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ON-SITE OTHER INFLATABLE OCCUPANT PROTECTION INVESTIGATION

CASE NUMBER - IN08050
LOCATION - MISSOURI
VEHICLE - 2007 JEEP COMPASS LIMITED
CRASH DATE - November 2008

Submitted:

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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

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16. *Abstract*

This report covers an On-Site Other Inflatable Occupant Protection Investigation that involved a 2007 Jeep Compass Limited, which departed a rural roadway and impacted a tree. This investigation focused on the Jeep and the sources of the injuries sustained by the second row right passenger (4-year-old male), who was seated in an Evenflo Big Kid Belt Positioning Booster Seat (BBS). The Jeep's driver filed a complaint with the Office of Defects Investigation (ODI) in Washington D.C. stating that the child sustained a serious head injury from the deploying side inflatable curtain (IC) air bag. The Jeep was occupied by a restrained 28-year-old female driver, a 2-year-old male second row left passenger who was restrained in an unknown make and model convertible Child Safety Seat, and the second row right passenger. The Jeep was traveling west and the driver was negotiating a left curve. The driver looked into the second row seat to check on the two child passengers, and the vehicle departed the right (north) side of the roadway. The front plane impacted a tree and the vehicle rolled over onto its left side and came to final rest. The driver's frontal air bag and both IC air bags deployed during the crash. The driver and both second row passengers were transported to a hospital. The two second row passengers were admitted to the hospital and the driver was treated and released. The investigation determined that the source of the second row right passenger's head injuries was the back of the front right seat.

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TABLE OF CONTENTS IN08050

Figure 1: The damaged 2007 Jeep Compass Limited

This on-site investigation focused on a 2007 Jeep Compass Limited (**Figure 1**) and the sources of the injuries sustained by the second row right passenger (4-year-old male), who was seated in an Evenflo Big Kid Belt Positioning Booster Seat (BBS). This crash was brought to the attention of the National Highway Traffic Safety Administration (NHTSA) on December 12, 2008 through the Office of Defects Investigation (ODI) in Washington, D.C. The Jeep's driver filed a complaint with ODI stating that the second row right passenger sustained a serious head injury from the deploying right side inflatable curtain (IC) air bag. This investigation was assigned on December 15, 2008. The crash involved the Jeep, which departed a rural roadway and impacted a tree. The crash occurred in November, 2008, at 0820 hours, in Missouri and was investigated by the county sheriff's department. This contractor interviewed the driver on December 13 and 17, 2008 and inspected the BBS and crash scene on December 17, 2008. The Jeep was inspected on December 18, 2008. This report is based on the police crash report, driver interviews, inspections of the crash scene, BBS, and the Jeep, occupant medical records, occupant kinematic principles, and this contractor's evaluation of the evidence.

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which the Jeep was traveling was a 2-lane, county roadway traversing in an east-west direction. The roadway traversed through a heavily wooded area and had one lane in each direction. The roadway was curved left on the Jeep's westerly direction of travel and there were numerous trees along the roadside. The impacted tree was located 1.2 m (3.8 ft) off the north side of the roadway at the top of a 76 cm (30 in) high embankment. The grade along the Jeeps direction of travel was positive 10.4% and the left curve was superelevated 3.1% to the north. The radius of curvature was 148 m (485 ft). There was no posted speed limit in the area of the crash and the police reported speed limit was 89 km/h (55 mph). At the time of the crash, the light condition was daylight, the atmospheric condition was clear, and the roadway pavement was dry bituminous. The traffic density was light and the site of the crash was rural. See the Crash Diagram on page 15 of this report.

Pre-Crash: The Jeep was occupied by a restrained 28-year-old female driver, a 2-year-old male second row left passenger who was restrained in an unknown make and model convertible Child Safety Seat (CSS), and a 4-year-old male second row right passenger who was restrained in the BBS. The driver was traveling west negotiating a left curve (**Figure 2**). She stated during the SCI interview that she was traveling approximately 64 km/h (40 mph). She had the radio on and was holding a cup of coffee. The driver turned her head to the right to look at the second row to check on the children. As she was looking at the children, the Jeep departed the right (north) side of the roadway where the crash occurred. The driver reported that she had no time to attempt any avoidance maneuvers.

Crash: The Jeep traveled up the embankment along a positive 31% grade (**Figure 3**) and the front of the vehicle (**Figure 4**) impacted a tree (event 1). The tree was 38 cm (15 in) in diameter at the approximate hood level and 58 cm (22.8 in) in diameter at the approximate bumper level. The Jeep's direction of force was within the 12 o'clock sector and the impact force was sufficient to deploy the driver's frontal air bag. The vehicle rotated slightly clockwise and rolled over (event 2) one quarter turn onto its left side (**Figure 5**). The vehicle was equipped with IC air bags with rollover sensing and the IC air bags deployed. The vehicle came to final rest on the roadway on its left side heading northwest.

Figure 2: Approach of the Jeep in the left curve; number shows feet to tree impact; arrow shows impacted tree

Figure 3: Approach of the Jeep to impact with the tree

Figure 4: Damage to the front of the Jeep from impact with the tree

Post-Crash: The police were notified of the crash by a passerby. The police crash report indicated the crash notification was received at 0826 hours and the investigating officer arrived on scene at 0834 hours. Emergency medical services were also notified of the crash and an ambulance and air evacuation unit responded to the scene. The passerby opened the Jeep's rear hatch and removed both second row passengers from their CSSs and took them out of the vehicle through the rear hatch. The passerby climbed back into the vehicle and helped the driver remove her safety belt. The driver opened the sun roof and the passerby helped her climb out of the vehicle. The driver and the second row right passenger were transported by ambulance to a hospital. The second row left passenger was transported to a children's hospital by an air evacuation unit. The second row right passenger was subsequently transferred to the same children's hospital. The vehicle was towed from the scene due to damage.

ROLLOVER DISCUSSION

The Jeep's rollover mitigation features consisted of IC air bags with rollover sensing and Electronic Stability Control (ESC). The NHTSA has given the vehicle a four star rollover rating on a five star scale and a Static Stability Factor of

Figure 5: Yellow tape outlines damage areas from the rollover

1.24[1]. A four star rating indicates that the vehicle has a 10%-20% chance of a rollover when involved in a single vehicle crash. The specific chance of rollover for this vehicle model was given as 16%. The Static Stability Factor (SSF) is a calculation based on the vehicle's track width and height of its center of gravity. The result of the calculation is a measure of a vehicle's resistence to rollover. A higher SSF indicates a more stable vehicle. The majority of passenger vehicles have an SSF of 1.30 to 1.50[2]. The test vehicle model also did not tip-up during the dynamic steering maneuver test in which the test vehicle is put through a fish-hook shaped steering maneuver (i.e., hard left and hard right steer) at between 56 km/h-80km/h (35-50 mph).

As the Jeep approached impact with the tree, it was traveling up a positive 31% grade on an embankment. The vehicle was rolled left due to the slope of the embankment, which was approximately 35 degrees as measured perpendicular to the roadway. The front of the vehicle impacted the tree. The center of the direct damage was offset 5 cm (2 cm) to the right and the vehicle rotated clockwise as it rolled over one quarter turn onto its left side and came to final rest. Based on the police crash schematic depicting the final rest position, the vehicle rotated clockwise approximately 15 degrees and traversed a distance of approximately 3 m (9.8 ft) during the rollover. The crash scene inspection revealed no evidence of the final rest position.

CASE VEHICLE

The 2007 Jeep Compass Limited was a 4-wheel drive, 4-door multi-purpose vehicle (VIN: 1J8FF57W57D------) manufactured in June of 2007. The vehicle was equipped with a 2.4-L 4-cylinder engine, an automatic transmission, 4-wheel, anti-lock disc brakes with electronic brake force distribution and braking assist, ESC, traction control, and an Event Data Recorder (EDR). The front row was equipped with bucket seats, adjustable head restraints, lap-and-shoulder safety belts, a tilt steering column, dual stage driver and front right passenger frontal air bags, and IC air bags with rollover sensing that provided protection for the front and second rows. Front seat back-mounted side impact air bags were an option for this model, but it was not so equipped. The second row was equipped with a bench seat with split folding backs (60/40), adjustable head restraints in the outboard seating positions, lap-and-shoulder safety belts, and Lower Anchors and Tethers for Children (LATCH) in the outboard seating positions. The vehicle's mileage at the time of the inspection was 25,860 kilometers (16,069 miles). The vehicle's specified wheelbase was 263 cm (103.5 in).

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[1] www.safercar.gov, 8/27/09

[2] "Trends in the Static Stability Factor of Passenger Cars, Light Trucks, and Vans", NHTSA Technical Report, DOT HS 809 868, June 2005

Exterior Damage: The Jeep's impact with the tree involved the front plane. The front bumper, grille, and hood were directly damaged. The direct damage was measured on the bumper fascia (**Figure 6**) and began 49 cm (19.3 in) right of the front left bumper corner. It extended 72 cm (28.3 in) across the front bumper. The crush measurements were taken at the bumper level (**Figure 4**) and the residual maximum crush was 62 cm (24.4 in) occurring at C_3 (**Figure 7**). The induced damage involved both fenders and the hood. The table below shows the vehicle's front crush profile.

Figure 6: Yellow tape shows ends of direct contact damage on the front bumper fascia

Units	Event	Direct Damage		Field L	C_1	C_2	C_3	C_4	C_5	C_6	Direct	Field L
		Width CDC	Max Crush								±D	±D
cm	1	72	62	65	1	42	62	59	43	9	5	0
in		28.3	24.4	25.6	0.4	16.5	24.4	23.2	16.9	3.5	2.0	0.0

The rollover involved the vehicle's left side plane (**Figure 5**) and the extent of the damage consisted of scratches on the sheet metal and abrasions on the left front and left rear wheels. The direct damage began 19 cm (7.5 in) rear of the left rear axle and extended 244 cm (96.1 in) forward along the side. The vertical extent of damage extended from the wheels to the left side view mirror. There was no damage to the roof side rail and no lateral crush to the vehicle's roof structure. The right side wheelbase was reduced 2 cm (0.8 in) while the left side wheelbase was extended 2 cm (0.8 in).

Figure 7: Crush to the front of the Jeep from the tree impact

Damage Classification: The Jeep's Collision Deformation Classifications were **12-FDEW-3** (**0** degrees) for the front impact with the tree (event1), and **00-LDAO-2** for the rollover. The Barrier algorithm of the WinSMASH program calculated the vehicle's total Delta-V for the front impact as 47 km/h (29.2 mph). The longitudinal and lateral velocity changes were -47 km/h (-29.2 mph) and 0.0 km/h, respectively. The WinSMASH results appeared reasonable based on the extent of damage. The severity of the rollover damage was minor based on the damage on the vehicle's left side.

The vehicle manufacturer's recommended tire size was P215/55R18. The Jeep was equipped with tires of the recommended size. The vehicle's tire data are shown in the table below.

Tire	*Measured Pressure*		*Vehicle Manufacturer's Recommended Cold Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kPa	psi	kPa	psi	milli-meters	32nd of an inch			
LF	207	30	241	35	4	5	None	No	No
LR	214	31	241	35	6	7	Sidewall abraded	No	No
RR	214	31	241	35	6	7	None	No	No
RF	Flat	Flat	241	35	5	6	None	No	Yes

Vehicle Interior: The inspection of the Jeep's interior revealed occupant contact evidence associated with the driver and second row right passenger. A transfer of makeup was present on the driver's frontal air bag and the IC air bag indicating that the driver's face contacted both air bags during the crash. There were also scuffs on the lower left instrument panel on each side of the steering column due to contact by the driver's knees. There was occupant contact evidence on the back of the front right seat (**Figure 8**), which consisted of a 5 cm (2 in) by 3 cm (1.2 in) abrasion on the plastic located 31 cm (12.2 in) below the top of the seat back and 21 cm (8.3 in) to the right of the seat back's centerline. A second abrasion, 3 cm (1.2 in) by 1 cm (0.4 in), was located 23 cm (9.1 in) below the top of the seat back and 7 cm (2.8 in) to the right of the seat back's centerline. These abrasions were probably due to contact by the second row right passenger's feet. A probable occupant contact, which consisted of a 13 cm (5.1 in) by 3 cm (1.2 in) area of discoloration in the seat material was also present at the top of the seat back located 6 cm (2.4 in) left of the seat back's centerline. The seat material in this area was lighter in color and appeared to have been stressed. The source of this contact was probably the second row right passenger's face. The front right seat track was adjusted to within 7 cm (2.8 in) of its full-rear position and the seat back was reclined 26 degrees. There was no discernable evidence of occupant contact on the right or left IC air bags in the second row.

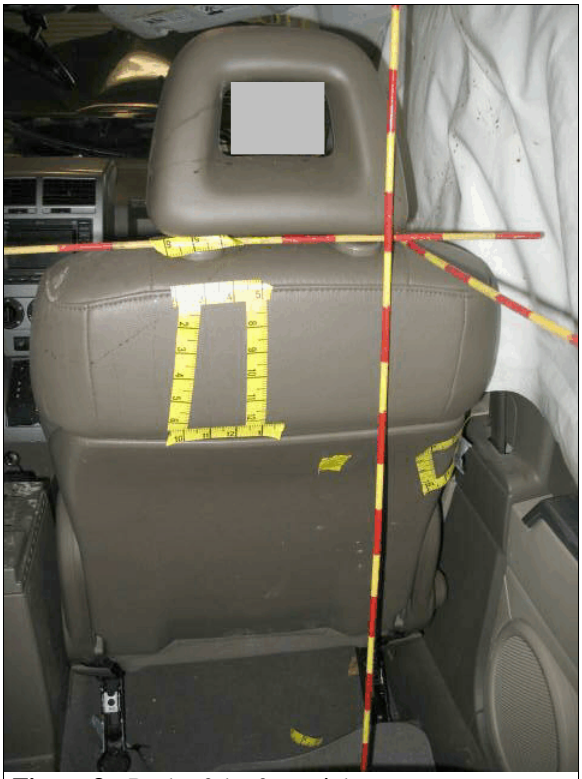

Figure 8: Back of the front right seat

All of the vehicle's doors remained closed and operational. The pre-crash status of all of the glazing was either fixed or closed. There was no damage and no evidence of occupant contact to any of the glazing. There was one passenger compartment intrusion. The left toe pan intruded 2 cm (0.8 in) longitudinally into the driver's occupant space.

EVENT DATA RECORDER

The imaging of the vehicle's EDR was first attempted via the Diagnostic Link Connector (DLC) using version 3.0 of the Bosch Crash Data Retrieval (CDR) tool. It was necessary to power up the vehicle's electrical system with a 12 volt auxiliary battery. The CDR tool could not communicate with the Occupant Restraint Controller (ORC). The cable connections and electrical fuses were checked and several more attempts were made with the same result. Attempts to obtain access to the ORC for a direct to module download were then undertaken. Removal of the center floor console and partial removal of the lower center instrument trim panel were required to locate and observe the ORC. It was located behind the gear shift and CD changer/GPS assemblies near the cowl and was surrounded by ventilation duct work, component brackets, and electrical wiring. Access to the ORC would have required significant disassembly of the instrument panel and gear shift assembly with possible damage to components. Due to these factors and time constraints the effort was terminated and no image of the EDR data was obtained. The removed components were reassembled.

AUTOMATIC RESTRAINT SYSTEM

The Jeep was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system that consisted of dual stage driver and front right passenger air bags, driver seat position sensor, an occupant weight sensor for the front right passenger seating position, safety belt buckle switch sensors and retractor mounted pretensioners. The frontal air bag sensors were located on the driver and passenger side radiator supports. The manufacturer has certified that the vehicle is compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208.

The vehicle was also equipped with roof side rail-mounted IC air bags. Based on the Holmatro Rescuer's Guide to Vehicle Safety Systems, the inflators were located within the roof side rails between the B and D pillars. The side impact sensors were located within the lower B and C pillars.

Figure 9: The driver's frontal air bag; yellow tape shows makeup transfer on the air bag

The driver's frontal air bag was located in the steering wheel hub. The deployed air bag (**Figure 9**) was 56 cm (22 in) in diameter and had two vent ports, each 2 cm (.08 in) in diameter located on the back of the air bag at the 11 and 1 o'clock positions. The air bag module was

equipped with two cover flaps, which opened at the designated tear seams. The makeup transfer identified above in the vehicle interior section was located 9 cm (3.5 in) below the center of the air bag and 3 cm (1.2 in) left of the air bag's centerline.

The front right passenger frontal air bag was located within the top of instrument panel. There was no front right passenger in the vehicle at the time of the crash and the deployment of this air bag was suppressed.

Figure 10: Driver's portion of the left IC air bag; yellow tape shows small transfer of makeup

Both IC air bags were located along the roof side rails (**Figures 10**, **11** and **12**) inside the headliner and extended from the A-pillar to the D-pillar. They were designed with inflation chambers adjacent to each outboard seat position and did not have external vent ports. Each deployed IC air bag was 166 cm (65.4 in) in width and 51 cm(20 in) in height. They extended 17 cm (6.7 in) below the beltline and there was no gap between the front of the IC air bag and the A-pillar. Each IC air bag was attached at the respective A-pillar by a 33 cm (13 in) cloth tether and a 30 cm (11.8 in) nylon rope tether at the D-pillar. The makeup transfer on the left IC air bag was located 6 cm (2.4 in) from the front of the air bag and 28 cm (11 in) from the top. There was no discernable evidence of occupant contact and no marks of any kind on the IC air bag adjacent to the second row right passenger seating position.

Figure 11: Second row left portion of left IC air bag

Figure 12: Second row right portion of right IC air bag

MANUAL RESTRAINT SYSTEM

The Jeep was equipped with lap-and-shoulder safety belts for the front and second row seating positions. The driver's safety belt consisted of continuous loop belt webbing, an Emergency Locking Retractor (ELR), sliding latch plate, and an adjustable upper anchor that was located in the full-down position. The front right safety belt was equipped with a switchable ELR/Automatic Locking Retractor (ALR), sliding latch plate, and adjustable upper anchor that was located in the middle position. The front row safety belts were equipped with retractor-mounted pretensioners. The second row safety belts consisted

of continuous loop belt webbing, switchable ELR/ALRs, sliding latch plates and fixed upper anchors. The second row outboard safety belts had a loop of belt webbing sewn to them that stopped the latch plate from sliding past the seat cushion.

The inspection of the driver's safety belt assembly revealed that the retractor was jammed and would not retract the safety belt webbing. This indicated that the pretensioner had probably actuated during the crash consistent with the deployment of the driver's frontal air bag. The latch plate belt guide and the D-ring were abraded and there was a 12 cm (4.7 in) area of stretching and wrinkling of the belt webbing that began 3 cm (1.2 in) above the stop button. The edge of the belt webbing was also slightly frayed in an area 12 cm (4.7 in) in length located 108 cm (42.5 in) above the stop button. This evidence indicated that the driver was restrained by the lap-and-shoulder belt.

The inspection of the second row left safety belt assembly revealed a heavy abrasion on the belt webbing located 35 cm (13.8 in) above the stop loop and a 9 cm (3.5 in) abrasion located 70 cm (27.6 in) above the stop loop. The belt webbing also appeared slightly stretched in this area and there was an impression of the belt webbing on the latch plate belt guide. This evidence supported the driver's statement that the second row left CSS was secured by the lap-and-shoulder belt.

The inspection of the second row right safety belt assembly revealed two abrasions on the safety belt webbing. They were located 10 cm (3.9 in) and 90 cm (35.4 in) above the stop loop. The latch plate belt guide was also abraded (**Figure 13**). This evidence and the load abrasions found on the BBS's right shoulder belt guide indicated that the second row right passenger was restrained by the lap-and-shoulder safety belt. The driver stated during the SCI interview that after she routed the safety belt through the shoulder belt guide and buckled the belt, she pulled the safety belt out of the retractor to actuate the ALR, then let the belt retract until it was snug on the passenger.

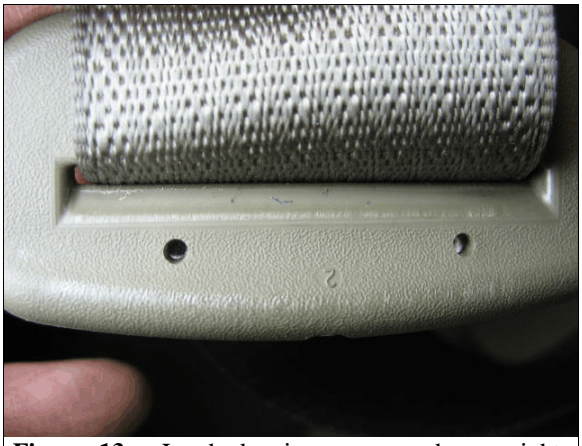

Figure 13: Load abrasion on second row right passenger's latch plate belt guide

CHILD SAFETY SEATS

Second Row Left Child Safety Seat: The Jeep's second row left passenger [2-year-old, male; 86 cm and 12 kg (34 in, 27 lbs)] was seated in an unknown make and model forward-facing, convertible Child Safety Seat (CSS) with tray shield. The CSS had been disposed of by the driver and she did not recall the make and model.

Second Row Right Child Safety Seat: The Jeep's second row right passenger [4-year-old, male; 104 cm and 16 kg (41 in, 36 lbs)] was seated in an Evenflo Big Kid BBS (**Figure 14**). It was manufactured on May 16, 2008 and the model number was 3371689A. The BBS was equipped with a removable back support with head restraint. When used with the back support, the BBS was designed for children who weighed 14-45 kilograms (30-100 pounds) and were 96 cm (38 in) to 145 cm (57 in) in height. When used without the back support, the BBS was designed for children who weighed 18-45 kilograms (40-100 pounds) and who were 101 cm (40 in) to 145 cm (57 in) in height and whose ears were below the top of the vehicle's head restraint. The BBS was used with the back support in this crash.

The BBS was constructed of plastic and had arm rests and a retractable drink tray on each side of the seat. The seat back height was adjustable via 5 detent positions. The height of the seat back was 60 cm (23.6 in) in the full down position and 72 cm (28.3 in) in the full up position. The seat back was adjusted to the full down position in this crash. The seat back and seat cushion pads were 4 cm (1.6 in) thick and the head restraint wing pads were 7 cm (2.8 in) thick.

Inspection of the BBS revealed load marks in the plastic on the top back and back inside surfaces of the right shoulder belt guide (**Figures 15** and **16**). The right portion of the head restraint was also bent forward 5 cm (2 in) to an angle of 17 degrees (**Figure 17**). The undamaged left side of the head restraint was angled forward 9 degrees. The load abrasions on the shoulder belt guide indicated that the right portion of the head restraint was deformed forward due to loading by the safety belt during the frontal impact as the passenger was displaced forward and loaded the safety belt.

Figure 14: The Evenflo Big Kid BBS

Figure 15: Safety belt abrasion on top back of BBS's right shoulder belt guide

Based on the SCI interview, the Jeep's driver [28-year-old, female; 152 cm and 50 kg (60 in and 110 lbs] was seated in an upright posture with her left foot on the floor and right foot on the accelerator. She had her left hand on the steering wheel at the 10 clock position and was holding a cup of coffee in her right hand. The driver's seat track was adjusted to between the middle and full-forward position and the seat back was reclined 27 degrees. The adjustable head restraint was located in the full-down position, and the distance from the top of the seat back to the top of the head restraint was 19 cm (7.5 in). The tilt steering column was located between the center and full-up position. The driver was not wearing glasses or contact lenses at the time of the crash.

Figure 16: Safety belt abrasion on back inside surface of BBS's right shoulder belt guide

Figure 17: Top view of deformation to the BBS's head restraint

The vehicle's front impact with the tree displaced the driver forward opposite the 12 o'clock direction of force and she loaded the lap-and-shoulder belt. Her face and chest loaded the deployed frontal air bag and both knees contacted the lower left instrument panel. The driver loaded through the air bag and her chest loaded the steering wheel, which caused contusions on the chest and right lung. The driver's left hand probably contacted the left instrument panel, which caused a fracture of the radial styloid process. She sustained abrasions on both knees due to contacting the lower left instrument panel. As the vehicle rolled over onto its left side, the left side of the driver's face contacted the deployed left IC air bag. She sustained no injury due to this contact. The driver remained restrained in her seat position and was laying against the left front door at final rest.

CASE VEHICLE DRIVER INJURIES

The driver was transported by ambulance to a hospital and was treated in the emergency room and released. She missed 10 work days as a result of the crash. The table below shows the driver's injuries and injury sources.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Contusion, small, anterior right middle lobe lung	serious 441406.3,1	Steering wheel hub and/or spokes and rim	Certain	Emergency room records
2	Fracture, non-displaced, left radial styloid process	moderate 752802.2,2	Left instrument panel	Probable	Emergency room records
3	Contusion chest, centrally, not further specified	minor 490402.1,4	Steering wheel hub and/or spokes and rim	Certain	Emergency room records
4	Contusion with swelling left wrist	minor 790402.1,2	Left instrument panel	Probable	Emergency room records
5	Abrasion right knee area, not further specified	minor 890202.1,1	Center lower instrument panel	Probable	Emergency room records
6	Sprain left ankle, not further specified	minor 850206.1,2	Floor, including toe pan	Probable	Emergency room records
7	Abrasion left ankle, not further specified	minor 890202.1,2	Left lower instrument panel, left of steering column	Probable	Emergency room records
8	Contusion left ankle, not further specified	minor 890402.1,2	Left lower instrument panel, left of steering column	Probable	Emergency room records

CASE VEHICLE SECOND ROW LEFT PASSENGER KINEMATICS

The Jeep's second row left passenger [2-year-old, male; 86 cm and 12 kg (34 in and 27 lbs] was seated in an upright posture in the CSS. He was restrained by the three-point harness and tray shield.

The vehicle's front impact with the tree displaced the second row left passenger and the CSS forward opposite the 12 o'clock direction of force. The CSS loaded the lap-and-shoulder safety belt and the passenger's face contacted the tray shield, which caused a nonanatomic brain injury and contusions to the face and forehead. The passenger remained restrained in the CSS as the vehicle rolled over onto its left side.

CASE VEHICLE SECOND ROW LEFT PASSENGER INJURIES

The second row left passenger was transported to a children's hospital by an air evacuation unit where he was hospitalized for 4 days. The table below shows the passenger's injuries and injury sources.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Nonanatomic brain injury with no known loss of consciousness but decreased responsiveness, GCS=11 and one emesis	moderate 160602.2,0	Child safety seat tray-shield	Probable	Hospitalization records
2	Contusion (hematoma) left forehead with swelling	minor 290402.1,7	Child safety seat tray-shield	Probable	Hospitalization records
3 4	Contusion (bruising, ecchymoses) bilateral periorbital areas	minor 297402.1,1 297402.1,2	Child safety seat tray-shield	Probable	Hospitalization records
5	Contusion (ecchymosis) left face, not further specified	minor 290402.1,2	Child safety seat tray-shield	Probable	Hospitalization records
6	Abrasion left cheek, not further specified	minor 290202.1,2	Child safety seat tray-shield	Probable	Hospitalization records

CASE VEHICLE SECOND ROW RIGHT PASSENGER KINEMATICS

The Jeep's second row right passenger [4-year-old, male; 104 cm and 16 kg (41 in, 36 lbs)] was seated in an upright posture in the BBS. He was restrained by the lap-and-shoulder safety belt.

The vehicle's front impact with the tree displaced the second row right passenger forward, opposite the 12 o'clock direction of force and he loaded the lap-and-shoulder safety belt, which caused bilateral pulmonary contusions, a liver contusion, and contusions and abrasions on the right shoulder, chest, abdomen, and right hip. The passenger's face also contacted the back of the front right seat, which was adjusted to within 7 cm (2.8 in) of its full-rear position, and the seat back was reclined 26 degrees (**Figure 8**). This contact resulted in a nonanatomic brain injury, small subarachnoid hemorrhage, an abduction of the right 6th cranial nerve, a tongue contusion, and hemorrhage in the left nare. The passenger's right ankle and lower leg contacted the front right seat back, and he sustained an abrasion on the ankle and a contusion on the right lower leg. The passenger remained restrained in the BBS as the vehicle rolled over onto its left side to final rest.

CASE VEHICLE SECOND ROW RIGHT PASSENGER INJURIES

The second row right passenger was initially transported from the crash scene by ambulance to a hospital where he was treated in the emergency. He was transferred to a children's hospital and was hospitalized for 4 days. He received 2 follow-up visits to his physician following release from the hospital. The table below shows the passenger's injuries and injury sources.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
	Nonanatomic brain injury without loss of consciousness; lethargic on initial observation, GCS = 12, emesis x 2, somnolent, intermittently responsive, fussy, irritable, confused speech, doesn't follow commands and had neurological deficit (i.e., visual field defect, including diplopia[3] and unequal pupils); post-concussive syndrome	Not coded	Seat back, front right passenger's	Probable	Hospitalization records[4]
1	Hemorrhage, small, subarachnoid, within supraseller[5] cistern and right basal cistern[3]	serious 140684.3,1	Seat back, front right passenger's	Probable	Hospitalization records
2	Defect (abduction), including right lateral gaze palsy, right 6th cranial nerve, not further specified	moderate 131499.2,1	Seat back, front right passenger's	Probable	Hospitalization records
3	Contusions, bilateral, pulmonary, left greater than right, not further specified	severe 441410.4,3	Torso portion of safety belt system	Certain	Hospitalization records
4	Contusion liver, left lobe, superior hepatic dome	moderate 541810.2,1	Torso portion of safety belt system	Certain	Emergency room records
5	Contusion, small, to tongue, not further specified	minor 243400.1,8	Seat back, front right passenger's	Probable	Emergency room records
6	Hemorrhage (epistasis) with blood in left nare	minor 251090.1,4	Seat back, front right passenger's	Probable	Emergency room records
7	Contusion (bruising) to left chest, not further specified	minor 490402.1,2	Torso portion of safety belt system	Certain	Hospitalization records

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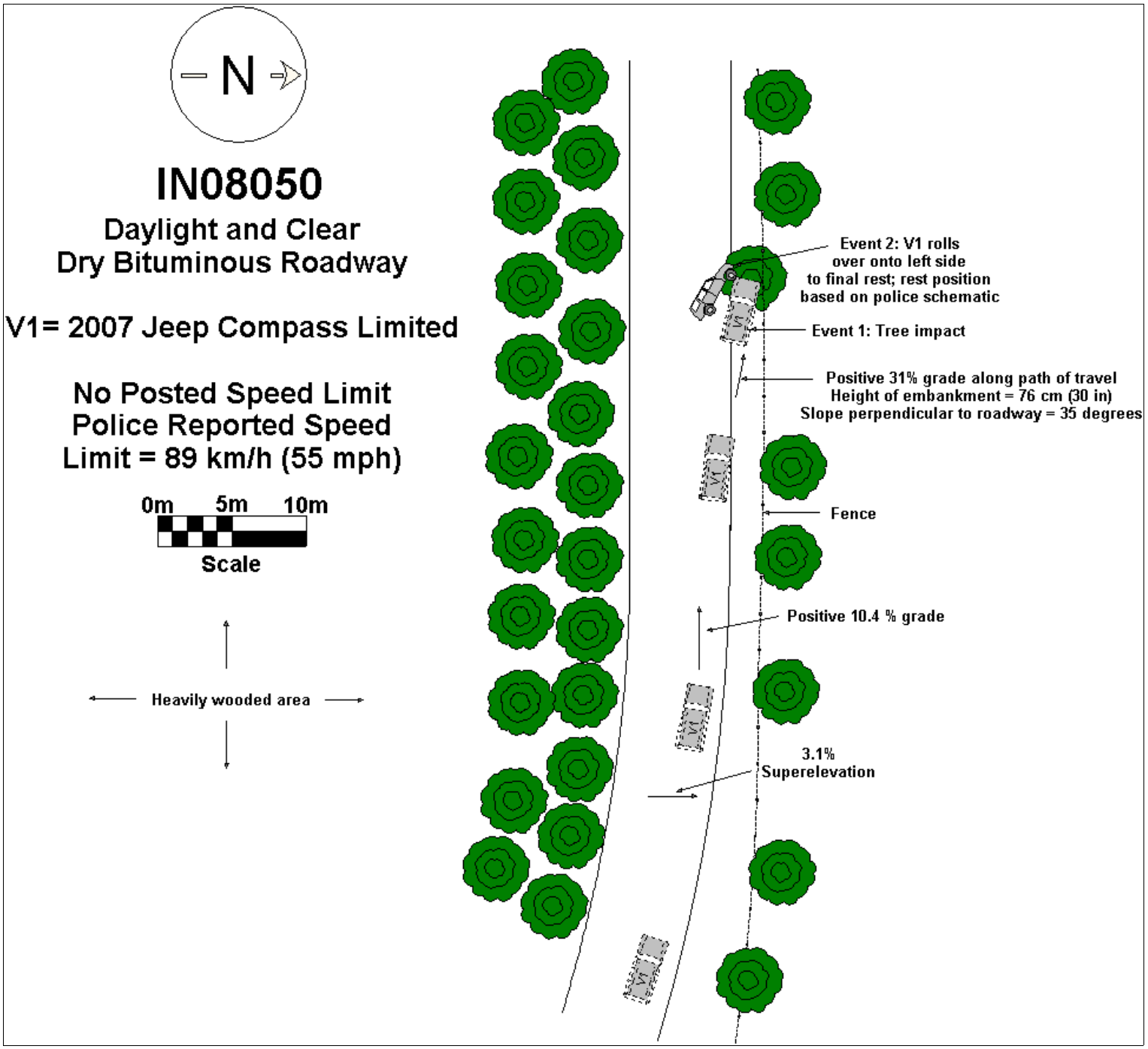
[3] The following term is defined in DORLAND'S ILLUSTRATED MEDICAL DICTIONARY as follows:
diplopia (di-plo/pe-a): the perception of two images of a single object; called also *double vision*.

[4] The "transferred to" hospital confirmed the initial facility's diagnosis and added to it, but the initial level of consciousness observations about this occupant came from the initial facility.

[5] The following terms are defined in DORLAND'S ILLUSTRATED MEDICAL DICTIONARY as follows:
cistern (sis/tern): a closed space serving as a reservoir for fluid; see also *cisterna*.
basal c.: cisterna interpeduncularis.
interpeduncular c.: cisterna interpeduncularis.
suprasellar c.: the subarachnoid space anterior and posterior to the optic chiasm above the sella turcica.
cisterna (sis-ter/na) **pl.** ***cister/nae***: a cistern -- a closed space serving as a reservoir for lymph or other body fluid, especially one of the enlarged subarachnoid spaces containing cerebrospinal fluid.
c. interpeduncula/ris: interpeduncular cistern -- a dilatation of the subarachnoid space between the cerebral peduncles; called also *basal cistern*.
suprasellar (soo"pra-sel/ar): superior to the sella turcica.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
8 9	Abrasion and contusion over right shoulder, not further specified	minor 790202.1,1 790402.1,1	Torso portion of safety belt system	Certain	Hospitalization records
10 11	Abrasion and contusion obliquely across central chest	minor 490202.1,4 490402.1,4	Torso portion of safety belt system	Certain	Hospitalization records
12 13	Abrasion and contusion obliquely across left abdomen	minor 590202.1,2 590402.1,2	Torso portion of safety belt system	Certain	Hospitalization records
14 15	Abrasion and contusion right hip, not further specified	minor 590202.1,1 590402.1,1	Lap portion of safety belt system	Certain	Hospitalization records
16	Contusion, small, over right distal tibia, not further specified	minor 890402.1,1	Seat back, front right passenger's	Certain	Emergency room records
17	Abrasion, small, medial right ankle, not further specified	minor 890202.1,1	Seat back, front right passenger's	Certain	Emergency room records


N
IN08050
Daylight and Clear
Dry Bituminous Roadway
V1= 2007 Jeep Compass Limited
No Posted Speed Limit
Police Reported Speed
Limit = 89 km/h (55 mph)
0m 5m 10m
Scale
Heavily wooded area
Event 2: V1 rolls over onto left side to final rest; rest position based on police schematic
Event 1: Tree impact
Positive 31% grade along path of travel
Height of embankment = 76 cm (30 in)
Slope perpendicular to roadway = 35 degrees
Fence
Positive 10.4 % grade
3.1%
Superelevation
V1