Certified Advanced 208 Compliant Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: 2004-82-082B
2004 Acura MDX
Washington
July, 2004

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 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.
2004-82-082B		

4. Title and Subtitle	5. Report Date
Remote Certified Advanced 208 Compliant Investigation	March 20, 2005
	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. DTNH22-01-C-27002

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

This remote investigation focused on the performance of the Certified Advanced 208-Compliant (CAC) supplemental restraint system in a 2004 Acura MDX. The vehicle was being driven by a 49-year-old female. The front right seat was occupied by a 49-year-old female. The crash occurred within the confines of a four-leg intersection. The intersection is controlled by tri-color traffic signals. The asphalt roadway was clear and dry at the time of the crash. The speed limit is 48 km/h (30 mph). The Acura MDX was traveling southbound and had begun a left turn to go east. A Honda Civic was traveling northbound. The driver of the Honda Civic saw the Acura and began braking but could not stop in time. The front of the Honda struck the right side of the Acura MDX. The right side seat mounted and curtain air bags in the MDX deployed at this time. The initial impact caused the Acura to rotate clockwise and it struck the northeast curb with the left rear wheel. The left side seat mounted and curtain air bags deployed at this time. The driver of the Acura sustained a minor abrasion; the front right occupant sustained a sore right arm and leg. The front right occupant of the Honda was fatally injured due to interaction with the torso belt. Both vehicles were towed from the scene.

17. Key Words	18. Distribution Statement
Air bag, deployment, Certified Advanced 208 Compliant, injury, air curtain, side air bag, passenger, seat belt related fatality.	

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

Form DOT F 1700.7 (8_72) Reproduction of this form and completed page is authorized

Dynamic Science, Inc.
Crash Investigation
Case Number: 2004-82-082B

TABLE OF CONTENTS

BACKGROUND:

This remote investigation focused on the performance of the Certified Advanced 208-Compliant (CAC) supplemental restraint system in a 2004 Acura MDX. The multi-stage air bags were certified by the manufacturer to meet the advanced air bag requirement of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The vehicle was being driven by a 49-year-old female. The front right seat was occupied by a 49-year-old female. The Acura MDX was struck in the right side by a 1990 Honda Civic as the Acura was making a left turn. The driver of the Acura sustained a minor abrasion; the front right occupant sustained a sore right arm and leg.

This CAC case was identified by the local National Automotive Sampling System (NASS), Primary Sampling Unit. The case was reported to DSI on August 31, 2004. This was an SCI/NASS combination case. The following information was obtained from the electronic data entry system.

SUMMARY

Crash Site

The crash occurred within the confines of a four-leg intersection. The southbound leg of the intersection is comprised of two southbound travel lanes and two northbound travel lanes. The northbound leg is comprised of two northbound travel lanes and two southbound travel lanes. There is a negative grade in the southbound direction. The intersection is controlled by tri-color traffic signals. The asphalt roadway was clear and dry at the time of the crash. The speed limit 48 km/h (30 mph).

Figure 1. Honda Civic Approach, north

Pre-Crash

The case vehicle was a 2004 Acura MDX (VIN: 2HNYD18984Hxxxxxx) that was being driven by a restrained 49-year-old female (168 cm/66 in, 108 kg/238 lbs). She was seated in an upright fashion. The bucket seat was adjusted to the rear most track position. The seat back was slightly reclined. The shoulder belt anchorage was in the full up position. The front right seat was occupied by a restrained 49-year-old female (163 cm/64 in, 54 kg/119 lbs). She was seated in an upright fashion. The bucket seat was adjusted to the rear most track position. The seat back was slightly reclined. The shoulder belt anchorage was in the full up position.

Figure 2. Acura MDX impact to the curb

The case vehicle was equipped with a driver's air bag, a front right passenger's air bag, and seat belt retractor type pretensioners for both front seats. The vehicle was also equipped with seat back mounted side air bags for the front seat positions and side air curtains.

The other vehicle was a 1990 Honda Civic that was being driven by a restrained 31-year-old female. The front right seat was occupied by an improperly[1] restrained 46-year-old male.

The Acura MDX was traveling southbound and had begun a left turn to go east. The Honda Civic was traveling northbound. The driver of the Honda Civic saw the Acura and began braking but could not stop in time.

Crash

The front of the Honda Civic (12FDEW2) struck the right side of the Acura MDX (02RZEW2). There was 225.0 cm (88.6 in) of direct contact that began 97.0 cm (38.2 in) aft of the front axle and extended rearward. The maximum crush was located 16.0 cm (6.3 in) forward of C3 and measured 20.0 cm (7.9 in). The total velocity change as calculated by the damage only algorithm of the WinSmash collision model was 17.0 km/h (10.6 mph). The longitudinal and lateral velocity changes were -11.0 km/h (-6.8 mph) and -13.0 km/h (-8.1 mph), respectively. The right curtain and the seat back mounted front right side air bag both deployed at this time.

Figure 3. Rear right, Acura MDX

The initial impact caused the Acura to rotate clockwise and it struck the northeast curb with the left rear wheel (09LBWN2). It appears likely that the left curtain and the seat back mounted front left side air bag both deployed at this time.

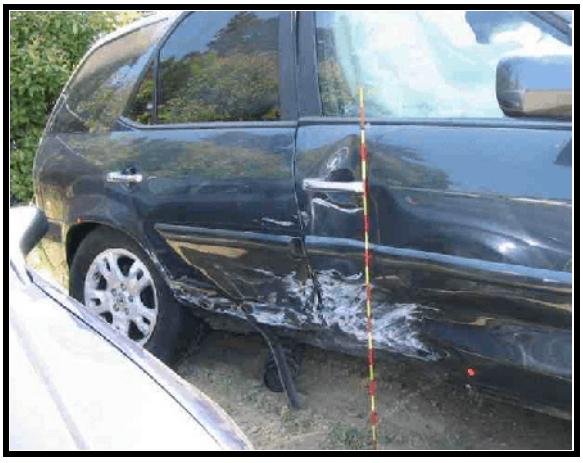

Figure 4. Right side, Acura MDX

[1]Occupant was using the automatic shoulder belt but not the manual lap belt

Post-Crash

The Acura came to rest up on the curb of the northeast corner facing south. The right rear door was jammed shut. The Civic came to rest in the intersection facing northeast in the northbound lanes.

Figure 5. Curb impact to Acura MDX

The driver of the Acura was able to exit the vehicle on her own. She sustained a minor shoulder abrasion and body soreness. She received treatment from her personnel physical at a later date. She was not transported. The front right occupant sustained a sore right arm and leg. She received treatment from her personal physician at a later date. She was not transported.
The driver of the Civic was restrained with the available manual lap belt and automatic shoulder belt. The front right occupant was restrained with the available automatic shoulder belt but was not wearing the available manual lap belt. The driver sustained contusions to the chest, face, abdomen and upper and lower extremities.

Figure 6. Front, 1990 Honda Civic

The front right occupant was removed unconscious from the vehicle. He sustained a cardiac laceration, an intraventicular laceration, multiple rib fractures; and spleen, pleura, and pericardium lacerations. He also sustained abrasions to the chest and upper and lower extremities. He was transported and later died at the hospital.

Both vehicles were towed from the scene due to damage.

VEHICLE DATA - 2004 Acura MDX four-door sport utility vehicle

The 2004 Acura MDX was identified by the Vehicle Identification Number (VIN): 2HNYD18984Hxxxxxx. There were 25,750 km (16,000 miles) on the odometer at the time of inspection. The Acura MDX is a four-door, seven-passenger sport utility vehicle that was equipped with a 3.5 liter V6 engine, a five-speed automatic transmission, anti-lock 4-wheel disc brakes and an anti-skid system, speed-sensing assisted steering, all wheel drive, heated power mirrors, power windows, door locks, sunroof, remote keyless entry, garage-door opener, trip computer, automatic day/night rear-view mirror, and a tilt steering column. Acura calls its anti-skid system Vehicle Stability Assist (VSA). VSA works by controlling brake pressure, engine power or both to help maintain traction.

The 2004 Acura MDX was equipped with Michelin P235/65R17tires. The recommended cold tire pressure is 221 kPa (32 psi). The specific tire data is as follows:

Tire	Tread	Measured Pressure	Maximum Pressure
LF	7 mm (0.27 in)	234 kPa (34 psi)	241 kPa (35 psi)
LR	7 mm (0.27 in)	159 kPa (23 psi)	241 kPa (35 psi)
RF	7 mm (0.27 in)	228 kPa (33 psi)	241 kPa (35 psi)
RR	7 mm (0.27 in)	228 kPa (33 psi)	241 kPa (35 psi)

The front seating positions in the 2004 Acura MDX were configured with leather covered bucket seats. Each front seat was equipped with adjustable head restraints. Both front seats were heated and the driver's seat had an 8-way power adjustment. The second row of seats was configured with a 60-40 folding split-bench seat. There were three seating positions for this row. All three positions were equipped with adjustable head restraints. The third row of seats was configured with a 50-50 folding split bench. There were two seating positions for this row. There were adjustable head restraints for both positions.

VEHICLE DAMAGE

Exterior Damage - 2004 Acura MDX

Damage Description:	There was moderate crush damage to the right sill from the initial vehicle to vehicle impact. There right rear tire was restricted. There was minor damage to the left rear tire/rim from the impact with the curb. The vehicle was towed due to axle damage.	
CDC:	Impact 1: 02RZEW2 Impact 2: 09LBWN2	
Delta V (Impact 1):	Total	17.0 km/h (10.6 mph)
	Longitudinal	-11.0 km/h (6.8 mph)
	Lateral	-13.0 km/h (8.1 mph)
	Energy	31,151 joules (22,975 ft-lbs)

There was 225.0 cm (88.6 in) of direct contact that began 97.0 cm (38.2 in) aft of the front axle and extended rearward. A crush profile was taken along the sill and measured: C1=9.0 cm (3.5 in), C2=17.0 cm (6.7 in), C3=18.0 cm (7.1 in), C4=14.0 cm (5.5 in), C5=10.0 cm (3.9 in), C6=8.0 cm (3.1 in). The maximum crush was located 16.0 cm (6.3 in) forward of C3 and measured 20.0 cm (7.9 in).

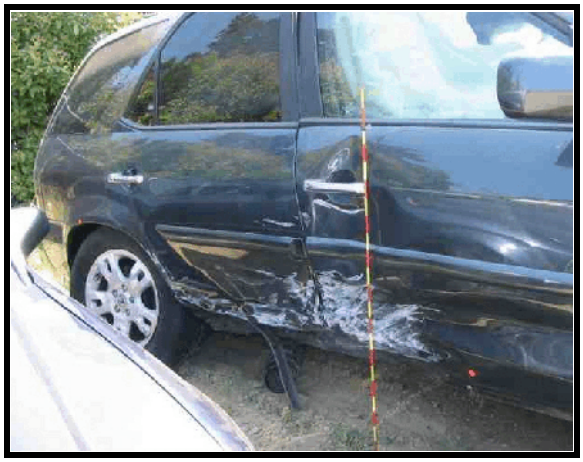

Figure 7. Right side, Acura MDX

Interior Damage - 2004 Acura MDX

There was lateral intrusion to the sill area for the first and second row right seats that measured 5.0 cm (3.1 in). There was B-pillar intrusion to the front right seat that measured between 3.0 and 8.0 cm (1.2 to 3.1 in). There was no glazing damage. The right rear door was jammed shut; the remaining doors and the hatchback remained closed and operational. The center console was slightly deformed from contact with the driver's hip. The steering column was scuffed due to contact with the driver's knee. The glove compartment door was scuffed by the left knee of the front right occupant. There was a transfer contact to the right side door arm rest.

MANUAL RESTRAINT SYSTEMS - 2004 Acura MDX

The MDX was configured with manual 3-point lap and shoulder belts for both front positions, all three second row positions, and both third row outboard positions. The front seat belts were equipped with retractor type pretensioners. Both front seat belt retractors actuated during the crash. All the seat belts were equipped with sliding latch plates. The driver's seat belt was equipped with an emergency locking retractor. The front right passenger's seat belt and all the remaining seat belts were equipped with switchable retractors (retractors that can be switched from an emergency locking retractor to an automatic locking retractor to assist in securing child seats).

SAFETY SYSTEMS - 2004 Acura MDX

The case vehicle was equipped with a driver's air bag, a front right passenger's air bag, and seat belt pretensioners for both front seats. The vehicle was also equipped with seat back mounted side air bags for the front seat positions. The passenger side air bag is controlled by what Honda calls its Occupant Position Detection System (OPDS). The OPDS determines the size and position of the passenger, and prevents deployment whenever it could cause head or neck injuries. It also alerts the driver when the passenger's position is unsuitable for side air bag deployment. The passenger's seat-back incorporates position sensors running from top to bottom. These determine the height of the occupant. Another sensor is incorporated into the seat-back bolster, this determines the lateral position of the occupant. Signals from these sensors allow the OPDS to determine the passenger's seated position. In a side-on collision, OPDS can then calculate if it is safe to deploy the side air bag or not. If the OPDS determines that it is unsafe to deploy the side air bag, a cutoff indicator on the instrument panel will alert the driver. Weight sensors are also included for the front passenger seat. If total weight on the passenger seat is less than 29 kg (65 pounds)--as if occupied by a small child or child safetyseat-- the air bag will not deploy. The driver's seat includes a seat track position indicator. If the seat is within 1.3 cm (0.5 in) of the most forward position, the front air bag will only deploy in the single-stage mode. If the seat is farther than a half inch from the forward position, the air bag deploys in either single or dual-stage mode based on the severity of the collision and seat belt usage.

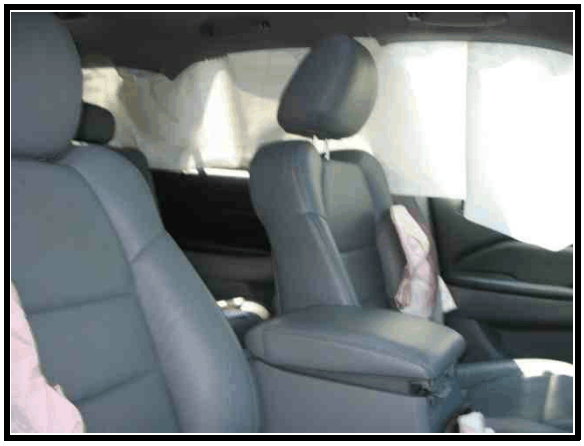

Figure 8. Left side air curtain

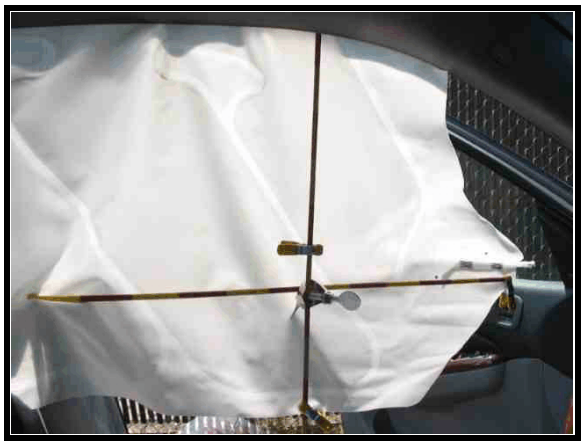

Figure 9. Left side air curtain, driver's position

Figure 10. Driver's seat back mounted side air bag

At impact with the Honda Civic the driver's side air bag and side air curtain deployed. At impact with the curb the passenger's side air bag and side air curtain deployed.

The side air bags were mounted in the left and right respective seat backs. The seat back mounted air bags are essentially six-sided polygons that deploy forward from the seat back. There are two circular tethers at the 10 and 4 o'clock positions. There are also two vent ports found at the base of the air bag. There were no indications of any contact or damage to either side air bag.

The side air curtains were mounted in the roof rail. The curtain is roughly rectangular in shape and covered all three rows of seats (running from A pillar to the D pillar). It is approximately 42.0 cm (16.5 in) high and 245.0 cm (96.5 in) long. There were no indications of any contact or damage to either side air curtain.

Figure 11. Right side air curtain

Figure 12. Front right seat back mounted side air bag

VEHICLE DATA - 1990 Honda Civic

Description:	1990 Honda Civic four-door sedan	
VIN:	1HGED3559LAxxxxxx	
Odometer:	241,400 km (149,999 miles)	
Engine:	4 cylinder, 1.5 L	
Reported Defects:	None	
Cargo:	None, per vehicle inspection	
Damage Description:	Moderate front end damage. The front right tire was restricted. The vehicle was towed from the scene due to damage.	
CDC:	12FDEW2	
Delta V:	Total	32.0 km/h (19.9 mph)
	Longitudinal	-32.0 km/h (19.9 mph)
	Lateral	6.0 km/h (3.7 mph)
	Energy	55,400 joules (40,860 ft-lbs)

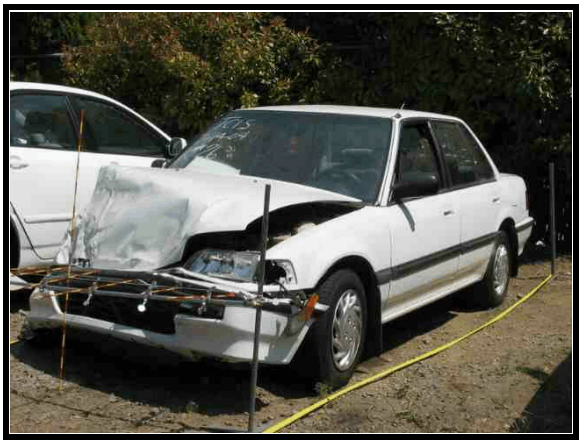

Figure 13. Front left, Honda Civic

OCCUPANT DEMOGRAPHICS - 2004 Acura MDX

	Driver	Occupant 2
Age/Sex:	49/Female	49/Female
Seated Position:	Front left	Front right
Seat Type:	Leather covered bucket seat. 8-way adjustable driver seat. Seat adjusted to rear most track position. Seat back slightly reclined.	Leather covered bucket seat. 4-way adjustable passenger seat. Seat adjusted to rear most track position. Seat back slightly reclined.
Height:	168 cm (66 in)	163 cm (64 in)
Weight:	108 kg (238 lbs)	54 kg (119 lbs)
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.	NA
Body Posture:	Normal, upright	Normal, upright
Hand Position:	On steering wheel at 3 and 9 o'clock positions, per interview	Unknown
Foot Position:	On floor or foot controls, per interview	On floor, per interview
Restraint Usage:	Lap and shoulder belt available, used. Retractor mounted pretensioner available, actuated.	Lap and shoulder belt available, used. Retractor mounted pretensioner available, actuated.
Air bag:	Driver's steering wheel mounted air bag available, did not deploy. Seat back mounted side air bag, deployed. Left side air curtain, deployed.	Instrument panel mounted front air bag available, did not deploy. Seat back mounted side air bag, deployed. Right side air curtain, deployed.

OCCUPANT DEMOGRAPHICS - Honda Civic

Age/Sex:	31/Female	46/Male
Seated Position:	Front left	Front right
Seat Type:	Bucket. Seat adjusted to between forward most and middle track position.	Bucket. Seat adjusted to between rear most and middle track position.
Height:	168 cm (66 in)	180 cm (71 in)
Weight:	64 kg (141 lbs)	75 kg (165 lbs)
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	None
Driving Experience:	Unknown	NA
Body Posture:	Unknown	Unknown
Hand Position:	On steering wheel at 11 and 1 o'clock position	Unknown
Foot Position:	Right foot on accelerator, left on floor	Both feet on floor
Restraint Usage:	Manual lap belt, used. Automatic shoulder belt, used.	Improperly restrained. Using automatic shoulder belt but not the manual lap belt.

OCCUPANT INJURIES -2004 Acura MDX

Driver: Injury data obtained from driver interview.

	Injury	NASS Injury Code	Injury Mechanism	Confidence Level
	Left posterior shoulder abrasion	790202.1,2	Side air bag/curtain	Probable

Front right occupant: Not injured.

OCCUPANT INJURIES - Honda Civic

Driver: Injuries obtained from emergency room records and interviewee.

	Injury	NASS Injury Code	Injury Mechanism	Confidence Level
	Left chest contusion	490402.1,2	Shoulder belt	Certain
	Left hip contusion	890402.1,2	Lap belt	Certain
	Abdominal contusion	590402.1,8	Lap belt	Certain
	Left shoulder contusion	790402.1,2	Shoulder belt	Certain
	Forehead contusion	290402.1,7	Steering wheel rim	Probable

Front right occupant: Injuries obtained from autopsy report.

	Injury	NASS Injury Code	Injury Mechanism	Confidence Level
	Heart laceration, complex or ventricular rupture	441014.6,2	Shoulder harness	Certain
	Intraventricular septum laceration	441300.5,2	Shoulder harness	Certain
	Rib fractures, 2-9 left side	450230.3,2	Shoulder harness	Certain
	Pleura laceration	441800.2,4	Shoulder harness	Certain
	Pericardium laceration	441602.2,4	Shoulder harness	Certain
	Splenar laceration	544222.2,2	Shoulder harness	Certain
	Chest abrasion, left side	490202.1,2	Shoulder harness	Certain
	Upper extremity abrasion	790202.1,9	Shoulder harness	Certain

	Lower extremity abrasion	890202.1,1	Lower instrument panel	Certain

OCCUPANT KINEMATICS - 2004 Acura MDX

Driver kinematics

The 49-year-old female (168 cm/66 in, 108 kg/238 lbs) driver of the Acura MDX was seated in an upright fashion. The bucket seat was adjusted to the rear most track position and the seat back was slightly reclined. She was wearing the available lap and shoulder belt. The shoulder belt anchorage was in the full up position. At impact with the Honda Civic, the belt pretensioners actuated. The female driver initiated a lateral and slightly forward trajectory to the right in response to the 2 o'clock direction of force. She remained in place throughout the crash sequence. The initial impact caused the Acura to rotate clockwise and it struck the northeast curb with the left rear wheel. It appears likely that the left seat back mounted side air bag and side air curtain both deployed at this time. She sustained a minor abrasion to her left shoulder from the deploying side air curtain. She was able to exit the vehicle on her own and was not transported. She received treatment from her personal physician at a later date.

Front right occupant kinematics

The 49-year-old female (163 cm/64 in, 54 kg/119 lbs) front right seat occupant of the Acura was seated in an upright fashion. The bucket seat was adjusted to the rear most track position and the seat back was slightly reclined. She was wearing the available lap and shoulder belt. The shoulder belt anchorage was in the full up position. At impact, the seat back mounted side air bag and side air curtain deployed and the safety belt pretensioners actuated. The female front right occupant initiated a lateral and slightly forward trajectory to the right in response to the 2 o'clock direction of force. She remained in place throughout the crash sequence and did not sustain any injuries. She indicated that her right arm and leg were sore, likely due to contact to the side curtain and the front right door. She received treatment from her personal physician at a later date.

Attachment 1. Scene Diagram