

**TRANSPORTATION SCIENCES
CRASH DATA RESEARCH CENTER**

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GENERAL DYNAMICS REMOTE CERTIFIED ADVANCED 208-COMPLIANT

VEHICLE CRASH INVESTIGATION

SCI TECHNICAL SUMMARY REPORT

NASS/SCI COMBO CASE NO. 03-42-050E

VEHICLE – 2003 HONDA ODYSSEY

LOCATION - STATE OF FLORIDA

CRASH DATE – APRIL 2003

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 performance of the Certified Advanced 208-Compliant (CAC) safety system in a 2003 Honda Odyssey. The manufacturer of this vehicle has certified that this 2003 Honda Odyssey meets the advanced air bag requirements of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The system included dual stage frontal air bags, seat track position sensors for the front left and front right seats, and an occupant presence sensor for the front right seat. The Honda was also equipped with retractor mounted pretensioners and seat back mounted side impact air bags for the front seating positions. In addition, the Honda was equipped with an Event Data Recorder (EDR) that was removed by the NASS researcher and forwarded by NHTSA to Honda for download. The recovered data (Deployment) was forwarded to the SCI team and is summarized in this report. The Honda was involved in a multiple impact collision with a 2002 Ford Taurus and a 2000 Jeep Grand Cherokee. As a result of the second impact with the front of the Jeep, the driver's frontal air bag deployed, the driver's safety belt pretensioner fired, and the front right seat back mounted side impact air bag deployed. The Honda was occupied by a restrained 40-year-old female driver, a 5-year-old male passenger positioned in a booster seat in the second row left seat, a 4-year-old male passenger positioned in a forward facing child safety seat in the second row right seat, and a 9-year-old male passenger seated in the third row left seat restrained by the vehicles 3-point manual lap and shoulder safety belt. The driver of the Honda sustained serious AIS-3 level injuries and was transported to a local hospital where she was hospitalized for three days. The 5-year-old male sustained minor severity injuries and was transported to a local hospital where he was treated and released. The 4-year-old male sustained possible injuries and was transported to a hospital; however it was unknown if he was treated. The 9-year-old male sustained minor injuries, however it was unknown if he was transported to a hospital for treatment. The 2002 Ford Taurus was occupied by a 53-year-old female driver and a 59-year-old male front right passenger. The driver and front right passenger of the Ford sustained possible injury and were not transported to a hospital. The 2000 Jeep Grand Cherokee was occupied by a 54-year-old male driver. The 54-year-old male driver sustained serious AIS-3 level injuries and was transported to a local hospital where he was hospitalized for eleven days. The Honda and Jeep sustained severe damage and were towed from the crash site. The Ford sustained minor damage and was driven from the crash site.			
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**GENERAL DYNAMICS REMOTE CERTIFIED ADVANCED 208-COMPLIANT
VEHICLE CRASH INVESTIGATION
SCI SUMMARY TECHNICAL REPORT
NASS/SCI COMBO CASE NO. 03-42-050E
SUBJECT VEHICLE – 2003 HONDA ODYSSEY
LOCATION - STATE OF FLORIDA
CRASH DATE – APRIL 2003**

BACKGROUND

This remote investigation focused on the performance of the Certified Advanced 208-Compliant (CAC) safety system in a 2003 Honda Odyssey (**Figure 1**). The manufacturer of this vehicle has certified that this 2003 Honda Odyssey meets the advanced air bag requirements of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The system included dual stage frontal air bags, seat track position sensors for the front left and front right seats, and an occupant presence sensor for the front right seat. The Honda was also equipped with retractor



Figure 1. 2003 Honda Odyssey.

mounted pretensioners and seat back mounted side impact air bags for the front seating positions. In addition, the Honda was equipped with an Event Data Recorder (EDR) that was removed by the NASS researcher and forwarded by NHTSA to Honda for download. The recovered data (Deployment) was forwarded to the SCI team and is summarized in this report. The Honda was involved in a multiple impact collision with a 2002 Ford Taurus and a 2000 Jeep Grand Cherokee. As a result of the second impact with the front of the Jeep, the driver's frontal air bag deployed, the driver's safety belt pretensioner fired, and the front right seat back mounted side impact air bag deployed. The Honda was occupied by a restrained 40-year-old female driver, a 5-year-old male passenger positioned in a booster seat in the second row left seat, a 4-year-old male passenger positioned in a forward facing child safety seat in the second row right seat, and a 9-year-old male passenger seated in the third row left seat restrained by the vehicles 3-point manual lap and shoulder safety belt. The driver of the Honda sustained serious AIS-3 level injuries and was transported to a local hospital where she was hospitalized for three days. The 5-year-old male sustained minor severity injuries and was transported to a local hospital where he was treated and released. The 4-year-old male sustained possible injuries and was transported to a hospital; however it was unknown if he was treated. The 9-year-old male sustained minor injuries, however it was unknown if he was transported to a hospital for treatment. The 2002 Ford Taurus was occupied by a 53-year-old female driver and a 59-year-old male front right passenger. The driver and front right passenger of the Ford sustained possible injury and were not transported to a hospital. The 2000 Jeep Grand Cherokee was occupied by a 54-year-old male driver. The 54-year-old male driver sustained serious AIS-3 level injuries and was transported to a local hospital where he was hospitalized for eleven days. The Honda and Jeep sustained

severe damage and were towed from the crash site. The Ford sustained minor damage and was driven from the crash site.

This crash was initially selected for investigation by PSU 42 of the National Automotive Sampling System (NASS) as Case No: 2003-42-050E. The Crash Investigation Division (CID) of the National Highway Traffic Safety Administration (NHTSA) assigned a combined investigative effort of the crash to the General Dynamics SCI team due to the agency's interest in the field performance of the Certified Advanced Compliant safety system in the 2003 Honda Odyssey. This remote effort involved a review of the NASS EDS file and the preparation of this narrative report.

SUMMARY

Crash Site

This three-vehicle crash occurred during the morning hours of February 2003 in the state of Florida. At the time of the crash, there were no adverse weather conditions and the asphalt road surface was wet. The crash occurred on the north and south bound lanes of an eight-lane divided state route with four through traffic lanes in each direction. The roadway was bordered by concrete shoulders on both road edges. A grass median that divided the north/south roadway was approximately 16.0 meters (52.0"). The roadway was straight and level at the crash site. The posted speed limit for the roadway was 88 km/h (55 mph). The NASS scene schematic is included as **Figure 16** of this report.

VEHICLE DATA – 2003 Honda Odyssey

The 2003 Honda Odyssey was identified by the Vehicle Identification Number (VIN): 5FNRL18093 (production sequence omitted). The odometer reading was unknown due to the lack of power to the vehicle at the time of the inspection. The Honda was a five-door minivan that was equipped with a 3.5-liter, six-cylinder engine with front wheel drive, 5-speed automatic transmission, 4-wheel disc brakes with ABS, and traction control. The Honda was equipped with Michelin Symmetry radial tires, size P225/60R16. The maximum pressure for these tires was 303 kpa (44 psi). The manufacturer recommended tire pressure for this vehicle was 248 kpa (36 psi). The specific tire data is listed in the table below:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	248 kpa (36 psi)	7 mm (9/32)	No	None
LR	262 kpa (38 psi)	8 mm (10/32)	No	None
RF	269 kpa (39 psi)	7 mm (9/32)	No	De-beaded
RR	234 kpa (34 psi)	8 mm (10/32)	No	None

The Honda was configured with front buckets seats with height adjustable head restraints. The front head restraint adjustment was unknown due to the head restraints being removed prior to the NASS inspection. The second row was configured with dual captain chairs with height adjustable head restraints. The second row head restraints

were adjusted to the full-up position at the time of the inspection. The third row was configured with a three-passenger bench seat with height adjustable head restraints. The right head restraint was adjusted to the full-down position at the time of the inspection. The center and left head restraints were adjusted between the middle and full-up positions at the time of the inspection.

2002 Ford Taurus

The 2002 Ford Taurus was not inspected by the NASS researcher.

2000 Jeep Grand Cherokee

The 2000 Jeep Grand Cherokee was identified by the VIN: 1J4G248S9Y (production sequence omitted). The odometer reading was unknown due to the lack of power to the vehicle at the time of the inspection. The Jeep was a four-door sport utility vehicle that was equipped with a 3.9-liter, six-cylinder engine with rear wheel drive, 4-speed automatic transmission, and 4-wheel disc brakes with ABS. The Jeep was equipped with Delta Sierradial A/S tires, size P225/75R16. The maximum pressure for these tires was 241 kpa (35 psi). The manufacturer recommended tire pressure for this vehicle was 228 kpa (33 psi). The specific tire data is listed in the table below:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	0 kpa	9 mm (11/32)	Yes	Unknown
LR	0 kpa	8 mm (10/32)	No	Flat
RF	0 kpa	8 mm (10/32)	Yes	Flat
RR	0 kpa	7 mm (9/32)	No	Flat

The Jeep was configured with front buckets seats with height adjustable head restraints. The front head restraints were adjusted to the full-up position at the time of the inspection. The second row was configured with a three-passenger split folding bench seat. At the time of the inspection the seat was folded forward for cargo. The vehicle contained cargo that consisted of boxes that contained tables and desks that were on top of the folded bench. The cargo was displaced forward during the crash and loaded the rear of the front seatbacks, deforming the seat backs forward.

Crash Sequence

Pre-Crash

The 40-year-old female driver of the 2003 Honda Odyssey was operating the vehicle northbound in the second lane on the state road (**Figure 2**). The 53-year-old female driver of the 2002 Ford Taurus was operating the vehicle northbound on the same road in the first lane (left lane) alongside the Honda. The 54-year-old male driver of the Jeep was operating the vehicle southbound (**Figure 3**) on the same road in the left lane. The driver of the Honda attempted to change lanes from the second lane to the first lane.



Figure 2. Honda's northbound approach to crash site.



Figure 3. Jeep's southbound approach to crash site.

Crash

As the Honda entered the first lane, the left rear of the Honda impacted the front right area of the Ford in a sideswipe-type impact configuration (**Figure 4**). The resultant directions of force were within the 12 o'clock sector for the Honda and 6 o'clock for the Ford. The sideswipe-type impact was out of scope for the WINSMASH program therefore, a delta V was not computed for this impact.



Figure 4. Northbound view of the area of impact between the Honda and the Ford.

Upon impact with the Ford, the driver of the Honda relinquished directional control of the vehicle. The Honda departed the west road edge and entered the grass median. The Honda continued traveling across the median in a northwest direction and entered the southbound lanes. As the Honda entered the first lane the frontal aspect of the Jeep impacted the front right aspect of the Honda (**Figure 5**). The resultant directions of force were within the 2 o'clock sector for the Honda and 11 o'clock for the Jeep. A WINSMASH Collision Deformation Classification (CDC) algorithm was used to calculate an approximate delta V for both vehicles due to the lack of crush measurements for the Honda. The total calculated delta V for the Honda was 32 km/h (20 mph). The longitudinal and lateral components for the Honda were -16 km/h (-10 mph) and -28 km/h (-17 mph),



Figure 5. Southbound view of area of impact between the Honda and the Jeep.

respectively. The total calculated delta V for the Jeep was 36 km/h (22 mph). The longitudinal and lateral components for the Jeep were -34 km/h (-21 mph) and 12 km/h (7 mph), respectively. The downloaded EDR data from the Honda indicated that the “Equivalent barrier collision speed” was approximately 32 km/h (20 mph) longitudinally.

The impact with the front of the Jeep induced a counterclockwise rotation to the Honda and a clockwise rotation to the Jeep. As both vehicles rotated, they began to travel in a southerly direction and the right rear aspect of the Honda impacted the left rear aspect of the Jeep in a sideslap impact configuration. A WINSMASH CDC algorithm was used to determine an approximate delta V for both vehicles due to the lack of crush measurements for the Honda. The total calculated delta V for the Honda was 10 km/h (6 mph). The longitudinal and lateral components for the Honda were 0 km/h and -10 km/h (-6 mph), respectively. The total calculated delta V for the Jeep was 11 km/h (7 mph). The longitudinal and lateral components for the Jeep were 0 km/h and 11 km/h (7 mph), respectively.

The Honda came to rest on the southbound roadway straddling the second and third lanes facing a northwesterly direction. The Jeep came to rest off the west road edge facing a southwesterly direction. The Ford came to rest on the center median facing north.

Post-Crash

The driver of the Honda sustained serious AIS-3 level injuries and was transported to a local hospital where she was hospitalized for three days. The 5-year-old male sustained minor severity injuries and was transported to a local hospital where he was treated and released. The 4-year-old male sustained minor severity injuries and was transported to a hospital; however it was unknown if he was treated. The 9-year-old male sustained minor injuries, however it was unknown if he was transported to a hospital for treatment. The driver and front right passenger of the Ford sustained possible injuries and were not transported to a hospital. The 54-year-old male driver of the Jeep sustained serious AIS-3 level injuries and was transported to a local hospital where he was hospitalized for eleven days. The Honda and the Jeep sustained disabling damage and were towed from the crash scene. The Ford sustained minor damage and was driven from the crash site.

VEHICLE DAMAGE

Exterior – 2003 Honda Odyssey

The 2003 Honda Odyssey sustained minor damage as result of the impact with the Ford (**Figure 6**). The direct damage width was 44.0 cm (17.3”) and began 50.0 cm (19.7”) rear of the left rear axle. The damage consisted of minor lateral deformation and scuffmarks on the left rear quarter panel. Six crush measurements were documented on the left rear quarter panel using a combined direct and induced damage width of 97.0 cm (38.2”) and were as follows: C1= 1.0 cm (0.4”), C2= 0.0 cm, C3= 3.0 cm



Figure 6. Sideswipe damage from impact with the Ford.

(1.2”), C4= 3.0 cm (1.2”), C5= 4.0 cm (1.6”), C6= 5.0 cm (2.0”). The CDC for this impact was 12-LBES-1.

The 2003 Honda Odyssey sustained severe right side damage (**Figure 7**) as a result of the initial impact with the Jeep. The direct contact damage began at the front right bumper and extended rearward to the right front door handle. The damage consisted of a laterally deformed front right fender, hood, door, and front right suspension components. The front right axle and suspension components were also fractured and the front right wheel separated from the axle. The damage also consisted of a disintegrated front right glazing and a cracked and holed windshield. The windshield was holed at the front left A-pillar area from the deforming front end. Crush measurements were not obtained for this impact. The CDC for this impact was 02-RYEW-4.



Figure 7. View of damage from the initial impact with the Jeep.

The Honda sustained minor right side damage from the secondary impact with the Jeep (**Figure 8**). The direct damage began at the right rear bumper corner and extended forward to the center of the right sliding door. The damage consisted of the right rear quarter panel and right sliding door being deformed lateral. The damage also consisted of the right rear, right rear quarter, and the backlight being disintegrated from impact forces. The remainder of the glazing was intact. The CDC for the impact was 03-RBEW-2.



Figure 8. View of damage from second impact with the Jeep.

Interior – 2003 Honda Odyssey

The 2003 Honda Odyssey sustained severe interior damage as a result of intrusions and occupant contacts (**Figure 9**). The intrusions are listed in table below:

Intruding Component	Intrusion Extent	Direction
Front left A-pillar (estimated)	2.0 cm (0.8”)	Lateral
Front left seat cushion	5.0 cm (2.0”)	Lateral
Center instrument Panel	2.0 cm (0.8”)	Longitudinal
Front right toe pan	12.0 cm (5.4”)	Longitudinal

Front instrument panel	10.0 cm (3.9")	Longitudinal
Front window frame	15.0 cm (5.9")	Lateral
Front right door panel	10.0 cm (3.9")	Lateral
Front right A-pillar	3.0 cm (1.2")	Lateral
Third row seat back	14.0 cm (5.5")	Longitudinal

The driver's contact points consisted of a deformed front left seat back from contact with driver's right hip and a scuffmark on the safety belt from the driver's chest. The driver's right hip contacted and deformed the seat back tray that folds between the front seats. Also body fluid was documented on the seatback from possible contact with the driver's right arm. The contacts for the 4-year-old male that was seated in the second row right seat in a forward facing child safety seat consisted of a possible contact to the rear of the front right seat back. This contact was evidenced by blood on the grab handle on the seat back. Also documented for this occupant was body fluid on the right side sliding door panel and possible body fluid on the child safety seat. The NASS researcher also documented body fluid on the third row left seat back from possible contact from the 9-year-old male.



Figure 9. View of interior first row.

Exterior – 2000 Jeep Grand Cherokee

The 2000 Jeep Grand Cherokee sustained severe frontal damage as a result of the initial impact with the right side of the Honda (**Figure 10**). The direct damage began on the front left bumper and extended to front right bumper and measured 141.0 cm (55.5"). The damaged components consisted of the front bumper, hood, fenders, and the radiator being longitudinally deformed from contact damage. The majority of longitudinal deformation was to the front left aspect of the vehicle, which caused a reduction to the left side wheelbase of 12.0 cm (4.7"). The reduction of the left side wheelbase caused the right wheelbase to be elongated 19.0 cm (7.5"). Maximum crush was located at the front left bumper corner and measured 48.0 cm (18.9"). Six crush measurements were documented the bumper beam using a combined direct and induced damage with of 141.0 cm (55.5") and were as follows: C1= 48.0 cm (18.9"), C2= 43.0 cm (16.9"), C3= 44.0 cm (17.3"), C4= 42.0 cm (16.5"), C5=



Figure 10. View of frontal damage from initial impact with the Honda.

21.0 cm (8.3”), C6= 30.0 cm (11.8”). The CDC for the impact was 71-FDEW-2 with an 11 o’clock direction of force that was incremented 70 for lateral right shift.

The second impact to the Jeep was the right side of the Honda impacting the left rear aspect of the Jeep. The direct contact damage began at the left rear bumper corner and extended forward 86.0 cm (33.9”). The damage consisted of a laterally deformed left rear quarter panel, door panel, and a disintegrated left rear glazing. Maximum crush was located at C1 and measured 19.0 cm (7.5”). Six crush measurements were documented along the mid-door level using a combined direct and induced damage width of 190.0 cm (74.8”) and were as follows: C1= 19.0 cm (7.5”), C2= 18.0 cm (7.1”), C3= 10.0 cm (3.9”), C4= 4.0 cm (1.6”), C5= 1.0 cm (0.4”), C6= 0.0 cm. The CDC for this impact was 09-LZEW-2.



Figure 11. View of damage from second impact with the Honda.

Certified Advanced Compliant Safety System - 2003 Honda Odyssey

The 2003 Honda Odyssey was equipped with a Certified Advanced Compliant safety system. The manufacturer of this vehicle has certified that this 2003 Honda Odyssey meets the advanced air bag requirements of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The system consisted of dual stage frontal air bags, seat track position sensors for the front left and front right seats, and an occupant presence sensor for the front right seat. The system was controlled by an Air Bag Control Module. The module deploys the appropriate safety systems dependant on crash severity, seat track position, and front right occupant presence. In this crash, the module commanded the deployment of the driver’s frontal air bag and safety belt pretensioner.

The front left air bag was located in the steering wheel hub (**Figure 12**). Two non-symmetrical cover flaps concealed the front left air bag. The top flap measured 8.0 cm (3.1”) height and 17.0 cm (6.7”) width at it widest point. The lower flap measured 5.0 cm (1.9”) in height and 13.0 cm (5.1”) in width at its widest point. The air bag was 61.0 cm (24.0”) in diameter. The air bag contained two tethers at the 12 and 6 o’clock positions on the face of the air bag and two vent ports at the 11 and 1 o’clock positions on the rear aspect. No contact evidenced was noted to the air bag.



Figure 12. Deployed driver's frontal air bag.

The front right air bag was top-mounted in the right instrument panel (**Figure 11**). A single cover flap concealed the air bag. The front right air bag did not deploy in this crash.

Event Data Recorder – 2003 Honda Odyssey

The 2003 Honda Odyssey was equipped with an Event Data Recorder (EDR). At the direction of NHTSA, the NASS researcher removed the EDR from the vehicle and forwarded the unit to NHTSA. NHTSA shipped the EDR to Honda for download. The downloaded data was then forwarded to the SCI team. The EDR data indicated that the driver's safety belt was buckled at the time of the crash and the front right passenger suppression switch was in the off position. The EDR also indicated that the collision was of high severity and the driver's frontal air bag and pretensioner deployed simultaneously. Additionally, the data shows that the deployment time was 9 milliseconds from algorithm wake-up and the longitudinal delta V (Equivalent barrier collision speed) was approximately 32.2 km/h (20.0 mph).

Side Impact Air Bags – 2003 Honda Odyssey

The 2003 Honda Odyssey was equipped with seat back mounted side impact air bags for the front seating positions. The driver's side impact air bag did not deploy in this crash.

The front right side impact air bag deployed as a result of the initial crash with the Jeep (**Figure 13**). The air bag was located in the front right seat back and was concealed by a leather cover that measured 45.0 cm (17.8") in height and 15.0 cm (5.9") in width. The air bag measured 24.0 cm (9.5") in height and 30.0 cm (11.8") in width. The air bag was vented by two vent ports at the forward aspect and contained a single tether at the center aspect. There was no contact evidence or damage noted to this deployed air bag.



Figure 13. Deployed right side impact air bag.

Manual Restraint System – 2003 Honda Odyssey

The 2003 Honda Odyssey was equipped with manual 3-point lap and shoulder belts for the six outboard seating positions. The third row center seat was configured with a manual 2-point lap belt. The front left safety belt was configured with a sliding latch plate and an Emergency Locking Retractor (ELR). The front left safety belt also contained a retractor-mounted pretensioner that fired as a result of the crash. The front right safety belt was configured with a sliding latch plate and a switchable ELR/Automatic Locking Retractor (ALR). The front right safety belt was also equipped with a retractor-mounted pretensioner; however, it did not fire in this crash. The second and third row outboard safety belts were configured with sliding latch plates and switchable ELR/ALR retractors. The third row center safety belt was configured with a locking latch plate and no retractor.

Child Safety Seats – 2003 Honda Odyssey

The 5-year-old male occupant of the Honda was seated in the second row left seat in a backless belt positioning booster seat (**Figure 14**). The manufacturer placard was not attached to the seat; therefore the date of manufacture was unknown. The seat was a Gerry Double Guard Model Number 072396C. The seat was constructed of a plastic shell and a cloth pad over the seating area. The seat also contained two metal latch plates on each side to be used with a shield. The child was restrained by the vehicles manual 3-point lap and shoulder safety belt.



Figure 14. Second row left backless belt positioning booster seat.

The 4-year-old male occupant of the Honda was seated in the second row right seat in a forward facing child safety seat (CSS) and was restrained by the integral 5-point harness system (**Figure 15**). The CSS was a Century Breverra, Model Number 4885CRT. The CSS was constructed of plastic and was equipped with an integrated head restraint and a 5-point harness system. Historical use was apparent on the harness system evidenced by creasing of the harness. The forward facing child safety seat (CSS) was restrained by the vehicles manual 3-point lap and shoulder belt system. The safety belt was routed through the rear belt paths. Also noted, was a locking clip that was on the vehicles seat cushion beside the CSS. It does not appear that the locking clip was used and no damage was noted to the CSS. The driver refused an interview with the NASS researcher; therefore the history of both child safety seats is unknown.



Figure 15. Second row right high back CSS.

OCCUPANT DEMOGRAPHICS – 2003 Honda Odyssey

Driver

Age/Sex: 40-year-old female
Height: Unknown
Weight: Unknown
Seat Track Position: Between middle and forward
Manual Restraint Use: Manual 3-point lap and shoulder belt system
Usage Source: Vehicle inspection
Eyewear: Unknown
Type of Medical Treatment: Hospitalized for three days

Driver Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanism
Right upper lobe lung contusion with a small left pneumothorax	Serious (441406.3,1)	Seat back tray
Cervical fracture at the odontoid (dens) of C2	Serious (650228.3,6)	Hyperflexion
Right side liver laceration, minor	Moderate (541822.2,1)	Center armrest
Left clavicle fracture	Moderate (752200.2,1)	Shoulder belt
Center abdominal abrasion	Minor (590202.1, 4)	Lap belt
Left shoulder contusion	Minor (790402.1, 2)	Shoulder belt
Right hip contusion	Minor (890402.1, 1)	Center armrest
Left chest contusion	Minor (490402.1, 2)	Shoulder belt
Right abdomen contusion	Minor (590402.1,1)	Armrest

Source: Emergency room records and post ER medical records

Driver Kinematics

The 40-year-old female driver of the 2003 Honda Odyssey was seated in a presumed upright posture and was restrained by the vehicle's manual 3-point lap and shoulder belt. The seat track was adjusted between the forward and mid position. The impact with the Ford was minor and did not displace the driver. At impact with the Jeep, the front left air bag deployed and the safety belt pretensioner fired. The driver initiated a right and forward trajectory in response to the 2 o'clock direction of force; she loaded the safety belt, armrest and seat back tray. The safety belt loading resulted in the left clavicle fracture, left shoulder contusion, left chest contusion, and abdomen contusion. The center armrest contact resulted in the minor right side liver laceration and right hip contusion. The contact to the seat back tray resulted in the upper right lobe lung contusion with a small left pneumothorax. The driver's loading of the safety belt arrested her forward travel. Her head flexed forward resulting in the hyperflexion cervical fracture at the odontoid (dens) of C2. The driver was transported to a local hospital where she was hospitalized for three days.

Second Row Left Seat Passenger

Age/Sex: 5-year-old male
Height: Unknown
Weight: Unknown
Seat Track Position: Not adjustable
Manual Restraint Use: Backless booster seat and manual 3-point lap and shoulder belt system
Usage Source: Vehicle inspection
Eyewear: Unknown
Type of Medical Treatment: Treated and released

Second Rear Left Seat Passengers Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanism
Neck contusion	Minor (390402.1,9)	Shoulder belt
Neck abrasion	Minor (390202.1, 9)	Shoulder belt
Left abdominal abrasion	Minor (590212.1, 2)	Lap belt
Left abdominal contusion	Minor (590402.1,2)	Lap belt
Left hip abrasion	Minor (890202.1, 2)	Lap belt
Left shoulder abrasion	Minor (790202.1,2)	Shoulder belt

Injury source: Emergency Records

Second Row Left Seat Passenger Kinematics

The 5-year-old male second row left seat passenger of the Honda was seated in a presumed upright posture in a backless booster seat and was restrained by the vehicle's lap and shoulder belt. The minor impact with the Ford did not displace this occupant. At impact with the Jeep, the rear left passenger initiated a right and forward trajectory and loaded the vehicles lap and shoulder belt. The loading of the safety belt resulted in the neck contusion and abrasion, left abdomen contusion and abrasion, left hip abrasion, and left shoulder abrasion. He was transported to a local hospital where he was treated and released.

Second Row Right Seat Passenger

Age/Sex: 4-year-old male
Height: Unknown
Weight: Unknown
Seat Track Position: Not adjustable
Manual Restraint Use: Restrained in a forward facing child safety seat with the 5-point harness system
Usage Source: Vehicle inspection
Eyewear: None
Type of Medical Treatment: Possible injury transported to a local hospital, unknown if treated

Second Row Right Seat Passenger Kinematics

The 4-year-old male occupant was seated in the second row right seat in the Century Breverra. He was seated in an unknown posture and was restrained by the 5-point harness system. In this configuration the CSS was used as a forward facing CSS. The vehicle's lap and shoulder belt was used to restrain the booster to the vehicle's seat. The impact with the Ford was minor and did not displace the child. At impact with the Jeep, the rear right passenger initiated a right and forward trajectory and loaded the 5-point harness. The child was reported as sustaining possible injury and was transported to a local hospital. Its unknown if the child was treated at the hospital.

Third Row Left Seat Passenger

Age/Sex: 9-year-old male
Height: Unknown
Weight: Unknown
Seat Track Position: Not adjustable
Manual Restraint Use: 3-point lap and shoulder belt system
Usage Source: Vehicle inspection
Eyewear: None
Type of Medical Treatment: Not injured

Third Row Left Seat Passenger Kinematics

The 9-year-old male was seated in the vehicle's third row left seat. He was seated in an unknown posture and was restrained by the vehicle's lap and shoulder belt. The initial impact with the Ford was minor and did not displace the child. At impact, the child initiated a right and forward trajectory in response to the 2 o'clock direction of force. The child rode down the force of the crash by loading the safety belt with his torso. The child was reported as not injured as a result of the crash, however it was unknown if the child was transported to a hospital.

2000 Jeep Grand Cherokee

Driver

Age/Sex: 54-year-old male
 Height: Unknown
 Weight: 120.0 kgs (265.0 lbs)
 Seat Track Position: Unknown
 Manual Restraint Use: 3-point lap and shoulder belt system
 Usage Source: Vehicle inspection
 Eyewear: Unknown
 Type of Medical Treatment: Hospitalized

Driver Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanism
Left lamina fracture of T2	Serious (650424.3,7)	Seat back (Reinforced by cargo)
Bilateral rib fractures (right 1-5, left 9 th rib)	Serious (450230.3,3)	Steering wheel
Transverse process fracture (T2)	Moderate (650420.2,7)	Seat back (Reinforced by cargo)
Right scapular fracture	Moderate (753000.2, 1)	Cargo shift in vehicle
Right talus head comminuted fracture	Moderate (853200.2, 1)	Foot controls and intruding toe pan
Right tarsal cuboid impact fracture	Moderate (852200.2, 1)	Foot controls and intruding toe pan
Right 1 st metatarsal base fracture and 5 th metatarsal comminuted fracture	Moderate (852200.2,1)	Foot controls and intruding toe pan
Right ankle talonavicular and calcaneocuboid dislocation, NFS	Moderate (850210,2.1)	Foot controls and intruding toe pan
Right knee laceration into joint 5.0 cm (1.9")	Moderate (850818,2.1)	Knee bolster
Right patella fracture	Moderate (852400,2.1)	Knee bolster
Right posterior upper arm laceration 12.0 cm (4.7")	Minor (790602,1.1)	Cargo shift in vehicle
Right toe distal phalanx fracture	Minor (853602,1.1)	Foot controls and intruding toe pan

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanism
Right subtalar joint dislocation, NFS	Minor (851203,1.1)	Foot controls and intruding toe pan

Injury source: Post emergency room records

Driver Kinematics

The 54-year-old male driver of the 2000 Jeep Grand Cherokee was seated in a presumed upright posture and was restrained by the vehicle’s manual 3-point lap and shoulder belt. The seat track position was unknown due to the seat being displaced by the cargo in the vehicle. The vehicle contained heavy boxed cargo that consisted of desks and tables, which was displaced forward from the impact and loaded the rear of the driver’s seat back. The cargo loading the seat back caused the seat to deform and move forward.

At impact with the Honda, the front left air bag deployed. The driver initiated a forward and left trajectory in response to the 11 o’clock direction of force. The driver loaded the safety belt and through the deploying air bag. The driver’s chest contacted the steering wheel, which resulted in the bilateral rib fractures (right 1-5, left 9th rib). The driver’s right knee contacted the knee bolster that resulted in a 5.0 cm (1.9”) right knee laceration into the joint and the right patella fracture. The loading of the cargo against the seat back resulted in the left lamina fracture, right posterior upper arm laceration 12.0 cm (4.7”), and transverse process fracture (T2). The toe pan intrusion displaced the foot pedals rearward and as a result, the driver sustained the right talus head fracture, right tarsal cuboid impact fracture, right 1st metatarsal base fracture and 5th metatarsal comminuted fracture, right ankle talonavicular and calcaneocuboid dislocation, right toe distal phalanx fracture, and right subtalar joint dislocation, from loading against the foot pedals and intruding toe pan. The driver was transported to a local hospital where he was hospitalized for eleven days.

Figure 11. NASS Scene Schematic.

