CALSPAN CORPORATION
CRASH DATA RESEARCH CENTER
BUFFALO, NY 14225

CALSPAN REMOTE ADULT AIR BAG RELATED SERIOUS INJURY INVESTIGATION

SCI TECHNICAL SUMMARY REPORT

NASS/SCI COMBO CASE NO. 04-45-214K

VEHICLE – 1996 HONDA CIVIC

LOCATION - STATE OF TENNESSEE

CRASH DATE – NOVEMBER 2004

Contract No. DTNH22-01-C-17002

Prepared for:

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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 are 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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16. Abstract This remote investigation focused on the severity of the crash and the air bag related serious injuries to a restrained 83-year-old female front right passenger of a 1996 Honda Civic. The Honda was equipped with a frontal air bag system for the driver and front right passenger positions that deployed as result of an intersection crash with a 2000 Pontiac Bonneville. The Honda was occupied by a restrained 46-year-old male driver and a restrained 83-year-old female front right passenger. The Pontiac was occupied by a 15-year-old female driver and two occupants. The driver of the Honda was operating the vehicle westbound on a local roadway approaching the intersection. The 15-year-old female driver of the Pontiac was traveling southbound on an intersecting roadway approaching the intersection. The driver of the Pontiac turned left across the path of the Honda at the intersection, which resulted in the front of the Honda impacting the front left aspect of the Pontiac. As a result of the impact, the frontal air bag system deployed in the Honda. The driver of the Honda sustained minor injuries and was transported to a local trauma center where he was treated and released. The front right occupant of the Honda sustained a left cerebrum hemorrhage, right cerebrum hemorrhage, right lung contusion, C1 fracture, sternum fracture, mesentery contusion, and several minor severity injuries. She was transported to local trauma center where she was hospitalized for 14 days and released. The 15-year-old female driver and the two occupants of the Pontiac were not injured. Both vehicles were towed from the crash site.			
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TABLE OF CONTENTS

CALSPAN REMOTE ADULT AIR BAG RELATED SERIOUS INJURY INVESTIGATION
SCI SUMMARY TECHNICAL REPORT
NASS/SCI COMBO CASE NO. 04-45-214K
SUBJECT VEHICLE – 1996 HONDA CIVIC
LOCATION - STATE OF TENNESSEE
CRASH DATE – NOVEMBER 2004

BACKGROUND

This on-site investigation focused on the severity of the crash and the air bag related serious injuries to a restrained 83-year-old female front right passenger of a 1996 Honda Civic **(Figure 1)**. The Honda was equipped with a frontal air bag system for the driver and front right passenger positions that deployed as result of an intersection crash with a 2000 Pontiac Bonneville. The Honda was occupied by a restrained 46-year-old male driver and a restrained 83-year-old female front right passenger. The Pontiac was occupied by a 15-year-old female driver and two occupants. The driver of the Honda was operating the vehicle westbound on a local roadway approaching the intersection. The 15-year-old female driver of the Pontiac was traveling southbound on an intersecting roadway approaching the intersection. The driver of the Pontiac turned left across the path of the Honda at the intersection, which resulted in the front of the Honda impacting the front left aspect of the Pontiac. As a result of the impact, the frontal air bag system deployed in the Honda. The driver of the Honda sustained minor injuries and was transported by ambulance to a local trauma center where he was treated and released. The front right occupant of the Honda sustained a left cerebrum subarachnoid hemorrhage, right cerebrum subarachnoid hemorrhage, right lung contusion, C1 fracture, sternum fracture, mesentery contusion, and numerous soft tissue injuries. She was transported by ambulance to a local trauma center where she was hospitalized for 14 days and was discharged to a nursing facility. The 15-year-old female driver and the two occupants of the Pontiac were not injured. Both vehicles were towed from the crash site.

Figure 1. Subject 1996 Honda Civic.

This crash was identified by the National Automotive Sampling System (NASS) PSU 45 during the weekly sampling of Police Accident Reports (PARs). This crash was selected and researched as CDS Case No. 04-45-214K. The NASS PSU performed the vehicle and scene inspections, and conducted the driver/occupant interviews. Due to the air bag related injuries sustained by the front right passenger of the Honda, NHTSA assigned the tasks of case review and report preparation to the Calspan SCI team on February 10, 2005.

SUMMARY

Crash Site

This crash occurred at a four-leg intersection during the evening hours of November 2004 in the state of Tennessee. At the time of the crash, there were no adverse weather conditions; however, the asphalt road surface was wet from previous precipitation. The east/west roadway was configured with two travel lanes in each direction separated by a painted center left turn lane/median. The westbound travel lanes widened prior to the intersection to accommodate a right turn lane. The north/south roadway on the north leg of the intersection was configured with one northbound lane and opposing right and left turn lanes for southbound traffic. Based on the lane configuration there was no southbound through lane. The south leg of the intersection was configured with one travel lane in each direction. Traffic flow through the intersection was controlled by stop signs for the north/south legs of the intersection. The posted speed limit for the north/southbound roadway was 40 km/h (25 mph) and 72 km/h (45 mph) for the east/westbound roadway.

Vehicle Data

1996 Honda Civic

The 1996 Honda Civic was identified by the Vehicle Identification Number (VIN): 2HGEJ6324T (production sequence omitted). The odometer reading was 115,258 kilometers (71,618 miles) at the time of the NASS inspection. The vehicle was a 2-door hatchback that was equipped with a 1.6-liter, four-cylinder engine linked to a five-speed manual transmission, front wheel drive, OEM steel rims, and a tilt steering wheel. The tires on the Honda were Michelin Weatherwise Sport, size P175/70R13. The maximum pressure for these tires was 303 kPa (44 PSI). The manufacturer recommended tire pressure was 221 kPa (32 PSI). The specific tire data was as follows:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	214 kPa (31 PSI)	8 mm (10/32)	No	None
LR	186kPa (27 PSI)	8 mm (10/32)	No	None
RF	207 kPa (30 PSI)	8 mm (10/32)	No	None
RR	207 kPa (30 PSI)	8 mm (10/32)	No	None

The Honda was configured with front bucket seats with height adjustable head restraints that were adjusted to the full-down position at the time of the NASS inspection. The second row was configured with a three-passenger splint bench seat with folding backs (60/40).

2000 Pontiac Bonneville

The NASS researcher did not inspect the 2000 Pontiac Bonneville due to the relocation of the vehicle out of the study area.

Crash Sequence

Pre-Crash

The restrained 46-year-old male driver of the Honda was operating the vehicle westbound approaching the intersection **(Figure 2)**. The 15-year-old female driver of the Pontiac was traveling southbound approaching the intersection **(Figure 3)** where the driver turned left across the path of the Honda. No pre-impact evidence [i.e. skid marks] was present at the crash site. However, a level of pre-impact braking was applied by the driver of the Honda, which was supported by the air bag interaction by the front right passenger. This interaction is discussed in the ***Front Right Passenger Kinematics*** section of this report. The NASS scene schematic is included as **Figure 9** of this report.

Figure 2. Honda's westbound approach to the intersection.

Figure 3. Pontiac's southbound approach to the intersection.

Crash

The full frontal aspect of the Honda impacted the front left aspect of the Pontiac in the northeast quadrant of the intersection **(Figure 4)**. The impact resulted in moderate frontal damage to the Honda and unknown severity damage to the Pontiac. The resultant directions of forces were 1 o'clock for the Honda and 11 o'clock for the Pontiac. The missing vehicle algorithm of the WINSMASH program was used to calculate a delta V for this impact. The total calculated delta V for the Honda was 45 km/h (27.9 mph). The longitudinal and lateral components were -39 km/h (-24 mph) and -23 km/h (-14.3), respectively. The total calculated delta V for the Pontiac was 28 km/h (17.3 mph). The longitudinal component was -18 km/h (-11.2 mph) and the lateral component was 21 km/h (13.0 mph). The missing vehicle algorithm of the WINSMASH program typically overestimates the delta V due the limitations of the algorithm in a side impact configuration. Based on SCI experience, it appears the delta V was in the range of 24.0-32.0 km/h (15.0-20.0 mph) for the Honda. As a result of this intersection crash, the frontal air bags deployed in the Honda. Both vehicles came to rest within the intersection.

Figure 4. Approximate area of impact.

Post-Crash

Police and rescue personnel arrived on scene shortly after the crash. The 46-year-old male driver of the Honda sustained minor injuries and was transported to a local trauma center where he was treated and released. The front right occupant of the Honda sustained a left cerebrum hemorrhage, right cerebrum hemorrhage, right lung contusion, C1 fracture, sternum fracture, mesentery contusion, and several minor severity injuries. She was transported to a local trauma center where she was hospitalized for 14 days and was discharged to a nursing facility. The 15-year-old female driver and the two occupants of the Pontiac were not injured or transported. Both vehicles were towed from the crash site.

Vehicle Damage

Exterior – 1996 Honda Civic

The 1996 Honda Civic sustained moderate severity frontal damage as a result of the intersection crash with the Pontiac **(Figure 5)**. The damage involved the frontal structure, which was displaced longitudinally and laterally left. Additionally, the front bumper fascia was separated from the vehicle at impact. The NASS researcher measured the direct contact damage on the bumper fascia, which was 139.0 cm (54.7") and began 64.0 cm (25.2") left of the centerline and extended to the front right bumper corner. The maximum crush on the bumper reinforcement beam measured 42.0 cm (16.5"), which was located approximately 40.0 cm (16.0") inboard of the left bumper reinforcement beam edge. Due to the separated bumper fascia, the NASS researcher documented the frontal crush along the bumper reinforcement beam using a combined direct and induced damage width of 95.0 cm (37.4") and were as follows: C1 = 0.0 cm, C2 = 19.0 cm (7.5"), C3 = 38.0 cm (14.9"), C4 = 34.0 cm (13.4"), C5 = 29.0 cm (11.4"), C6 = 25.0 cm (9.8"). The CDC for this impact was 01-FDEW-2. The left and right side doors remained closed and operational post-crash. The windshield was fractured as result of the front right air bag deployment and the side and rear glazing remained intact.

Figure 5. Resultant frontal damage from the impact with the Pontiac.

Interior – 1996 Honda Civic

The 1996 Honda Civic sustained minor interior damage as result of occupant contacts. There was no intrusion of the passenger compartment. Occupant contacts were noted to the front left air bag from contact with the driver's left hand, left wrist, and face. These contacts were evidenced by scuffmarks. Also noted was an occupant contact to the front right air bag from the front right passenger's face, which was evidenced by body fluid.

Figure 6. Overall view of the interior first row.

Additionally, the NASS researcher noted a scuffmark to the right knee bolster from contact with the front right passenger's right knee. **Figure 6** is an overall of the front passenger compartment.

Frontal Air Bags – 1996 Honda Civic

The 1996 Honda Civic was equipped with a frontal air bag system that deployed as result of the crash. The driver's air bag was conventionally located in the steering hub **(Figure 7)**. The air bag membrane measured 62.0 cm (24.4") in diameter in its deflated state. Two vent ports at the 10 and 2 o'clock positions on the rear panel vented the air bag. The air bag contained two tether straps, which controlled the deployment pattern of the air bag. The air bag module consisted of two H-configuration asymmetrical cover flaps. The top cover flap measured 12.0 cm (4.7") in width and 7.0 cm (2.7") in height. The lower cover flap measured 14.0 cm (5.5") in width at the top and 11.0 cm (4.3") in width at the bottom and 5.0 cm (2.0") in height.

Figure 7. Deployed driver's frontal air bag. The area of occupant contacts was to the upper left quadrant.

The front right air bag was a top mount design in the front right instrument panel **(Figure 8)**. The air bag membrane measured 50.0 cm (19.7") in width and 60.0 cm (23.6") in height in its deflated state. The air bag was not tethered and was vented by two vent ports at the 10 and 2 o'clock positions on the side panels the air bag. The front right air bag consisted of two symmetrical cover flaps that measured 23.0 cm (9.0") in width and 5.0 cm (2.0") in height. No damage or failures were noted to the frontal air bags.

Figure 8. Deployed front right air bag.

Manual Restraint Systems – 1996 Honda Civic

The 1996 Honda Civic was equipped with manual 3-point lap and shoulder safety belts for the outboard seating positions. The driver's safety belt was configured with a sliding latch plate, and a belt-sensitive Emergency Locking Retractor (ELR). The driver utilized his safety belt in this crash. The NASS researcher did not report or document loading evidence to the safety belt system. The lack of severe injuries and occupant contact evidence supported the driver utilizing the safety belt in this crash. The front right safety belt was configured with a sliding latch plate and a switchable ELR/Automatic Locking Retractor. The front right passenger utilized her safety belt in this crash. This was supported by the lack of interior occupant contacts and the safety belt related injuries that

are described in the front right passenger injury section of this report. The rear outboard safety belts were configured with sliding latch plates and switchable ELR/ALR. The rear center safety belt was a 2-point manual lap belt that was configured with a locking latch plate and no retractor.

Occupant Demographics– 1996 Honda Civic

Driver

Age/Sex:	46-year-old Male
Height:	193 cm (76.0”)
Weight:	95.0 kg (209.0 lbs)
Seat Track Position:	Rear track
Manual Restraint Use:	Manual 3-point lap and shoulder belt
Usage Source:	Vehicle inspection
Eyewear:	Eyeglasses
Type of Medical Treatment:	Transported to a local trauma center where he was treated and released.

Driver Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Source
Abrasion over the left knee	Minor (890202.1,2)	Knee bolster
Contusion over the left knee	Minor (890402.1,2)	Knee bolster
Sternum contusion	Minor (450802.1,4)	Shoulder belt

Source of injury data – Post-emergency room records and driver interview

Driver Kinematics

The 46-year-old male driver of the 1996 Honda Civic was seated in a presumed upright driving posture and was restrained by the manual 3-point lap and shoulder belt. The seat track was adjusted to the mid-to-full rear position. At impact with the Pontiac, the frontal air bags deployed. The driver initiated a front and right trajectory in response to the 1 o’clock direction of force. The driver’s torso loaded the shoulder belt which resulted in the sternum contusion. The driver’s left knee contacted the knee bolster which resulted in the abrasion and contusion over the knee. He was transported by ambulance to a local trauma center where he treated and released.

Front Right Passenger

Age/Sex:	83-year-old female
Height:	168.0 cm (66.0”)
Weight:	71.0 kg (156.5 lbs)
Seat Track Position:	Unknown
Manual Restraint Use:	Manual 3-point lap and shoulder belt
Usage Source:	Vehicle inspection
Eyewear:	Eyeglasses
Type of Medical Treatment:	Transported to a local trauma, hospitalized for 14 days and released.

Front Right Passenger Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Source
Left cerebrum subarachnoid hemorrhage	Serious (140684.3,2)	Front right air bag
Right cerebrum subarachnoid hemorrhage	Serious (140684.3,1)	Front right air bag
Right lung contusion (upper and superior lower lobe) without hemo/pneumothorax	Serious (441406.3,1)	Shoulder belt
C1 fracture (left ring)	Moderate (650216.2,6)	Front right air bag
Sternum fracture (OIS grade II or III)	Moderate (450804.2,4)	Shoulder belt
Mesentery contusion	Moderate (542010.2,8)	Lap belt
Bilateral hip/pelvic contusion	Minor (890402.1,3)	Lap belt
Lower abdomen contusion	Minor (590402.1,8)	Lap belt
Right neck contusion	Minor (390402.1,1)	Shoulder belt
Lower lateral left back contusion	Minor (690402.1,2)	Lap belt
2.5 cm (1.0”) left eyebrow laceration	Minor (290602.1,7)	Front right air bag / eyeglasses
Left upper and lower lip laceration 2.0 cm (0.8”)	Minor (290602.1,2)	Front right air bag
5.0 cm x 3.9 cm (1.9” x 1.5”) left breast contusion (OIS grade I)	Minor (490402.1,2)	Shoulder belt

Source of injury data – Post-emergency room records and medical examiner record

Front Right Passenger Kinematics

The 83-year-old female front right passenger was seated in a presumed upright posture and was restrained by the manual 3-point lap and shoulder safety belt. The seat track was adjusted between the mid-to-rear track position at the time of the NASS inspection. However, the seat track was possibly moved post-crash by rescue personnel during the egress of the front right passenger; therefore, the position of the seat track at the time of the crash was unknown. The seatback was in the upright position at the time of the NASS inspection. Prior to the impact, the driver applied a level of braking which allowed the passenger's head to jackknife forward over the belt system.

At impact with the Pontiac, the frontal air bags deployed. The front right passenger initiated a forward and slight right trajectory in response to the 1 o'clock direction of force. Her torso loaded the shoulder belt portion of the safety belt causing the sternum fracture, right lung contusion, right neck contusion, and 5.0 cm x 3.9 cm (1.9" x 1.5") left breast contusion. The passenger's lower torso loaded the lap belt, which resulted in the mesentery contusion, bilateral hip/pelvic contusion, lower abdomen contusion, and lower lateral left back contusion.

The loading of the shoulder belt restricted the movement of her torso, which allowed her to continue to flex forward over the shoulder belt. As a result of the head flexion, the passenger's face moved into the path of the deploying front right air bag, which resulted in the left upper and lower lip laceration 2.0 cm (0.8"). The expanding non-tethered air bag displaced the passenger's eyeglasses, which resulted in the 2.5 cm (1.0") left eyebrow laceration. The continued expansion of the air bag against her head/face resulted in the bilateral subarachnoid hemorrhages. The air bag induced a rearward motion (hyperextension) of her head, thus resulting in the fracture of C1.

The passenger came to rest within the front right seating position and was removed from the vehicle by rescue personnel.

Front Right Passenger Medical Treatment

The 83-year-old female front right passenger was transported to a local trauma center where she was admitted for treated of her injuries. This treatment included sutures for the facial lacerations, 2 units of blood and observation for the closed head injuries. She was hospitalized for 14 days and discharged to a nursing facility.

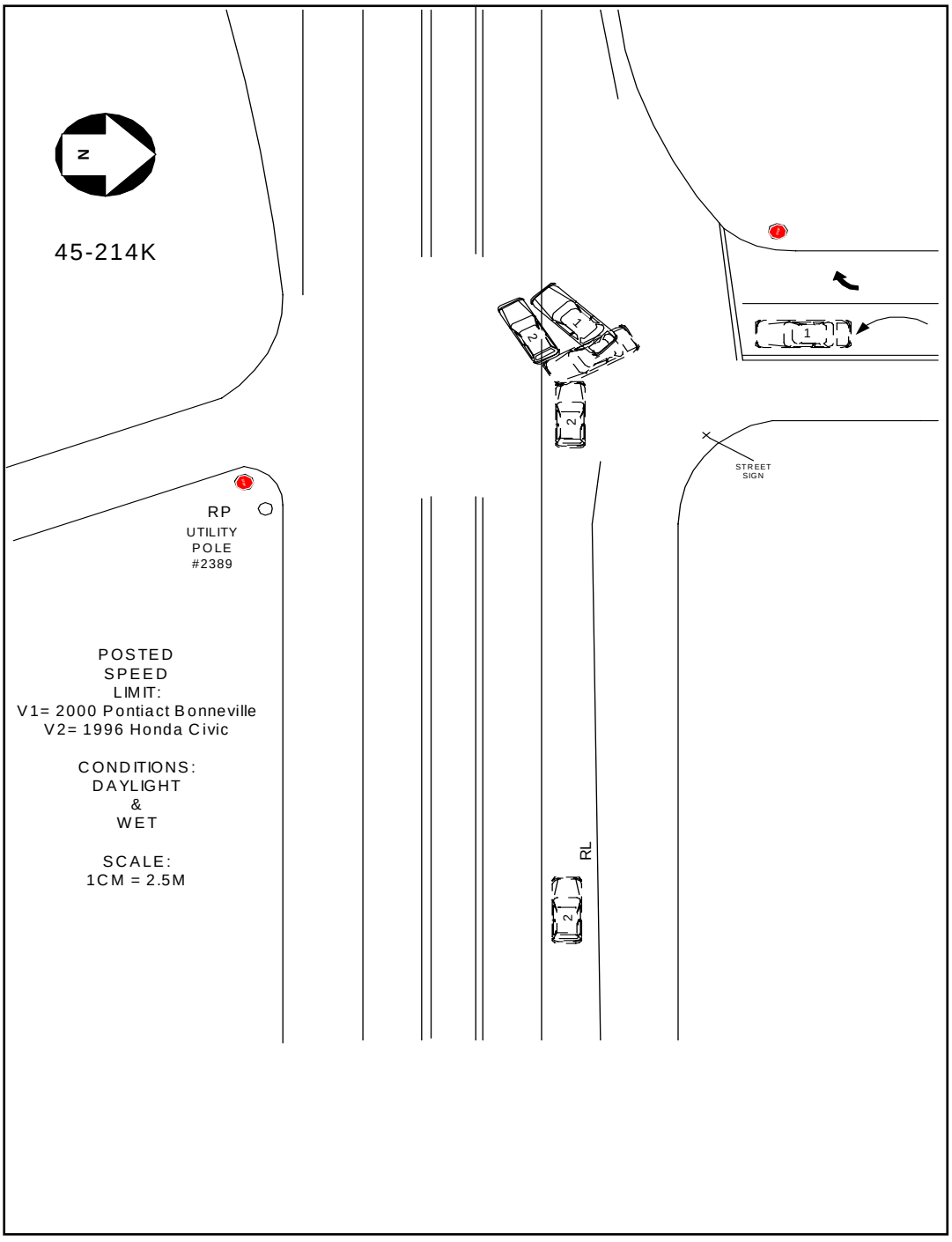

Figure 9. NASS Scene Schematic