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ON-SITE AIR BAG INVESTIGATION

CASE NUMBER - IN97-005
LOCATION - OHIO
VEHICLE - 1996 HYUNDAI ACCENT
CRASH DATE - February, 1997

Submitted:

August 31, 1998

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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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15. *Supplementary Notes* On-site air bag deployment investigation involving a 1996 Hyundai Accent, with manual belts and dual front air bags, a 1994 Oldsmobile Cutlass Ciera S, a 1991 Nissan Stanza, and a 1993 Saturn SL			

16. *Abstract*

This report covers an on-site investigation of an air bag deployment crash that involved a 1996 Hyundai Accent (case vehicle), a 1994 Oldsmobile Cutlass Ciera S (vehicle #2), a 1991 Nissan Stanza (vehicle #3), and a 1993 Saturn SL (vehicle #4). This crash is of special interest because the case vehicle's unrestrained, front right passenger (4-year-old male) sustained fatal cervical injuries as a result of contacting his front right air bag module's cover flap and the deploying air bag. The case vehicle was traveling north in the outside, northbound through lane and was approaching a four-leg intersection. The south leg had five undivided lanes, including a northbound left-hand turn lane; the north leg had five-lanes, but was divided. Vehicle #2 was traveling south in the southbound, left-hand turn lane and was attempting to turn left. The crash occurred in the intersection when the front left of the case vehicle impacted the right front corner of vehicle #2, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. Subsequently, vehicle #2 impacted vehicles #3 and #4. The case vehicle's driver (18-year-old male, stepfather), was seated with his seat track located between its middle and rearmost positions; the case vehicle was not equipped with a tilt steering wheel. He was not wearing his available, active, three-point, lap and shoulder belt and sustained, according to his interview, a laceration to his left elbow when it shattered the driver's side window glazing. The front right passenger was seated all the way forward in the seat and leaning forward playing with some toy cars between his thighs. The front right passenger's seat track was located between its middle and rearmost positions, and he was not wearing his available, active, three-point, lap and shoulder belt. He sustained, according to his medical records, fatal injuries which included: a gaping laceration across his neck from ear to ear, a spinal cord laceration at C_2-C_3 with hangman's type fracture of C_2 and a dislocation between C_2 and C_3, lacerations of the larynx, trachea, and right internal jugular vein, and bilateral intraventricular hemorrhages. In addition, he sustained a spleen laceration, a fracture/dislocation with abrasion to the left distal forearm, and facial and neck abrasions. The neck laceration gives the appearance of a partial decapitation. The neck and cervical injuries resulted from the deploying air bag module's cover flap.

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CASE SUMMARY

TRC/IU ON-SITE AIR BAG INVESTIGATION

SCI Team #2, TRC/IU Case Number IN97-005

Ohio

February, 1997

This on-site investigation was brought to NHTSA's attention on February 6, 1997 by personnel of VRTC in East Liberty, Ohio. The primary crash involved a 1996 Hyundai Accent (case vehicle), and a 1994 Oldsmobile Cutlass Ciera S (vehicle #2). Also involved in this crash were a 1991 Nissan Stanza (vehicle #3), and a 1993 Saturn SL (vehicle #4). The crash occurred in February, 1997, at 4:25 p.m., in Ohio and was investigated by the applicable county sheriff department. This crash is of special interest because the case vehicle's front right passenger (4-year-old male) sustained fatal cervical injuries as a result of contacting his front right air bag module's cover flap and the deploying air bag. This contractor inspected the scene and vehicles on 10-11 February 1997. This summary is based on the Police Crash Report, interviews with both vehicle drivers and the investigating police officer, scene and vehicle inspections, occupant kinematic principles, occupant medical records, and this contractor's evaluation of the evidence.

The case vehicle was traveling northbound in the outside, northbound through lane of a five-lane, undivided, county road (i.e., two northbound and two southbound through lanes and one left-hand northbound turn lane) and intended to continue in its northward direction of travel. Vehicle #2 (a stolen vehicle) was traveling southward in the southbound, left-hand turn lane of the same five-lane, county trafficway and was attempting to turn left to go eastbound (Note: the north leg of this four-leg intersection was a divided trafficway while the south leg was undivided. For the northern leg, the northbound roadway had two through lanes while the southbound roadway had two through lanes and one left-hand turn lane that was opposite the northbound left-hand turn lane on the south leg of the intersection). The case vehicle's driver braked attempting to avoid the crash. The crash occurred in the four-leg intersection of the two trafficways.

According to the vehicle inspection, the front left of the case vehicle impacted the right front corner of vehicle #2, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The crash severity to the case vehicle was low [14-23 km.p.h. (9-14 m.p.h.)]. Subsequently, vehicle #2 attempted to depart the scene by driving eastward between vehicles #3 and #4, which were both stopped heading west on the east leg of the intersection. As a result, the front left of vehicle #2 impacted the front and left side of vehicle #3, and the right side of vehicle #2 impacted the right side of vehicle #4.

According to the case vehicle's driver, the front right passenger [stepson, 107 centimeters and 19 kilograms (42 inches, 42 pounds)] was restrained by his available, active, three-point, lap and shoulder belts. The case vehicle's driver was positive that his stepson was belted because he had trouble unbuckling the belt post-crash. The driver did state that he felt sure that the torso portion of the his stepson's belt was behind him. A deputy sheriff and this investigator interviewed the case vehicle's driver simultaneously, and it should be noted that during this interview the case vehicle's driver made some conflicting statements regarding the usage of the front right occupant's restraints. According to the coroner and the investigating deputies who viewed the child's body at the morgue, there was no evidence of belt pattern bruising or abrasions to the front right passenger's body. In addition, the inspection of the front right passenger's seat belt webbing, "D"-ring, and latch plate showed no evidence of loading. An inspection of the front right

passenger's air bag revealed an oil smear, skin transfers, and a transfer mark from the child's jacket to the air bag's top portion. In addition, there appeared to be an oil smear and skin flakes on the front right air bag module's cover flap. Furthermore, the interior inspection found a spider web to the windshield with skin embedded in it and a contact to the roof and a contact to the integral headrest from the front right passenger's head and neck. Based on the contact evidence previously mentioned, the case vehicle's front right passenger was not using the available safety belts.

The case vehicle's driver braked attempting to avoid the crash. As a result of the driver's pre-impact braking and the nonuse of his available safety belts, the front right passenger moved forward and slightly upward, on top of the dash/air bag module, just prior to impact. The case vehicle's impact with vehicle #2, not only deployed the front right passenger air bag, but struck the child in his neck, sending the boy upward into the windshield, Photographs taken by the investigating officers while at the autopsy showed that the front right passenger sustained a gaping 16.5 centimeter (6.5 inch) laceration across his neck from ear to ear. This lesion gives the appearance of a partial decapitation. According to the photographs, there is no evidence of trauma above this occupant's chin except for an abrasion to the left side of his forehead from contacting the windshield. As the air bag continued to deploy, the boy was thrown upwards into the roof where he then fell back onto the headrest and back into the seat. According to the driver, at final rest the front right occupant's hips were against the center console with his upper torso leaning to the left with his head turned to the left. This final rest positioning would match with some pooled blood that was found atop and down the driver side of the center console.

The front right occupant was transported to the hospital. He sustained fatal injuries and was pronounced dead approximately one hour post-crash. The injuries sustained by the case vehicle's front right passenger included: a large neck laceration (specified above), a laceration of the spinal cord at C_2-C_3 with accompanying hangman's type fracture of C_2 and a 3.8 centimeter (1.5 inch) dislocation between C_2 and C_3, lacerations of the larynx, trachea, and right internal jugular vein, and bilateral intraventricular hemorrhages. In addition, he sustained a spleen laceration, a fracture/dislocation with abrasion to the left distal forearm, and facial and neck abrasions. Based on the available evidence, the neck and cervical injuries resulted from the deploying air bag module's cover flap.

The case vehicle was a front wheel drive 1996 Hyundai Accent, three-door hatchback (VIN: KMHVD14N4TU------). The case vehicle was equipped with anti-lock brakes. Vehicle #2 is a front wheel drive 1994 Oldsmobile Cutlass Ciera S, four-door sedan (VIN: 1G3AG55M3R6------). Vehicle #3 is a front wheel drive 1991 Nissan Stanza, four-door sedan (VIN: JN1FU21P7MX------), and vehicle #4 is a front wheel drive 1993 Saturn SL, four-door sedan (VIN: 1G8ZF5593PZ------). Vehicles #3 and #4 were involved in the crash but neither impacted the case vehicle. The case vehicle and vehicle #2 were both towed due to damage; vehicles #3 and #4 were driven from the scene. The CDCs were determined to be: **11-FYEW-2 (-20)** for the case vehicle [maximum crush was 27 centimeters (10.6 inches)] and **01-RFEW-3 (+30)** for vehicle #2 [maximum crush was 30 centimeters (11.8 inches)]. The WinSMASH reconstruction program, damage only algorithm, was used on the highest severity impact to the case vehicle. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 21.3 km.p.h. (13.2 m.p.h.), -20.0 km.p.h. (-12.4 m.p.h.), and +7.3 km.p.h. (+4.5 m.p.h.).

According to the case vehicle's driver, immediately prior to the crash the front right passenger was seated all the way forward in the seat and leaning forward, his legs were hanging down, and he was playing

with some toy cars between his thighs. In addition, the front right passenger's seat track was located between its middle and forward-most positions. However, the vehicle inspection showed that his seat track was located between its middle and rearmost positions, and the seat back was slightly reclined. Based on the available evidence, this contractor believes that the front right seat track was located between its middle and rearmost positions.

According to the case vehicle's driver (18-year-old male, stepfather), immediate prior to the crash he was seated with his back against the seat back, his left elbow on the armrest, his right hand on the steering wheel--six o'clock position, his left foot on the floor, and his right foot on the brake. The driver indicated that his seat track was located in its middle position, with the seat back slightly reclined. However, the vehicle inspection showed that his seat track was located between its middle and rearmost positions with the seat back was sightly reclined. The driver's seat track was reclined more so than the front right passenger's. The case vehicle was not equipped with a tilt steering wheel. Based on the available evidence, this contractor believes that the driver's seat track was located between its middle and rearmost positions. According to the case vehicle's driver, he was not wearing his available, active, three-point, lap and shoulder belt. According to the investigating police officer and the Police Crash Report, the case vehicle's driver initially indicated that he was restrained. According to the case vehicle's driver, he sustained a laceration to his left elbow when it impacted (and shattered) the driver's side window glazing. According to the Police Crash Report and the case vehicle's driver, the driver was not treated.

TRC/IU ON-SITE AIR BAG INVESTIGATION

TRC/IU CASE NO. IN97-005

VEHICLE: 1996 HYUNDAI ACCENT
LOCATION - OHIO

CRASH DATA

Location/Street:	County Road
State:	Ohio
Area/Type:	Rural, commercial
Crash Date/Time:	February, 1997 @ 4:25 p.m.
Investigating Police Agency:	County sheriff
Crash Type:	Vehicle / Vehicle - Obtuse angle
Occupant Injury Severity (air bag vehicle):	Cervical fracture/dislocation with transection of spinal cord (AIS-6)

AMBIENT CONDITIONS

Light Conditions:	Daylight
Weather Condition:	Cloudy/overcast
Precipitation:	Rain
Road Surface:	Wet
Temperature:	50 degrees F (10 degrees C) @ local airport

ROADWAY

	Case Vehicle	**Vehicle #2**
Location:	County road	County road
Number of Travel Lanes:	Five-lanes, undivided: two lanes northbound, two lanes southbound, one northbound left-hand turn lane	Five-lanes, divided: two lanes northbound, two lanes southbound, one southbound left-hand turn lane
Width:	4.0 meters (13.2 feet)	3.9 meters (12.9 feet)
Surface Type:	Bituminous	Bituminous
Median:	None	Barrier curb
Shoulders:	Paved, 0.6 meters (2.0 feet)	Paved, 0.6 meters (2.0 feet)
Vertical alignment:	0.9 percent, positive to north	Level
Horizontal alignment:	Straight	Straight

ROADWAY (CONTINUED)

	Case Vehicle	Vehicle #2
Estimated Coefficient of Friction:	.65	.65
Traffic Density:	Moderate to heavy	Moderate to heavy

TRAFFIC CONTROLS

	Case Vehicle	Vehicle #2
Signals:	Vertically mounted on-colors traffic control signal with separate left turn control arrow	Vertically mounted on-colors traffic control signal with separate left turn control arrow
Signs:	Regulatory SPEED LIMIT sign	Regulatory SPEED LIMIT sign
Markings:	Dashed white lines sep-erating inside and outside northbound lanes; solid white line separating through lanes from left-hand turn lane; double solid yellow center lines between north and south-bound lanes	Dashed white lines separating inside and outside southbound through lanes; solid white line separating through lanes from left-hand turn lane
Speed Limit:	56 km.p.h. (35 m.p.h.)	56 km.p.h. (35 m.p.h.)

VEHICLES

	Case Vehicle	Vehicle #2
Year:	1996	1994
Make:	Hyundai	Oldsmobile
Model:	Accent L	Cutlass Ciera S
Body Type:	Three-door hatchback; five passengers	Four-door sedan; six passengers
V.I.N.	KMHVD14N4TU------	1G3AG55M3R6------
Color:	Green	Navy Blue
Mileage:	38,631 km (24,004 miles)	86,501 km (53,749 miles)
Engine:	1.5 liter, L4	3.1 liter, V-6
Transmission:	Four-speed, automatic	Four-speed, automatic
Steering:	Power-assisted	Power-assisted
Brakes:	Power-assisted, front disc, rear drum	Power-assisted, front disc, rear drum

VEHICLES (CONTINUED)

	Case Vehicle	**Vehicle #2**
Padding:	Steering wheel and hub, "A"-pillars, sun visors, dash, side door surfaces	Steering wheel and hub, "A"-pillars, sun visors, dash, side door surfaces
Active Restraints:	Three-point, manual, lap and shoulder belts in front and back outboard seating positions; lap belt only at back center position	Two-point, manual, lap belt only at front center position and all three back seat positions
Passive Restraints:	Factory installed driver and front right passenger supplemental restraint systems (air bags)	Factory installed driver supplemental restraint system (air bag); three-point, automatic, lap and shoulder belts in front outboard seating positions
Anti-lock brakes:	Option, four wheel	Yes, four wheel
Defects:	None	None
Fleet:	Private vehicle	Private vehicle/stolen
Tow status:	Towed due to damage	Towed due to damage

	Vehicle #3	**Vehicle #4**
Year:	1991	1993
Make:	Nissan	Saturn
Model:	Stanza	SL
Body Type:	Four-door sedan, five-passengers	Four-door sedan, five passengers
V.I.N.	JN1FU21P7MX------	1G8ZF5593PZ------
Engine:	2.4 liters, L4	1.9 liters, L4
Active Restraints:	Two-point, manual, lap belts in front and back outboard seating posi-tions; lap belt only at back center position	Two-point, manual, lap belts in front and back outboard seating posi-tions; lap belt only at center back position
Passive Restraints:	Two-point, motorized, automatic, shoulder belts in front outboard seating positions	Two-point, motorized, automatic, shoulder belts in front outboard seating positions; factory installed driver supplemental re-straint system (air bag)
Anti-lock brakes:	No	No
Defects:	Private vehicle	Private vehicle
Fleet:	Driven away	Driven away

VEHICLE DAMAGE

	Vehicle #3	**Vehicle #4**
Tow status:	Not towed	Not Towed
EXTERIOR	**Case Vehicle**	**Vehicle #2**
Deployment Impact		
Event number:	One	One
Object Struck:	Vehicle #2	Case vehicle
Damage location		
Damaged Plane:	Front	Right
Vertical Location		
On Plane:	Bumper level	Bumper/sill level
Direct Begins:	Left bumper corner	Right bumper corner
Length Direct:	69.0 cm (27.2 in)	49.0 cm (19.3 in)
Field L:	118.0 cm (46.5 in)	123.0 cm (48.4 in)
C_1:	15.0 cm (5.9 in)	0.0 cm (0.0 in)
C_2:	27.0 cm (10.6 in)	2.0 cm (0.8 in)
C_3:	16.0 cm (6.3 in)	0.0 cm (0.0 in)
C_4:	0.0 cm (0.0 in)	1.0 cm (0.4 in)
C_5:	0.0 cm (0.0 in)	30.0 cm (11.8 in)
C_6:	0.0 cm (0.0 in)	30.0 cm (11.8 in)
D:	-30.5 cm (12.0 in)	191.0 cm (75.2 in)
Maximum Crush:	27.0 cm (10.6 in)	30.0 cm (11.8 in)
Location:	C_2	C_5
CDC:	11-FYEW-2 (-20)	02-RFEW-3 (+30)
Damaged Components:	Front bumper, grille, hood, and both fenders	Front bumper, grille, hood, and right fender
INTERIOR	**Case Vehicle**	**Vehicle #2**
Damaged Components:	Windshield, driver and front passenger air bag modules	Center arm rest, steering column-mounted transmission selector lever, windshield, rearview mirror
Other Evidence of Occupant Contact:	Roof, front right seat's headrest, steering column	Left and center dash
Manual Restraint System Failures:	None	None
Seat Performance Failures:	None	None
REPAIR		
Cost Estimate:	Unknown	Unknown

VEHICLE VELOCITY ESTIMATES

HIGHEST DELTA "V"	**Case Vehicle**	**Vehicle #2**
Reconstruction Program:	WinSMASH	WinSMASH
Program Algorithm:	Damage only	Damage only
Barrier Equivalent Delta V:	20.6 km.p.h. (12.8 m.p.h.)	17.0 km.p.h. (10.6 m.p.h.)
Total Delta "V":	21.3 km.p.h. (13.2 m.p.h.)	16.3 km.p.h. (10.1 m.p.h.)
Longitudinal Delta "V":	-20.0 km.p.h. (-12.4 m.p.h.)	-14.1 km.p.h. (-8.8 m.p.h.)
Lateral Delta "V":	+7.3 km.p.h. (+4.5 m.p.h.)	-8.2 km.p.h. (-5.1 m.p.h.)

COLLISION SEQUENCE

The following is based on the Police Crash Report, interviews with the case vehicle's driver and the investigating police officer, scene and vehicle inspections, occupant medical records, and this contractor's evaluation of the evidence.

PRE-CRASH: The case vehicle (Accent) was traveling northbound in the outside, northbound through lane of a five-lane, undivided, county road (i.e., two northbound and two southbound through lanes and one left-hand northbound turn lane) and intended to continue in its northward direction of travel. Vehicle #2 was traveling southward in the southbound, left-hand turn lane of the same five-lane, county trafficway and was attempting to turn left to go eastbound (Note: the north leg of this four-leg intersection was a divided trafficway while the south leg was undivided. For the northern leg, the northbound roadway had two through lanes while the southbound roadway had two through lanes and one left-hand turn lane that was opposite the northbound left-hand turn lane on the south leg of the intersection). Vehicle #3 was stopped heading west in the outside westbound lane of a four-lane, undivided, roadway waiting for the traffic control signal to change. Likewise, vehicle #4 was stopped heading west in the inside westbound lane of the same roadway. The case vehicle's driver braked (ABS), without lock-up, attempting to avoid the crash. The case vehicle continued essentially straight ahead prior to impact. The driver of vehicle #2 made no pre-crash avoidance maneuvers. Vehicle #2 continued ahead, making its left turn, prior to impact. The drivers of vehicles #3 and #4 made no pre-crash avoidance maneuvers. Vehicles #3 and #4 remained in their stopped position just prior to impact. The initial impact occurred in the four-leg intersection of the two trafficways.

CRASH: The front left of the case vehicle impacted the right front corner of vehicle #2, causing both the driver and front right passenger supplemental restraint systems (air bags) to deploy. The case vehicle rotated approximately 50 degrees clockwise after the impact and came to rest heading northeast in the outside, northbound lane, in the middle of the intersection. Vehicle #2 rotated approximately 25 degrees counterclockwise after the impact and came to a momentary rest in the outside, northbound of the intersection. Subsequently, vehicle #2 drove forward (i.e., eastward) striking its front left corner to the front left corner of vehicle #3, which was stopped on the east leg of the intersection in the outside westbound lane waiting for the traffic signal to change. Vehicle #2 then sideswiped down the left side of vehicle #3. Vehicle #3 came to rest a few feet north of its original position. Vehicle #2 continued driving eastward, sideswiping the right rear of vehicle #4

COLLISION SEQUENCE (CONTINUED)

CRASH: (Continued)

with its right front, prior to departing the scene. Vehicle #4 was also stopped waiting for the traffic signal to change when it was sideswiped. Vehicle #4 came to rest a few inches south of its original position.

POST-CRASH:

Occupants: The case vehicle's driver and front right passenger both remained inside the vehicle at final rest. The driver was conscious and able to exit the case vehicle without any assistance. The front right passenger was unconscious and was unable because of his injuries to exit the case vehicle. Initially the case vehicle's driver (i.e., stepfather) claimed that both he and the front right passenger (i.e., stepson) were properly restrained. The case vehicle's driver later recanted and indicated that he was not wearing his available, active, three-point lap and shoulder belt and that the front right passenger may have been improperly restrained (i.e., shoulder portion was behind his back). Based on the abundance of evidence found during the vehicle inspection and the lack of loading evidence on the body of the deceased front right occupant, this contractor's conclusion is that the front right passenger was not wearing his available, active, three-point, lap and shoulder belt.

Police: The investigating police agency was notified of the crash within one minute post-crash and arrived on-scene five minutes later. Traffic control procedures were established and emergency medical and towing services were called to assist.

Rescue: The driver was not transported and did not seek medical treatment for his injury. The front right passenger was transported by ambulance to a medical facility where he was pronounced dead one hour and ten minutes post-crash. The case vehicle's driver sustained a minor lacerative injury to his left elbow, caused when his elbow broke out the glazing of the driver's side door. The front right passenger sustained, according to his medical records, fatal injuries which included: a large gaping, 16.5 centimeter (6.5 inch) laceration across his neck from ear to ear, a laceration of the spinal cord at C_2-C_3 with accompanying hangman's type fracture of C_2 and a 3.8 centimeter (1.5 inch) dislocation between C_2 and C_3, lacerations of the larynx, trachea, and right internal jugular vein, and bilateral intraventricular hemorrhages. In addition, he sustained a spleen laceration, a fracture/dislocation with abrasion to the left distal forearm, and facial and neck abrasions. The neck lesion gives the appearance of a partial decapitation. Based on the available evidence, the neck and cervical injuries resulted from the deploying air bag module's cover flap. There is no evidence of trauma above this occupant's chin except for an abrasion to the left side of his forehead from contacting the windshield.

COLLISION SEQUENCE (CONTINUED)

POST-CRASH:

Rescue: (Continued)

Vehicle #2's driver and front right passenger did not require any medical treatment, nor did the drivers of vehicles #3 and #4.

Removal: Following the police investigation, the case vehicle was towed from the scene. Vehicle #2 which left the scene of the crash became disabled a few blocks away and was also towed away. Vehicle #3 and #4 were driven from the scene.

HUMAN FACTORS/OCCUPANT DATA

DRIVERS:	**Case Vehicle**	**Vehicle #2**
Age:	18-year-old	12-year-old
Sex:	Male	Male
Height:	183 cm (72 in)	Unknown
Weight:	73 kg (160 lbs)	Unknown
Occupation:	Heavy machine operator	Student
Active Restraint System/Usage:	Three-point lap and shoulder/Not used	None available
Usage Source:	Vehicle inspection and interviewee	Not applicable
Passive Restraint System/Usage:	Factory installed air bag/Air bag deployed	Factory installed air bag/Air bag did not deploy; three-point, automatic, lap and shoulder/Not used
Usage Source:	Vehicle inspection, interviewee, and Police Crash Report	Vehicle inspection and Police Crash Report
Eyeglasses/contacts:	None	Unknown
Vehicle Familiarity:	19,312 kilometers (12,000 miles) per year	Unknown; stolen vehicle
Route Familiarity:	Daily	Unknown
Trip Plan:	Restaurant to home	Joyriding
Manner of Leaving Scene:	Taken by police squad car to hospital	Fled the scene only to be apprehended later and taken into police custody
Type of Medical Treatment:	None	None

HUMAN FACTORS/OCCUPANT DATA (CONTINUED)

DRIVERS:	**Vehicle #3**	**Vehicle #4**
Age:	45-year-old	27-year-old
Sex:	Male	Male
Height:	Unknown	Unknown
Weight:	Unknown	Unknown
Occupation:	Unknown	Unknown
Active Restraint System/Usage:	Two-point lap belt/Used	Two-point lap belt/Used
Usage Source:	Police Crash Report	Police Crash Report
Passive Restraint System/Usage:	Two-point, automatic, shoulder belt/Used	Two-point shoulder/Used; Factory installed driver air bag/Did not deploy
Usage Source:	Police Crash Report	Police Crash Report
Eyeglasses/contacts:	Unknown	Unknown
Vehicle Familiarity:	Unknown	Unknown
Route Familiarity:	Unknown	Unknown
Trip Plan:	Unknown	Unknown
Manner of Leaving Scene:	Drove away	Drove away
Type of Medical Treatment:	None	None

FRONT RIGHT PASSENGERS:	**Case Vehicle**	**Vehicle #2**
Age:	4-year-old	18-year-old
Sex:	Male	Male
Height:	107 cm (42 in)	Unknown
Weight:	19 kg (42 lbs)	Unknown
Active Restraint System/Usage:	Three-point lap and shoulder/Not used	Not equipped
Usage Source:	Vehicle inspection	Not applicable
Passive Restraint System/Usage:	Factory installed air bag/Air bag deployed	Three-point, automatic, lap and shoulder belts/Not used
Usage Source:	Vehicle inspection, interviewee, Police Crash Report	Vehicle inspection and Police Crash Report
Eyeglasses/contacts:	None	Unknown
Manner of Leaving Scene:	Ambulance	Fled the scene only to be apprehended later and taken into police custody

HUMAN FACTORS/OCCUPANT DATA (CONTINUED)

FRONT RIGHT PASSENGERS:	**Case Vehicle**	**Vehicle #2**
Type of Medical Treatment:	Treated but expired 70 minutes post-crash	None

CASE VEHICLE DRIVER INJURIES

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Laceration *{cut}*, deep, left elbow	790600.1 minor	Glazing, driver's side	Probable	Interviewee (same person)

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1 2	Laceration[1] spinal cord @ C_2-C_3 level with hangman's fracture of C_2 and complete dislocation/distraction[2] of C_2 on C_3 resulting in the presence of subarachnoid hemorrhage surrounding the inferior surfaces of the cerebellum and brain stem and the entire length of the spinal cord	640276.6 untreatable 140466.3 serious	Front right module's cover flap	Certain	Autopsy
3 4	Hemorrhage, intraventricular, in both lateral ventricles[3]	140678.4 140678.4 severe	Air bag, front right passenger's	Possible	Autopsy
5	Laceration larynx, including base of epiglottis, and involving the vocal cords, bilaterally	340210.4 severe	Front right module's cover flap	Certain	Autopsy

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1 This laceration involved a complete transection of the spinal cord.

2 The following terms are defined in DORLAND'S ILLUSTRATED MEDICAL DICTIONARY as follows:
hangman's f.: fracture through the pedicles of the axis (C_2) with or without subluxation of the second cervical vertebra on the third.
distraction (dis-trak'shen): a form of dislocation in which the joint surfaces have been separated without rupture of their binding ligaments and without displacement.

3 This lesion is possibly a result of the spinal cord transection and subsequent subarachnoid hemorrhage noted throughout the inferior cerebellum, brain stem, and spinal cord.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES (CONTINUED)

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
6	Laceration right internal jugular vein	320802.2 moderate	Front right module's cover flap	Certain	Emergency room records
7	Laceration trachea, anteriorly	442604.3 serious	Front right module's cover flap	Certain	Emergency room records
8	Laceration along lateral edge of spleen	544220.2 moderate	Center console	Possible	Autopsy
9	Fracture (palpated) distal left forearm, bone not specified	751800.2 moderate	Right instrument panel and below (i.e., bracing)	Probable	Autopsy
10	Dislocation left forearm above wrist, not further specified	751430.2 moderate	Right instrument panel and below (i.e., bracing)	Probable	Autopsy
11	Abrasion left forehead	290202.1 minor	Windshield	Probable	Autopsy
12	Abrasion on point of chin	290202.1 minor	Air bag, front right passenger's	Probable	Autopsy
13	Abrasion on undersurface of chin	290202.1 minor	Front right module's cover flap	Probable	Autopsy
14	Abrasion on right edge of neck laceration	390202.1 minor	Front right module's cover flap	Certain	Autopsy
15	Laceration[4] 16.5 cm (6.5 in), anterior neck[5] (i.e., partial decapitation)	390604.2[6] moderate	Front right module's cover flap	Certain	Autopsy
16	Abrasion left lower forearm and wrist	790202.1 minor	Air bag, front right passenger's	Certain	Autopsy

CASE VEHICLE DRIVER KINEMATICS

Based on the interview with the case vehicle's driver and occupant kinematic principles, immediately prior to the crash he was seated reclined with his back against the seat back, leaning to his left with his left elbow on the armrest, his right hand on the steering wheel--six o'clock position, his left foot on the floor, and his right foot on the brake. According to the case vehicle's driver, his seat track was located in its

4 The neck laceration (i.e., partial decapitation) and accompanying lacerations of the right internal jugular vein, larynx, and trachea most likely produced the resulting hemorrhage into the anterior thymus, extensive hemorrhage in anterior and posterior mediastinum, and the hemorrhage in bilateral pleural cavities (i.e., hemothorax). No lesions were noted to the heart, lung, or great vessels.

5 According to the autopsy report, the spinal cord separation was directly behind this laceration.

6 Given the nature (i.e., partial decapitation) of this laceration, the A.I.S. assigned should be two despite the length of the laceration being less than or equal to 20 centimeters (7.9 inches).

CASE VEHICLE DRIVER KINEMATICS (CONTINUED)

middle position with the seat back slightly reclined; however, based on the vehicle inspection, his seat track was located between its middle and rearmost positions, and the seat back was sightly reclined--the driver's more so than the front right passenger's. The case vehicle was not equipped with a tilt steering wheel. The case vehicle's driver indicated that he was not wearing his available, active, three-point, lap and shoulder belt. According to the investigating police officer and the Police Crash Report, the case vehicle's driver initially indicated that he was restrained, but during the interview with this investigator he admitted to not wearing it.

The case vehicle's driver braked (ABS), attempting to avoid the crash. As a result of this attempted avoidance maneuvers and the nonuse of his available safety belts, he most likely moved slightly forward just prior to impact.

Based on the vehicle and scene inspections and occupant kinematic principles, the case vehicle's primary impact with vehicle #2, not only deployed the driver's side air bag, but initially thrust the driver forward and slightly leftward towards the -20 degree Direction of Principal Force.

As the case vehicle reached maximum engagement, it rotated approximately 50 degrees clockwise sending the driver farther to his left. At the same time, the air bags outward excursion pushed him rearwards. As the case vehicle rotated clockwise the driver's left elbow contacted the left front door's window glazing disintegrating it and causing the laceration to his left elbow. The only other visible evidence of contact by the driver was a scuff to the steering column from his right knee. The driver complained that after the crash the top of his head hurt, indicating that during the clockwise rotation to final rest his head may have struck the left side rail or roof; although, there is no visible evidence supporting this contact. An inspection of the driver's air bag revealed no visible evidence of contact. In addition, there appeared to be no visible evidence of contact on the driver air bag module's cover flaps. According to the Police Crash Report and the case vehicle's driver, the driver was not treated.

As the case vehicle rotated clockwise to final rest, the case vehicle's driver rebounded backwards and to the right. The driver came to rest in the driver's seat.

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

Based on the interview with the case vehicle driver, immediately prior to the crash the front right passenger [stepson, 107 centimeters and 19 kilograms (42 inches, 42 pounds)] was seated all the way forward on the seat cushion and leaning forward, his legs were hanging down, and he was playing with some toy cars between his thighs. In addition, the front right passenger's seat track was located between its middle and forward-most positions. The vehicle inspection showed that his seat track was located between its middle and rearmost positions, and the seat back was slightly reclined.

According to the case vehicle's driver, the front right passenger was restrained by his available, active, three-point, lap and shoulder belts. The case vehicle's driver was positive that his stepson was belted because he had trouble unbuckling the belt post-crash. The driver did state that he felt sure that the torso portion of the his stepson's belt was behind him. A deputy sheriff and this investigator interviewed

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS (CONTINUED)

the case vehicle's driver simultaneously, and it should be noted that during this interview the case vehicle's driver made some conflicting statements regarding the usage of the front right occupant's restraints. According to the coroner and the investigating deputies who viewed the child's body at the morgue, there was no evidence of belt pattern bruising or abrasions to the front right passenger's body. In addition, the inspection of the front right passenger's seat belt webbing, "D"-ring, and latch plate showed no evidence of loading or any evidence of usage during the crash. In addition, based on the contact evidence mentioned below, case vehicle's front right passenger was not using the available safety belts.

The case vehicle's driver braked attempting to avoid the crash. As a result of the driver's pre-impact braking and the nonuse of his available safety belts, the front right passenger moved forward and slightly upward, on top of the dash/air bag module, just prior to impact.

Based on the vehicle and scene inspections and occupant kinematic principles, the case vehicle's primary impact with vehicle #2 deployed the front right passenger air bag. As the front right passenger moved forward, the passenger's forward excursion put him directly above the deploying front right air bag's cover flap. The cover flap struck the child in his neck, sending the boy upward into the windshield. Photographs (see **CASE PHOTOGRAPHS #25** and **#26**) taken by the investigating officers while at the autopsy showed that the front right passenger sustained a gaping 16.5 centimeter (6.5 inch) laceration across his neck from ear to ear. This lesion gives the appearance of a partial decapitation. According to the photographs, there is no evidence of trauma above this occupant's chin except for an abrasion to the left side of his forehead from contacting the windshield. An inspection of the front right passenger's air bag revealed an oil smear, skin transfers, and a purple transfer mark from the child's jacket to the bag's top portion (only). In addition, there appeared to be an oil smear and skin flakes on the front right air bag module's cover flap (see **CASE PHOTOGRAPH #13**). In addition, there was a spiderweb to the windshield (see **CASE PHOTOGRAPH #15**) with skin embedded in it.

As the front right air bag fully deployed, the front right passenger continued farther upwards and back where he contacted the roof (see **CASE PHOTOGRAPH #16**) with his head before falling downwards and back into the seat. The front right passenger contacted the front right seat's integral headrest (see **CASE PHOTOGRAPH #17**) with his head and neck. According to the driver, at final rest the front right occupant's hips were against the center console with his upper torso leaning to the left with his head turned to the left. This final rest positioning matches with some pooled blood (see **CASE PHOTOGRAPH #18**) that was found atop and down the driver's side of the center console.

CASE VEHICLE AIR BAG SYSTEM

	DRIVER AIR BAG	**FRONT RIGHT AIR BAG**
Air Bag Diameter (seam-to-seam, deflated):	Width: 62 cm (24.4 in) Height: 60 cm (23.6 in)	Width: 48 cm (18.9 in) Height: 45 cm (17.7 in)
Number of Vent Holes:	Two	Two
Vent Hole Diameter:	2.5 cm (1.0 in)	Unknown

CASE VEHICLE AIR BAG SYSTEM (CONTINUED)

	DRIVER AIR BAG	**FRONT RIGHT AIR BAG**
Vent Hole Clock Positions:	Approximately 10:30 and 1:30 clock positions	Approximately 9 and 3 o'clock
Number of Air Bag Tethers:	Two	Two, each 44 cm (17.3 in) wide
Number of Air Bag Module Cover Flaps:	Two	One
Upper Cover Flap Dimensions:	Width: 15 cm (5.9 in) Height: 8 cm (3.2 in)	Width: 35 cm (13.8 in) Height: 20 cm (7.9 in)
Lower Cover Flap Dimensions:	Width: 15 cm (5.9 in) Height: 5 cm (2.0 in)	Not applicable
Distance between Dash and leading (i.e., closest) edge of Module's Cover Flap:	**Not applicable**	0 cm (0 in)
Mount Location:	Steering wheel hub	Top instrument panel
Generant Residue:	No unusual amount found	No unusual amount found