Investigation Type:** On-scene  
**Crash Location:** California  
**Crash Date:** February, 2002  
**Notification Date:** February 21, 2002  
**Field Work Completed:** February 28, 2002

**SUMMARY:**

The crash occurred on a curved three-lane divided state route in February, 2002 at 0142 hours. It was dark at the time of the crash and there were no streetlights available. The roadway was dry and free of any defects. The speed limit is 105 km/h (65 mph).

The case vehicle, a 2002 Jaguar X-type 3.0 four-door sedan driven by a 55-year-old male (206 cm/81 in, 118 kg/260 lbs), was traveling northbound in the first lane from the right. Police report this driver as being under the influence of alcohol (BAC > 0.08%). The case vehicle was equipped with dual stage driver and front passenger air bags, seat mounted side air bags for the driver and front passenger, and side curtain air bags for the front and rear outboard occupants.



**Figure 1.** Area of impact (north)

The other vehicle, a 1988 Honda Civic four-door driven by a restrained 27-year-old male, was traveling in the same direction and in front of the case vehicle. Police report this driver as being under the influence of both drugs and alcohol. This vehicle was traveling substantially slower than the case vehicle. The vehicle was occupied by two additional persons. The front right seat was occupied by a restrained 53-year-old female (mother of driver). The rear left seat was occupied by a 19-year-old female (sister of driver).



**Figure 2.** Front, case vehicle

The driver of the other vehicle slowed/braked for some unknown reason. The front of the case vehicle (12FDEW1) struck the rear of the other vehicle (06BDEW6).

The case vehicle sustained a total delta v of 46 km/h (29 mph), a longitudinal delta v of -46 km/h (-29 mph), a latitudinal delta v of 0 km/h (0 mph), and a barrier equivalent speed of 14 km/h (9 mph)<sup>1</sup>. The results of the WinSmash run are high. The air bags in the case vehicle did not deploy. This is likely due to the long crash pulse (an extended delta T) caused by the relatively soft rear structure of the struck Honda vehicle. The driver's seat belt pretensioner did, however, fire. The driver's seat belt pretensioner did, however, fire.



**Figure 3.** Honda at final rest

The Honda sustained a delta v of 67 km/h (42 mph), a longitudinal delta v of 67 km/h (42 mph), a latitudinal delta v of 0 km/h (0 mph), and a barrier equivalent speed of 85 km/h (53 mph). The results of the WinSmash run are high.

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<sup>1</sup>Calculated using WinSmash version 2.32. The size and stiffness factors for the case vehicle were based on its wheelbase.

The Honda was pushed into a clockwise rotation. The front of this vehicle struck a concrete wall on the right side of the roadway<sup>2</sup>. The vehicle continued rotating until it came to rest in the middle travel lane facing east.

The case vehicle came to rest approximately 189 m (620 ft) north of the impact area facing north on the right hand shoulder. The driver of the case vehicle sustained a fractured sternum and rib contusions. He fled the scene to the east. He was picked up by a private party and taken to a local hospital. He was later located by the investigating agency and placed under arrest for driving under the influence of alcohol and drugs.

As a result of the initial vehicle to vehicle impact, the Honda vehicle caught on fire. It appears that the gas tank ruptured during the crash. Fire fully engulfed the vehicle. Police officers traveling in the opposite direction stopped their vehicle, jumped the median barrier, and attempted to put out the fire using their fire extinguishers. The driver of this vehicle was initially knocked unconscious by the impact. He was removed from the vehicle by a police officer. The front right occupant was able to exit the vehicle on her own. Despite efforts by a number of persons, the rear seat occupant could not be extricated. The right rear door of the case vehicle was jammed shut. The left door opening had been compressed by the rear end damage. Police indicate that this occupant was knocked unconscious but details are not known. She remained trapped inside the vehicle and died from smoke inhalation and thermal burns.

Both vehicles were towed from the scene due to damage. The case vehicle was placed under a police hold. The other vehicle has since been sold to a salvage facility.

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<sup>2</sup>There was no mention of a second impact in the police report; however, vehicle dynamics and frontal damage to the vehicle suggest otherwise.

### Scene Diagram

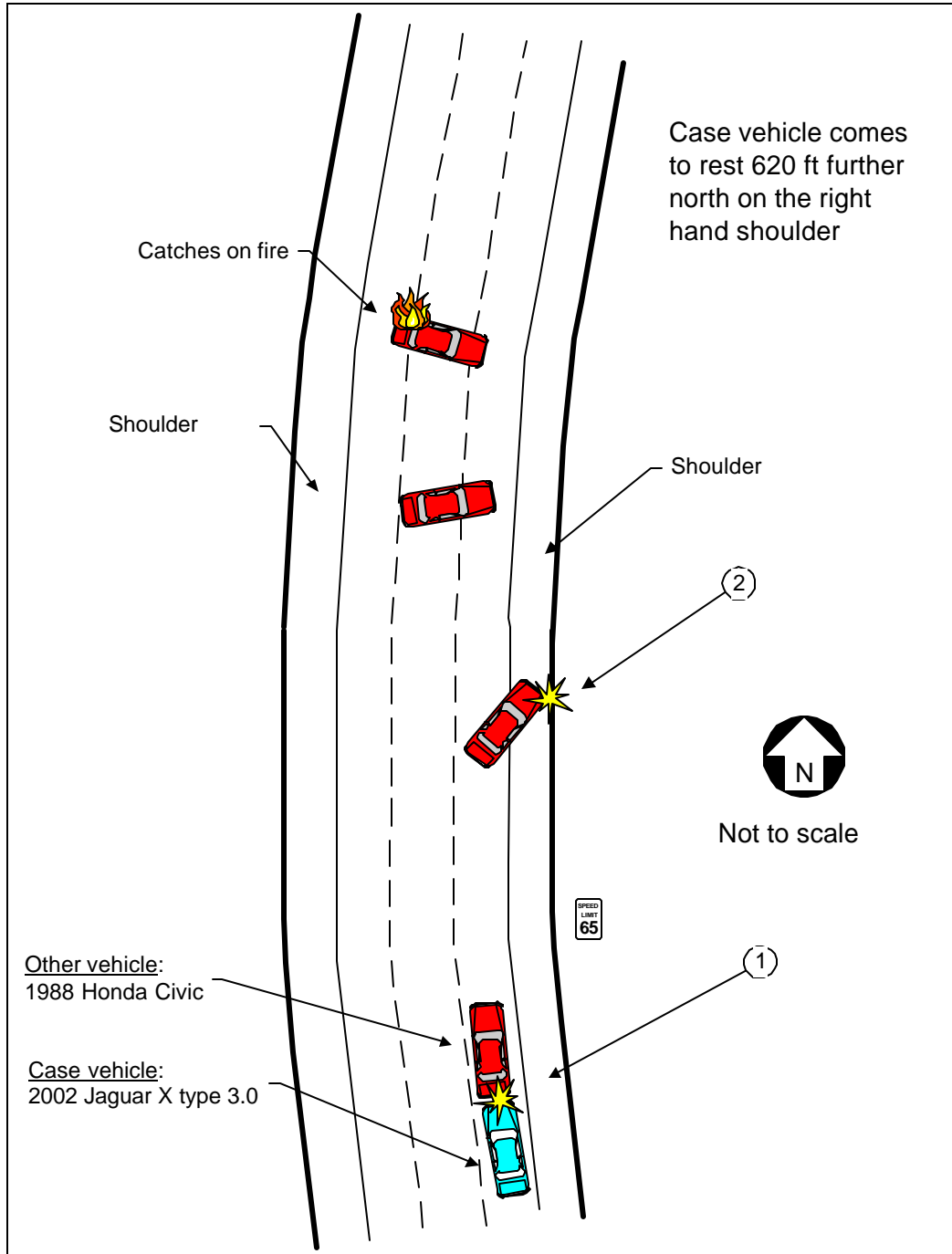


Figure 4. Scene diagram



COLLISION MEASUREMENT TABLE						
Crash Data	Case vehicle (Jaguar)	Other vehicle (Honda)				
Heading Angle	355	355				
Surface Type	Concrete - Roadway	Concrete - Roadway				
Surface Condition	Dry	Dry				
Grade (pre-impact)	0E	0E				
Grade (impact)	0E	0E				
Speed Limit	105 km/h (65 mph)	105 km/h (65 mph)				
Reference Point:			Reference Line:			
Data Point	Distance and Direction from RP			Distance and Direction from RL		
	ft	m	d	ft	m	d
Beginning of gouge	4.0	1.2	W	0	0	N
End of gouge	4.0	1.2	W	2.0	0.6	N
Begin tire mark	8.0	2.4	W	4.0	1.2	N
End tire mark	7.0	2.1	W	21.0	6.4	N
Begin tire mark	4.0	1.2	W	26.0	7.9	N
End tire mark	22.0	6.7	W	152.0	46.3	N
Fluid trail (Jaguar) - begin	6.0	1.8	W	45.0	13.7	N
Fluid trail (Jaguar) - end	4.0	1.2	E	772.0	235.3	N
ERF - Jaguar	7.0	2.1	E	772.0	235.3	N
ERR - Jaguar	7.0	2.1	E	763.0	232.6	N
ERF - Honda	16.0	4.9	W	148.0	45.1	N
ERR - Honda	22.0	6.7	W	152.0	46.3	N

**DETAILED INFORMATION****Vehicles**Case vehicle

Description:	2002 Jaguar X type 3.0	
VIN:	SASJEA51C52Wxxxxxx	
Odometer:	1,322 km (822 miles), per police	
Engine:	3.0 L, V6	
Reported Defects:	None	
Cargo:	None	
Damage Description:	Moderate front end damage.	
CDC:	12FDEW1	
Delta V: (results appear high)	Total	46 km/h (29 mph)
	Longitudinal	-46 km/h (-29 mph)
	Latitudinal	0 km/h (0 mph)
	Energy	11,688 joules (8,621 ft-lbs)



**Figure 5.** Front right, case vehicle

The case vehicle sustained 141 cm (56 in) of direct contact that extended across the entire front end width of the vehicle. The residual crush measured along the bumper was as follows: C1=0 cm (0 in), C2=0 cm (0 in), C3=3 cm (1 in), C4=6 cm (2 in), C5=7 cm (3 in), C6=4 cm (2 in). The maximum crush was located at C5. The principle direction of force was within the 12 o'clock sector and was an estimated 0 degrees. The impact energy was managed by the forward structures of the vehicle. The damaged components include the bumper fascia and reinforcement bar, hood, and grille. There was no measured change in the wheelbase dimensions. There were no glazing fractures and all the doors remained operational.

Safety Systems Discussion

The case vehicle was equipped with dual stage frontal air bags that did not deploy. The driver's air bag was mounted in the steering wheel. The front right passenger's air bag was mounted in the top instrument panel. The vehicle was also equipped with driver's and front right passenger seat mounted side air bags and side air curtains for front and rear occupants.

There were no air bag deployments. This is likely due to the long crash pulse (an extended delta T) caused by the relatively soft rear structure of the struck Honda vehicle. It should be noted that the Jaguar is 31% heavier than the Honda (1558 to 1078 kg, 3434 to 2374 lbs).

The front outboard seats were equipped with seat belt pretensioners. The driver's seat belt pretensioner fired as a result of the crash. The front right passenger's pretensioner did not fire.

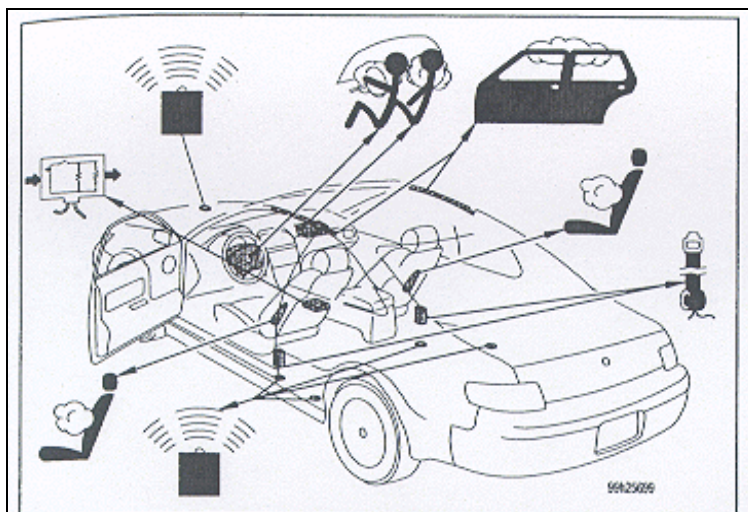


Fig. 02-3: Identifying Air Bag Components (X Type)



**X Type:** Head impact air bag modules will deploy downward from driver and passenger-side roof rails over front and rear doors. Inflation cylinders are located in C-pillars between roof rail and lower edge of door window opening. Remove interior trim panels to obtain a visual fix on inflation cylinders before cutting C-pillars.

Table 02-3: Component Locations (X Type)

Component	<sup>1</sup> Location
Control Module.....	Under Center Console
Driver Air Bag Module .....	On Steering Wheel
Head Impact Air Bag Modules.....	Driver & Passenger-Side Roof Rails Over Front & Rear Doors
Impact Sensor.....	Center Radiator Support Behind Hood Latch
Passenger Air Bag Module.....	Passenger-Side Instrument Panel
Side Impact Air Bag Modules .....	Driver & Passenger Front Seat Outer Seat Backs
Side Impact Sensors .....	Driver & Passenger-Side Lower B & C-Pillars
Seat Belt Pretensioners.....	Driver & Passenger-Side Lower B-Pillars

Figure 6. Air bag component locations (Jaguar)

### Air bag control module activities

The air bag control module was removed by this investigator and released by the police to this investigator. The module was manufactured by the Visteon Corporation for Jaguar. DSI contacted Ford Motor Company to locate the proper Visteon contacts in order to download any available data from the module. After some NHTSA intervention, DSI was provided with the party's name and number. DSI first contacted the police agency to determine the legality of shipping the module to Visteon. The police agency agreed and on March 11, 2002, DSI shipped the module via Federal Express to the Visteon Technical Center in Detroit, Michigan. On March 13, 2002, DSI was contacted by Visteon and Ford. The purpose of the call was to explain some possible data loss issues that might come about as the module is downloaded and to indicate that it is still necessary to obtain the driver's permission to read the module. Visteon returned the module to DSI the following week. Since that time the investigating police agency requested that the module be returned to their official custody; this was done. At the time of this writing the module remains unread.



Figure 7. Control module

Other vehicle

Description:	1988 Honda Accord four-door	
VIN:	1HGED3640JAxxxxxx	
Odometer:	Unknown	
Engine:	Unknown	
Reported Defects:	None noted	
Cargo:	Unknown	
Damage Description:	Major rear end damage.	
CDC:	Impact 1: 06BDEW6 Impact 2: 10FZEW1	
Delta V (Impact 1): (results appear high)	Total	67 km/h (42 mph)
	Longitudinal	67 km/h (42 mph)
	Latitudinal	0 km/h (0 mph)
	Energy	303,545 joules (223,883 ft-lbs)
Delta V (Impact 2):	Total	11 km/h (7 mph)
	Longitudinal	-4 km/h (-2 mph)
	Lateral	10 km/h (6 mph)
	Energy	16,889 joules (12,457 ft-lbs)



As a result of the vehicle to vehicle impact, the Honda sustained 138 cm (54 in) of direct contact damage that extended across the entire rear end width of the vehicle. The residual crush measured along the rear surface behind the reinforcement bar was as follows: C1=123 cm (48 in), C2=120 cm (47 in), C3=116 cm (46 in), C4=95 cm (37 in), C5=77 cm (30 in), C6=55 cm (22 in). The maximum crush was located at C1. The principle direction of force was within the 6 o'clock sector and was an estimated 180 degrees. The rear structure failed. The damaged components included the bumper fascia and reinforcement bar, trunk lid, rear axle, fuel tank, left rear door, and rear passenger compartment. The left wheelbase was reduced by 16 cm (6 in). The right rear door was jammed shut. The backlight and left rear side glass were likely disintegrated by the impact. Shortly after the crash, this vehicle caught on fire due to a ruptured fuel tank. The vehicle was completely engulfed by the fire.



**Figure 8.** Rear left, Honda



**Figure 9.** Frontal damage to Honda from barrier impact

**Occupants**

<u>Case vehicle</u>	Occupant 1
Age/Sex:	55/Male
Seated Position:	Front left
Seat Type:	Leather covered bucket seat. Seat adjusted to rear most track position.
Height:	206 cm (81 in)
Weight:	118 kg (260 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	Unspecified heart condition
Alcohol/Drug Involvement:	Police report driver as being under the influence of alcohol (BAC > 0.08%).
Driving Experience:	Presumed to be greater than 20 years
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt available, used
Air bag:	Steering wheel mounted driver's air bag. Air bag did <u>not</u> deploy.

<u>Other vehicle</u>	Occupant 1	Occupant 2	Occupant 3
Age/Sex:	27/Male	53/Female	19/Female
Seated Position:	Front left	Front right	Rear left
Seat Type:	Bucket, unknown track position	Bench with folding back	Bench with folding back
Height:	168 cm (66 in)	Unknown	147 cm (58 in)
Weight:	64 kg (140 lbs)	Unknown	48 kg (106 lbs)
Occupation:	Unknown	Unknown	Unknown
Pre-existing Medical Condition:	None noted	None noted	None
Alcohol/Drug Involvement:	Police report driver as being under the influence of both drugs and alcohol.	None noted	Negative for drugs.
Driving Experience:	Unknown	NA	NA
Body Posture:	Unknown	Unknown	Unknown
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	Unknown	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt used, per police report	Lap and shoulder belt used, per police report	Unknown



**Injuries and Injury Mechanisms**

## Case vehicle (Jaguar)

	<u>INJURY</u>	<u>OIC CODE</u>	<u>ICD-9</u>	<u>SOURCE</u>
Driver:	Sternum fracture	450804.2,4	807.2	Shoulder harness
	Chest/rib contusions, left	490402.1,2	922.1	Shoulder harness
	Abrasion, left shoulder	790202.1,2	911.0	Shoulder harness

## Other vehicle (Honda)

Driver:	Minor laceration to chin	290600.1,8	873.49	Unknown
	Brief LOC, per PAR	Not codeable		
Front right occupant	LOC, per PAR	No codeable injuries		Unknown
Rear left occupant	LOC, per PAR	No codeable injuries		Unknown
	Entire body sustained 2 <sup>nd</sup> and 3 <sup>rd</sup> degree thermal burns except for several small areas	992032.6,0	948.99	Fire

## Occupant Kinematics

The 55-year-old male driver (206 cm/81 in, 118 kg/260 lbs) of the case vehicle was using the available lap and shoulder belt. He was seated in a forward facing position. The leather covered seat had been adjusted to the rear-most track position. The seat belt anchorage was in the full up position. Upon impact, the driver's pretensioner fired. The driver responded to the 12 o'clock direction of force by exhibiting a forward trajectory and loading the pretensioned and locked manual restraint system. The belt became entrapped in the sliding latch plate as it began to load. The soft tissue injuries to his left shoulder and left chest were caused by the seat belt, as was the sternal fracture.

The steering wheel was not deformed and the shear capsules did not exhibit any loading.



Figure 10. Driver's seated position



Figure 11. Driver's seat belt latch