On-scene Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS01-010
2000 Honda Insight
Arizona
March, 2001

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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

1. Report No.	2. Government Accession No.	3. Recipient Catalog No.
DS01-010		

4. Title and Subtitle	5. Report Date
In-Depth Accident Investigation	
	6. Performing Organization Report No.

7. Author(s)	8. Performing Organization Report No.
Dynamic Science, Inc.	

9. Performing Organization name and Address	10. Work Unit No. (TRAIS)
Dynamic Science, Inc. 530 College Parkway, Ste. K Annapolis, MD 21401	11. Contract or Grant no. DTNH22-94-D-27058

12. Sponsoring Agency Name and Address	13. Type of report and period Covered [Report Month, Year]
U.S. Dept. of Transportation (NRD-32) National Highway Traffic Safety Administration 400 7th Street, SW Washington, DC 20590	14. Sponsoring Agency Code

15. Supplemental Notes

16. Abstract

The case vehicle was a 2000 Honda Insight driven by a restrained 39-year-old male. The front right seat was occupied by a restrained 33-year-old female. The other vehicle was a 1988 Mitsubishi Montero sport utility vehicle driven by a 32-year-old male.

Both vehicles were traveling southbound on a five-lane divided interstate highway at a police estimated speed of 89 km/h (55 mph). The case vehicle was in the second lane from the right. The other vehicle was in the lane to the right of the case vehicle. The driver of the case vehicle began a lane change to the left. At this point he noticed a vehicle to his left. He steered back to the right to return to his original lane of travel. In the meantime, the Mitsubishi had changed lanes to the left and was now partially in the case vehicle's original lane of travel.

The right side of the case vehicle (03RDEW1) came into contact with the left side of the other vehicle. The driver of the case vehicle steered to the left and lost control. The vehicle traveled through three southbound travel lanes before entering the center median and striking a three-strand cable guardrail with its front end (12FYEW1) and along its left side (12LDAS1). It appears that the case vehicle penetrated the cable guardrail to some degree and several of the cables may have come free. Generating a valid delta v is not possible due to the yielding nature of the guardrail, but it would appear that it was below 25 km/h (10 mph). Neither frontal air bags deployed.

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

The case vehicle was towed from the scene due to damage and was subsequently declared a total loss by the insurance company. There were no indications of any damage to the engine or the rear mounted battery pack. The other vehicle was driven from the scene.

17. Key Words	18. Distribution Statement
Crash, electric, battery, hybrid	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No of pages	22. Price

Dynamic Science, Inc.
Accident Investigation
Case Number: DS01-010

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BACKGROUND:

Description:	This hybrid vehicle case was generated by DSI through existing insurance contacts. NHTSA was notified of the case on May 1, 2001. DSI was assigned the case on May 2, 2001. This case was conducted as an on-scene investigation.
Investigation Type:	On-scene
Crash Location:	Arizona
Crash Date:	March, 2001
Notification Date:	May 1, 2001
Field Work Completed:	May, 2001

SUMMARY:

This crash occurred in March, 2001 at 0719 hours. The weather was clear and the concrete roadway was dry and free of defects. The speed limit is 89 km/h (55 mph). The case vehicle was a 2000 Honda Insight driven by a restrained 39-year-old male. The front right seat was occupied by a restrained 33-year-old female. The other vehicle was a 1988 Mitsubishi Montero sport utility vehicle driven by a 32-year-old male.

Both vehicles were traveling southbound on a five-lane divided interstate highway at a police estimated speed of 89 km/h (55 mph). The case vehicle was in the second lane from the right. The other vehicle was in the lane to the right of the case vehicle. The driver of the case vehicle began a lane change to the left. At this point he noticed a vehicle to his left. He steered back to the right to return to his original lane of travel. In the meantime, the Mitsubishi had changed lanes to the left and was now partially in the case vehicle's original lane of travel.

Figure 1. Front left side, case vehicle

The right side of the case vehicle (03RDEW1) came into contact with the left side of the other vehicle. The driver of the case vehicle steered to the left and lost control. The vehicle traveled through three southbound travel lanes before entering the center median and striking a three-strand cable guardrail with its front end (12FYEW1) and along its left side (12LDAS1). It appears that the case vehicle penetrated the cable guardrail to some degree and several of the cables may have come free. Generating a valid delta v is not possible due to the yielding nature of the guardrail, but it would appear that it was below 25 km/h (10 mph). Neither frontal air bags deployed.

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

The case vehicle was towed from the scene due to damage and was subsequently declared a total loss by the insurance company. There were no indications of any damage to the engine or the rear mounted battery pack.

The other vehicle was driven from the scene.

Figure 2. Left side, case vehicle

Figure 3. Interior, case vehicle

Scene Diagram

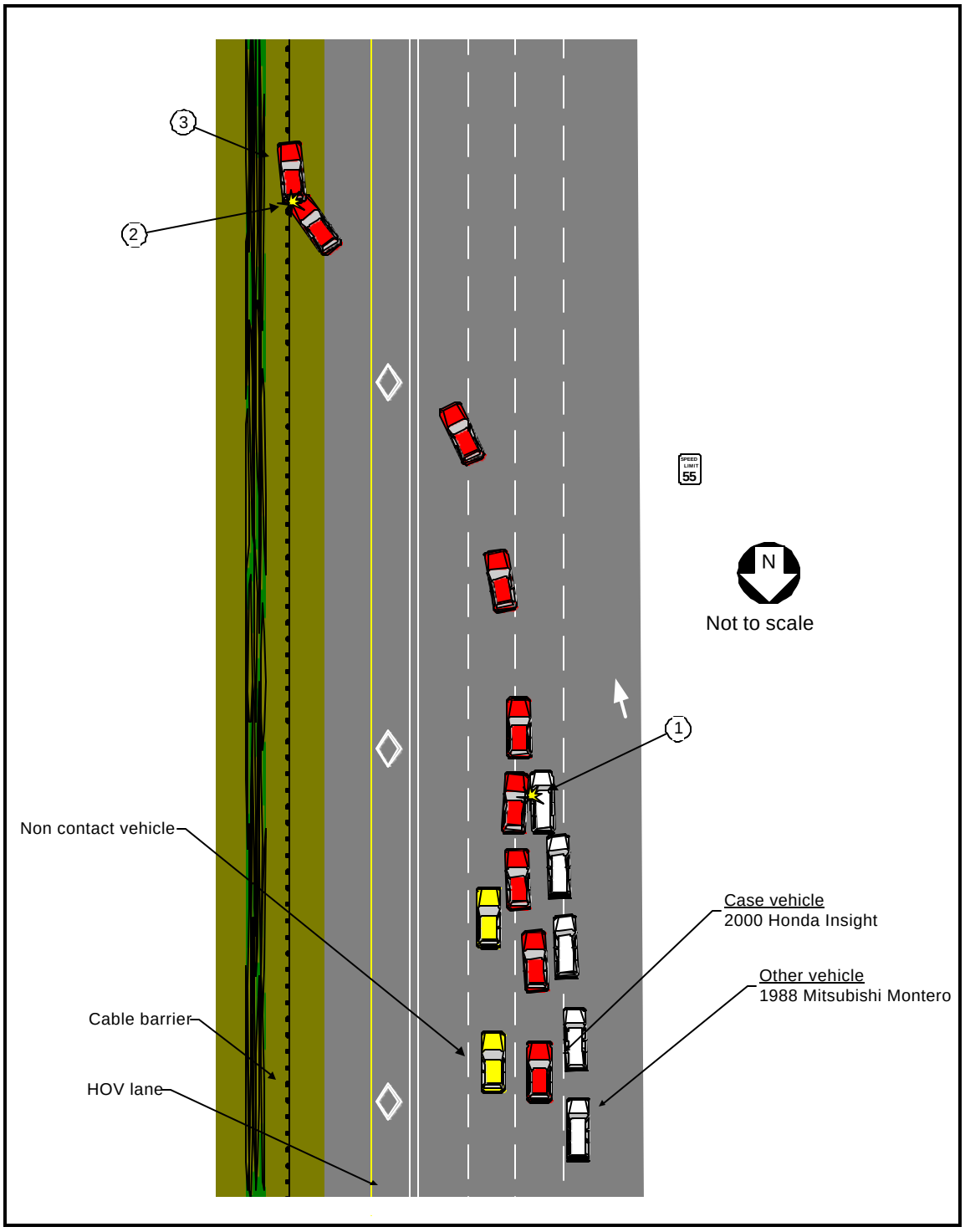

Figure 4. Scene diagram

DETAILED INFORMATION

Vehicles

Case vehicle

Description:	2000 Honda Insight two-door hybrid electric	
VIN:	JHMZE1377YTxxxxxx	
Odometer:	Unknown	
Gasoline Engine:	1.0-liter, 3-cylinder	
Reported Defects:	None	
Cargo:	None	
Damage Description:	Minor contact damage to right side from contact with other vehicle. Direct contact to the front bumper from contact with the guardrail. Light scratching damage along both sides and the roof from contact with the guardrail.	
CDC:	Impact 1: 03RDEW1 Impact 2: 12FYEW1 Impact 3: 12LDAS1	
Delta V:	Total	Unknown
	Longitudinal	Unknown
	Latitudinal	Unknown
	Energy	Unknown

Additional vehicle details

The Honda Insight is a hybrid powered vehicle. It combines electric power with a conventional internal combustion engine in a system Honda calls Integrated Motor Assist (IMA). The Insight's primary power source is a 67-horsepower 1.0-liter, three-cylinder engine. The other part of the system is a thin electric motor, sandwiched between the engine and the five-speed manual transmission. It is powered by a 144 volt nickel metal hydride battery pack, which is stowed at the back of the car and consists of 120 cells providing 1.2 volts each. There is also a conventional 12-volt lead-acid battery under the hood, but that is only for starting up. It doesn't contribute to propulsion.

Figure 5. Rear battery compartment, with cover on

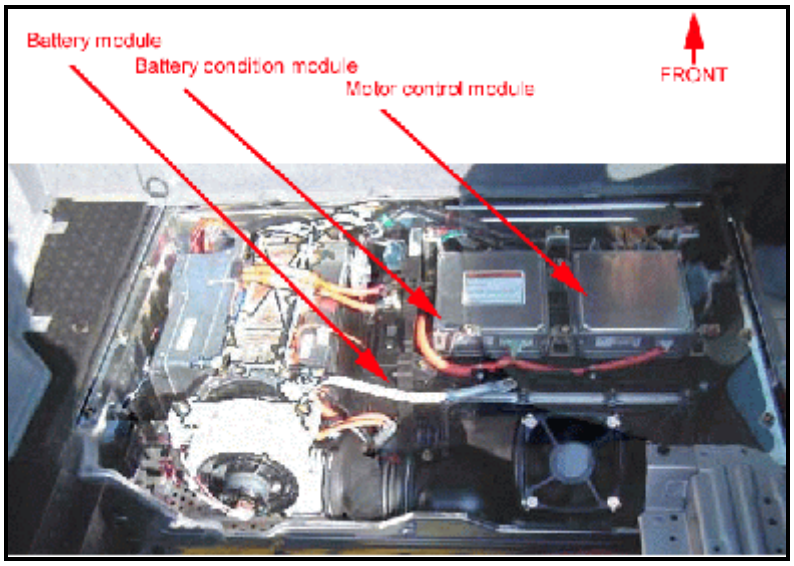

Figure 6. Exemplar view, rear battery compartment. Shows IMA components

When the IMA system detects a demand for additional power, via the throttle position sensor, the electric motor kicks in and adds horsepower. When the Insight is coasting, or the driver is using the brakes, the electric motor becomes a generator, recharging the battery. The Insight has an idle stop feature that will automatically stop the engine in the event one of the following conditions occur:

- the vehicle speed is less than 30 km/h (18.6 mph) and the brake pedal is pressed, or vehicle speed is less than 5 km/h (3.1 mph)
- the transmission is in any gear, except 1st, before slowing down
- the clutch is disengaged or neutral position is now selected
- the engine speed is less than 1000 rpm

If the brake pedal is released while the Insight is slowing down, the engine starts again, unless vehicle speed is below a certain speed. Even in this situation, the engine will be restarted if a gear is selected or the gas pedal pressed.

In this case, the case vehicle was cruising at a constant speed and the IMA motor/generator would have been operating in the generation mode to charge the battery module and to send some energy to

the 12v accessories. As the driver braked, the gasoline engine would switch into the fuel cut mode and the motor/generator would be operated in the generation mode. As the driver continued to brake, the speed would have dropped below idle stop cutoff speed (30 km/h, 18.6 mph) if the climate control was not in the Auto mode then the engine would have stopped. If the climate control was in the Auto mode the engine would have continued running to operate the air conditioning compressor. It is not known which mode the vehicle was in.

Compliance with Sec.571.305 Standard No.305; Electric-powered vehicles: electrolyte spillage and electrical shock protection

The case vehicle was examined to determine compliance with the 305 standards.

1. There were no indications of electrolyte spillage from the propulsion battery.
2. There was no movement of the battery module.
3. The electrical isolation test could not be conducted. The propulsion battery was not charged. There were no indications, however, of any arcing, fire, or component meltdown.

Responding agency training

The responding officers did not have any EV specific training. Their academy does, however, provide limited hazardous materials training.

Other vehicle

Description:	1988 Mitsubishi Montero sport utility vehicle	
VIN:	JA4FJ53E4JJxxxxxx	
Odometer:	Unknown	
Engine:	2.6 L	
Reported Defects:	None	
Cargo:	Unknown	
Damage Description:	Minor. Vehicle not disabled. Driven from the scene by the driver.	
CDC:	Unknown	
Delta V:	Total	Unknown
	Longitudinal	Unknown
	Latitudinal	Unknown
	Energy	Unknown

Occupants

Case vehicle	Occupant 1	Occupant 2
Age/Sex:	39/Male	33/Female
Seated Position:	Front left	Front right
Seat Type:	Bucket	Bucket
Height:	Unknown	Unknown
Weight:	Unknown	Unknown
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	None
Driving Experience:	Presumed to be greater than 10 years	Unknown
Body Posture:	Normal, upright	Normal, upright
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt used	Lap and shoulder belt used
Air bag:	Available, not deployed	Available, not deployed

Other vehicle

Age/Sex:	32/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

Injuries and Injury Mechanisms

Case vehicle

	INJURY	OIC CODE	ICD-9	SOURCE
Driver:	Not injured			
RF Occupant:	Not injured			

Other vehicle

	INJURY	OIC CODE	ICD-9	SOURCE
Driver:	Not injured			

Occupant Kinematics

The 39-year-old male driver was seated upright in a normal fashion. He was wearing the available lap and shoudler belt. The 33-year-old female front right passenger was seated upright in a normal fashion. She was wearing the available lap and shoulder belt. It is unlikely that either occupant reacted to any significant degree to the light impact to the right side of the vehicle. Both would have moved somewhat to the right as the driver steered sharply to the left after the initial contact. As the case vehicle crossed multiple lanes of traffic and struck the wire guardrail, both occupants moved slightly forward in response to the 00 degree direction of force. This was a very soft collision and there would have not have been much belt loading. Neither occupant reported any injuries.