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ON-SITE CHILD AIR BAG-RELATED FATALITY INVESTIGATION

CASE NUMBER - IN-04-006
LOCATION - Louisiana
VEHICLE - 1999 HYUNDAI ELANTRA
CRASH DATE - February 2004

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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 child air bag-related fatality investigation involving a 1999 Hyundai Elantra, four-door sedan with manual safety belts and redesigned driver and front right passenger air bags.			
16. *Abstract* This report covers an on-site investigation of an air bag deployment crash that involved a 1999 Hyundai Elantra (case vehicle) and a 1995 Ford F-150 pickup truck (other vehicle), which collided in the intersection of a rural street and a four-lane divided U.S. highway. This crash is of special interest because the case vehicle was equipped with redesigned air bags and the case vehicle's front right passenger (6-year-old, male) sustained a fatal injury from his deploying front right passenger air bag. The case vehicle was traveling southwest in the inside lane of a four-lane divided U.S. highway and was approaching a "T" intersection. The Ford was traveling south southeast on a two-lane rural roadway and was crossing the "T" intersection. The front of the case vehicle impacted the left rear of the Ford causing the case vehicle's driver and front right passenger air bags to deploy. The case vehicle rotated counterclockwise and came to rest partially on the grassy median and partially on the paved shoulder facing south southwest. The impact caused the Ford to rotate counterclockwise, and it came to final rest partially on the grassy median and paved shoulder facing northeast. The case vehicle's front right passenger was seated upright and was unrestrained. The case vehicle's driver steered right and braked just prior to impact causing the front right passenger to move slightly left and forward, and he contacted the instrument panel and was over the air bag module cover flap at the time of the crash. As the air bag deployed, the module cover flap contacted the passenger's chin and neck and the air bag contacted the passenger's face causing a severe abrasion to the right side of his face, abrasions underneath his chin and on his neck and a dislocation of his atlanto-occipital with probable spinal cord injury. In addition, he sustained a blunt abdominal injury from the air bag as it inflated. The front right passenger was then directed upward and rearward toward the seat back by the deploying air bag. He was transported to a hospital by ambulance and was pronounced dead 59 minutes post-crash. The 38-year-old female driver, 22-year old female back left passenger and 2-year old female back center passenger were all unrestrained. They sustained minor to moderate injuries and were transported to the hospital by private conveyance and were treated and released.			
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This on-site investigation was brought to NHTSA's attention on February 25, 2004 by a newspaper article. This crash involved a 1999 Hyundai Elantra (case vehicle) and a 1995 Ford F-150 (other vehicle). The crash occurred in February, 2004, at 1:13 p.m., in Louisiana and was investigated by the Louisiana state police. This crash is of special interest because the case vehicle was equipped with redesigned air bags, and the case vehicle's front right passenger [6-year-old, Black (non-Hispanic), male]; sustained a fatal injury from his deploying front right passenger air bag. This contractor inspected the scene and vehicles on March 2-3, 2004. This contractor interviewed the case vehicle driver on March 2, 2004. This report is based on the police crash report, scene and vehicle inspections, medical records interviews with the case vehicle driver, occupant kinematic principles and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling southwest in the inside lane of a four-lane divided U.S. highway and was approaching a “T” intersection. The Ford was traveling south southeast on a two-lane rural roadway and was crossing the “T” intersection. The front of the case vehicle impacted the left rear of the Ford causing the case vehicle’s driver and front right passenger air bags to deploy. The case vehicle rotated counterclockwise and came to rest partially on the grassy median and partially on the paved shoulder facing south southwest. The impact caused the Ford to rotate counterclockwise, and it came to final rest partially on the grassy median and paved shoulder facing northeast. At the time of the crash the light condition was daylight, the atmospheric condition was clear and the road pavement was dry. Traffic density was light, and the site of the crash was rural residential.

The CDC for the case vehicle was determined to be **12-FYEW-1** (**10** degrees). The CDC for the Ford was determined to be **09-LBEW-3** (**280** degrees). The WinSMASH reconstruction program, damage algorithm or missing vehicle algorithm, could not be used on this crash because the case vehicle underrode the left rear side of the Ford, and the Ford’s damaged area was made of fiberglass and an appropriate stiffness category could not be assigned. However, the WinSMASH, barrier algorithm, was used to determine the case vehicle’s Barrier Equivalent Speed (BES). The BES was determined to be 15 km.p.h. (9.3 m.p.h.).

The case vehicle’s front right passenger was seated upright and was unrestrained. The case vehicle’s driver steered right and braked just prior to impact causing the front right passenger to move slightly left and forward, and he contacted the instrument panel and was over the air bag module cover flap at the time of the crash. As the air bag deployed, the module cover flap contacted the passenger’s chin and neck and the air bag contacted the passenger’s face causing a severe abrasion to the right side of his face, abrasions underneath his chin and on his neck and a dislocation of his atlanto-occipital with probable spinal cord injury. In addition, he sustained a blunt abdominal injury from the air bag as it inflated. The front right passenger was then directed upward and rearward toward the seat back by the deploying air bag. He transported to a hospital by ambulance and was pronounced dead 59 minutes post-crash.

The case vehicle's driver (38-year-old, female) was not restrained by her manual, three-point, lap-and-shoulder, safety belt system. The driver impacted her knees on the knee bolster, her right foot loaded the brake pedal spraining her right ankle, and her chest and face impacted the air bag straining her neck. In addition, her right hand was burned by the air bag exhaust gasses, and the palm of her left hand impacted the windshield, however, no injury resulted from this contact. The back left passenger (22-year-old, female) and back center passenger (2-year-old, female) were not restrained. They sustained minor injuries in the crash. The driver, back left passenger and back center passenger exited the vehicle under there own power and were transported by private conveyance to a hospital and treated and released.

CRASH CIRCUMSTANCES

Crash Environment: The roadway on which the case vehicle was traveling was a level, bituminous, four-lane, divided, U.S. highway traversing in a southwest and northeast direction, and the case vehicle was approaching a three leg (i.e., "T") intersection. Each travel direction had two travel lanes, improved shoulders, and the roadway was divided by a grass median. Each travel lane was approximately 3.4 meters (11.2 feet) wide, the outside shoulders were approximately 3 meters wide, the inside shoulders were 1.6 meters (5.2 feet) wide, and the median was 14.6 meters (47.9 feet) wide. Roadway pavement marking consisted of broken white center lines, solid white outside edge lines and yellow median edge lines. The roadway on which the Ford was traveling was a two-lane, bituminous, undivided, rural street traversing in a south southeast and north northwest direction and extending through the median of the U.S. highway. This roadway was controlled by a stop sign and the roadway had a slight positive grade in the Ford's direction of travel. At the time of the crash the light condition was daylight, the atmospheric condition was clear and the road pavement was dry. Traffic density was light, and the site of the crash was rural residential. See the Crash Diagram at the end of this report.

Pre-Crash: The case vehicle was traveling southwest in the inside lane (**Figure 1**), and the driver was intending to continue straight ahead. The Ford was traveling south southeast in the south southeast bound lane (**Figure 2** below), and the driver was intending to cross the intersection, travel through the median cut and make a left turn onto the U.S. highway. The case vehicle's driver steered to the right and braked attempting to avoid the crash. The crash occurred within the "T" intersection in the outside, southwest bound lane of the U.S. highway.

Figure 1: Approach of the case vehicle southwest bound to the crash site, arrow shows area of impact

Figure 2: Approach of the Ford south southwest bound to the intersection

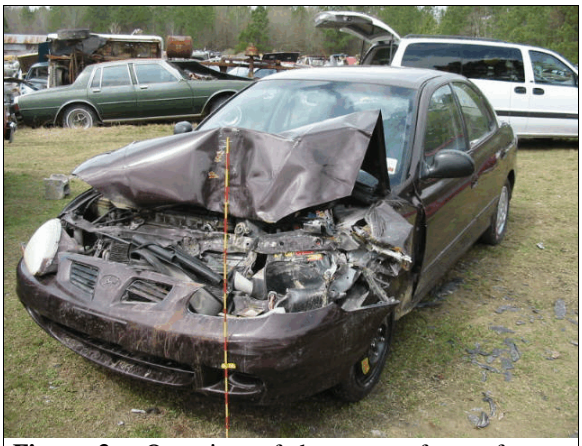


Figure 3: Overview of damage to front of case vehicle from impact with the Ford

Figure 4: Damage to left rear side of Ford's truck bed from impact with the case vehicle

Crash: The front of the case vehicle (**Figure 3**) impacted the left rear of the Ford (**Figure 4**), causing the case vehicle's driver and front right passenger air bags to deploy. There was a vertical mismatch of the contact surfaces of the two vehicles, and the case vehicle underrode the left side of the Ford.

Post-Crash: As a result of the impact, the case vehicle rotated counterclockwise approximately 385 degrees and came to final rest partially on the grassy median and partially on the paved shoulder **(Figure 5)** facing southwest. The impact caused the Ford to rotate approximately 120 degrees counterclockwise, and it came to final rest partially on the grassy median and paved shoulder (**Figure 6** below) facing northeast.

Figure 5: Case vehicle's final rest position partially on shoulder and in median, view is back to impact area

CASE VEHICLE

The 1999 Hyundai Elantra was a front wheel drive, four-door sedan (VIN: KMHJF25F0XU------) equipped with a 2.0L, four cylinder engine and a three speed automatic transmission. The front seating row was equipped with driver and front right passenger redesigned air bags, bucket seats with adjustable head restraints; manual, three-point, lap-and-shoulder safety belts with retractor-mounted pretensioners, knee bolsters and a tilt steering column. The back seat was equipped with a bench seat with

manual, three-point, lap-and-shoulder safety belts in the outboard seat positions and a lap belt in the middle seat position. Four wheel, anti-lock brakes were an option on the case vehicle, but it is unknown if it was so equipped. The case vehicle's odometer reading at the inspection was 275,778 kilometers (171,365 miles), and its undeformed wheelbase was 255 centimeters (100.4 inches).

Figure 6: Final rest location of the Ford (indicated by pink lines) partially on shoulder and in median, view is south southwest

CASE VEHICLE DAMAGE

Exterior Damage: The case vehicle's contact with the Ford involved the front bumper, bumper fascia, grille, hood, and left fender. Direct damage began at the front left bumper corner and extended 75 centimeters (29.5 inches), along the front bumper. Due to significant damage above the front bumper as a result of the underride, the C-Measurements were taken at the bumper level and along the upper radiator support. The crush values were averaged at C_1, C_2, and C_3. Residual crush at the bumper was 0 centimeters along the entire front bumper. The residual maximum crush above the bumper was 26 centimeters (10.2 inches) occurring at C_1 (**Figure 7** below). The case vehicle's front bumper, bumper fascia, grille, radiator, left turn signal and headlamp assemblies, left fender and hood were directly damaged and crushed rearward. The case vehicle's average front crush values are shown in the table below.

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	75	26	145	13	10	11	0	0	0	-37	0
in		29.5	10.2	57.1	5.1	3.9	4.3	0.0	0.0	0.0	-14.6	0.0

The case vehicle's left side wheelbase was unaltered from the crash while the right side wheelbase was extended 1 centimeter (0.4 inch). There was induced damage to both fenders, hood, the right headlamp and turn signal assemblies and the windshield glazing. No obvious induced damage or remote buckling was noted to the remainder of the case vehicle's exterior

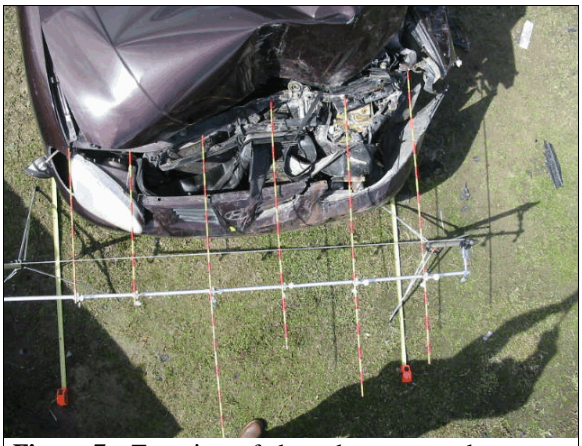


Figure 7: Top view of above bumper crush to case vehicle, each stripe on rods in 5 cm (2 in)

The recommended tire size was: P195/60R14, but the tires on the case vehicle at the time of inspection were not on the case vehicle at the time of the crash. The case vehicle's tire information is unknown, but according to a relative of the driver, none of the tires were damaged during the crash.

Vehicle Interior: Inspection of the case vehicle's interior revealed a large skin transfer on the front right passenger air bag and air bag module flap, a possible occupant contact scuff on the driver's air bag, a palm print on left portion of the windshield and a skin and hair transfer on the right portion of the windshield. No passenger compartment intrusion was observed and there was no deformation of the steering wheel or compression of the energy absorbing steering column.

Damage Classification: Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **12-FYEW-1** (**10** degrees).

The WinSMASH reconstruction program, damage algorithm or missing vehicle algorithm, could not be used on this crash because the case vehicle underrode the left rear side of the Ford, and the Ford's damaged area was made of fiberglass and an appropriate stiffness category could not be assigned. However, the WinSMASH, barrier algorithm, was used to determine the case vehicle's BES, which was determined to be 15 km.p.h. (9.3 m.p.h.).

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with redesigned driver and front right passenger air bags. Both air bags deployed in this crash as a result of the impact with the Ford.

Figure 8: Case vehicle's driver's air bag module cover flaps

The case vehicle's driver air bag was located in the steering wheel hub. An inspection of the air bag module cover flaps and the air bag fabric revealed that the cover flaps opened at the designated tear points. There was no evidence of damage during the deployment to the air bag or the air bag module cover flaps. The module cover

(**Figure 8** above) consisted of symmetrical "H"-configuration cover flaps made of pliable vinyl. The upper cover flap was 15 centimeters (5.9 inches) in width and 5 centimeters (2.0 inches) in height. The lower cover flap was 14.5 centimeters (5.7 inches) in width and 7 centimeters (2.8 inches) in height. The driver's air bag was designed with two tethers, each approximately 8 centimeters (3.1 inches) in width, and had two vent ports, each approximately 4 centimeters (1.6 inches) in diameter, located at the 11 and 1 o'clock positions. The deployed driver's air bag (**Figure 9**) was round with a diameter of approximately 63 centimeters (24.8 inches). An inspection of the driver's air bag fabric revealed only a very light scuff, which appeared to be a possible occupant contact mark, to the right center portion of the air bag's fabric. The distance between the mid-center of the driver's seat back, as positioned at the time of the vehicle inspection (i.e., seat track between mid and full forward, seat back upright), and the front surface of the air bag's fabric at full excursion was 31 centimeters (12.2 inches).

Figure 9: Overview of case vehicle's driver air bag, yellow tape shows light scuff on air bag, which appeared related to deployment

Figure 10: Overview of location of front right air bag and case vehicle's instrument panel, windshield and steering wheel

The front right passenger's air bag was located on the top of the instrument panel (**Figure 10**). An inspection of the air bag module cover flap and air bag fabric revealed that the cover flap opened at the designated tear points. There was no damage to the cover flap or the air bag due to the deployment. However, there were cracks in the exterior vinyl of the cover flap as well as skin transfers on the cover flap (**Figure 11**) indicating the unrestrained front right passenger was projected forward into the instrument panel due to driver braking and was in contact with the module cover flap when the air bag deployed. The single module cover flap was rectangular in shape and constructed of thick vinyl. The cover flap was 18.5 centimeters (7.3 inches) in width and 30.5 centimeters (12 inches) in height. The leading edge of the cover flap was flush with the front edge of the instrument panel. The front right passenger's air bag was designed without tethers

Figure 11: Case vehicle's front right passenger air bag module cover flap, yellow tape outlines damage to flap as well as area of skin transfer (arrows) due to contact with front right passenger

and had two vent ports, approximately 6 centimeters (2.4 inches) in diameter, located at the 3 and 9 o'clock positions. The deployed front right air bag was rectangular with a height of approximately 57 centimeters (22.4 inches) and a width of approximately 44 centimeters (17.3 inches). An inspection of the air bag fabric revealed a large vertical skin transfer on the center portion of the air bag (**Figure 12**). This transfer began approximately 12 centimeters (4.7 inches) from the left edge of the air bag and was approximately 12 centimeters (4.7 inches) in width and extended from the middle portion of the air bag to the top of the air bag face and onto the top section of the air bag. In addition several horizontal scuffs and possible cloth transfers were noted in the same area and on the bottom portion of air bag face. The distance between the mid-center of the front right passenger's seat back, as positioned at the time of the vehicle inspection (i.e., seat track full rear, seat back slightly reclined), and the front surface of the air bag's fabric at full excursion was 25 centimeters (9.8 inches).

Figure 12: Case vehicle's front right passenger air bag, yellow tape outlines area of skin transfer on air bag and module cover flap and possible cloth transfer on air bag

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

Immediately prior to the crash the case vehicle's front right passenger [six-year-old, black (non-Hispanic) male, 109 centimeters and 25 kilograms (43 inches, 55 pounds)] was seated upright and was using both hands to eat lunch. His back was against the seat back and his feet were dangling over the front edge of the seat cushion. His seat track was located in its rearmost position and the seat back was slightly reclined.

Based on this contractor's vehicle inspection, the front right passenger was not restrained by his manual, three-point, lap-and-shoulder safety belt system. The safety belt system was equipped with a retractor-mounted pretensioner housed within the "B"-pillar. The inspection of the safety belt assembly revealed that the pretensioner had actuated, stretching the webbing tautly between the "D"-ring and the floor anchor. This indicated the belt was not in use at the time of the crash. In addition, the occupant contact evidence on the front right passenger air bag and air bag module cover flap also indicated the front right passenger was not restrained at the time of the crash.

The case vehicle's driver steered to the right and braked, attempting to avoid the crash. The driver stated she extended her right arm in an attempt to restrain the front right passenger just prior to impact. However, as a result of the attempted avoidance maneuvers and the non-use of his safety belt, the front right passenger moved slightly left and forward just prior to impact and contacted the instrument panel and was over the air bag module cover flap at the moment of the crash. As the air bag deployed, the module cover flap contacted the passenger's chin and neck and the air bag contacted his face causing a severe abrasion to the right side of his face, abrasions

underneath his chin and on his neck and a dislocation of his atlanto-occipital with probable spinal cord injury (opinion of the ER physician). In addition, he sustained a blunt abdominal injury from the air bag as it inflated. The deploying air bag projected the front right passenger upward, and he impacted and scuffed the windshield with his head. He was then projected rearward toward his seat back. He most likely made contact with his seat back, and probably the right front door as the case vehicle rotated counterclockwise. It is not known if he landed on the seat cushion or tumbled onto the front floor to final rest.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The front right passenger was removed from the case vehicle while unconscious and was transported by ambulance to the hospital. He sustained fatal injuries and was pronounced dead 59 minutes post-crash. The table below shows the front right passenger's injuries and injury contact mechanisms.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Dislocation {separation}, 1.5 to 2 cm (0.6-0.8 in), atlanto-occipital with ***probable*** spinal cord injury and unconsciousness; unresponsive; pupils fixed and nonreactive; no pulse, blood pressure, or gag reflex; and cardiac arrest with prolonged apnea[1]	moderate 650206.3,6	Air bag module cover flap, front right passenger's	Certain	Emergency room records
2	Abrasion {friction burn}, severe, right side of face, not further specified	minor 290202.1,1	Air bag, front right passenger's	Probable	Interviewee (driver)
3	Abrasions, strap-like, underneath chin, not further specified	minor 290202.1,8	Air bag module cover flap, front right passenger's	Probable	Emergency room records
4	Abrasions, strap-like, across anterior neck, not further specified	minor 390202.1,5	Air bag module cover flap, front right passenger's	Probable	Emergency room records
5	Blunt abdominal injury, died without further evaluation; no autopsy	unknown 515999.7,0	Air bag, front right passenger's	Possible	Interviewee (driver)

[1] The following term is defined in DORLAND'S ILLUSTRATED MEDICAL DICTIONARY as follows:
apnea (ap/ne-a): 1. cessation of breathing. 2. asphyxia.

Immediately prior to the crash, the case vehicle's driver [38-year-old, Black (non-Hispanic) female; 163 centimeters and 72.6 kilograms (64 inches, 160 pounds)] was seated in an upright posture. Her left foot was on the floor, her right foot on the brake, and her left arm on the steering wheel, and her right arm was extended to the right in an attempt to restrain the front right passenger. Her seat track was located between its middle and forward-most positions. The seat back was slightly reclined, and the tilt steering wheel was located in its full up position.

Figure 13: Hand print (single head arrow) and food deposit (double head arrow) on windshield

The case vehicle's driver was not restrained by her manual, three-point, lap-and-shoulder, safety belt system. The safety belt system was equipped with a retractor-mounted pretensioner housed within the "B"-pillar. The inspection of the seat belt assembly revealed that the pretensioner had actuated, stretching the webbing tautly between the "D"-ring and the floor anchor, indicating the belt was not in use at the time of the crash.

As a result of the case vehicle driver's left steer and braking avoidance maneuvers and the non-use of her safety belt, the driver most likely moved slightly left and forward prior to the impact. As a result of the impact, the driver moved forward and slightly rightward along a path opposite the case vehicle's 10 degree direction of principal force as the case vehicle decelerated. The driver impacted her knees on the knee bolster, her right foot loaded the brake pedal spraining her right ankle, and her chest and face impacted the air bag straining her neck. In addition, her right hand was burned by the air bag exhaust gasses, and the palm of her left hand impacted the windshield (**Figure 13**), however, no injury resulted from this contact. The driver rebounded back into her seat and remained in her seat as the case vehicle rotated counterclockwise and came to final rest. The driver was able to exit the vehicle under her power following the crash.

CASE VEHICLE DRIVER INJURIES

The case vehicle's driver was transported by private conveyance to the hospital. She sustained moderate injuries and was treated and released. The driver reported she received follow-up treatment for her injuries and, as of her interview date, had not yet returned to work. The table below shows the driver's injuries and injury contact mechanisms.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Strain neck, not further specified	minor 640278.1,6	Air bag, driver's	Probable	Emergency room records

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
2	Burn, 12.7 x 5.1 cm (5 x 2 in), on top of right hand, not further specified	minor 792002.1,1	Noncontact mechanism: air bag exhaust gases	Possible	Interviewee (same person)
3	Sprain right ankle, not further specified	minor 850206.1,1	Foot controls in toepan	Probable	Emergency room records

CASE VEHICLE BACK LEFT PASSENGER KINEMATICS

Immediately prior to the crash, the case vehicle's back left passenger [22-year-old, Black (non-Hispanic) female, 165 centimeters and 45 kilograms (65 inches and 100 pounds)] was seated in an upright position. Her feet were on the floor and the position of her hands and arms is not known. Her seat track and seat back were not adjustable.

The back left passenger was not restrained by her manual, three-point, lap-and-shoulder, safety belt system. Inspection of her seat belt webbing, "D"-ring, and latch plate revealed that the safety belt had been used very little, and had not been recently used.

As a result of the case vehicle driver's left steer and braking avoidance maneuvers and the non-use of her safety belt, the back left passenger most likely moved slightly left and forward prior to the impact. As a result of the impact, the passenger continued forward and moved slightly rightward along a path opposite the case vehicle's 10 degree direction of principal force as the case vehicle decelerated, and she impacted the back of the driver's seat causing a bruise on her forehead. The back left passenger most likely rebounded back into her seat and remained on the seat as the case vehicle rotated counterclockwise and came to final rest. The back left passenger was able to exit the vehicle under her power following the crash.

CASE VEHICLE BACK LEFT PASSENGER INJURIES

The back left passenger was transported by private conveyance to the hospital and was treated and released. The driver reported that this passenger received follow-up treatment for her injuries and, as of driver interview date, had not yet returned to work. The table below shows the back left passenger's injuries and injury contact mechanisms.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusion mid-forehead	minor 290402.1,7	Seat back, driver's	Certain	Emergency room records

Immediately prior to the crash, the case vehicle's back center passenger [2-year-old, Black (non-Hispanic) female; 81 centimeters and 10 kilograms (32 inches and 23 pounds)] was seated in an upright position, her feet were on the seat, and the position of her hands and arms is not known. Her seat track and seat back were not adjustable.

The back center passenger was not restrained by the two-point lap belt or a child safety seat. Inspection of her seat belt webbing, "D"-ring, and latch plate revealed that the safety belt had been used very little, and had not been recently used. In addition, the police crash report indicated this passenger was not restrained and was found on the floor in the front right passenger area following the crash.

As a result of the case vehicle driver's left steer and braking avoidance maneuvers and the non-use of her safety belt, the back center passenger most likely moved slightly left and forward prior to the impact and may have moved off her seat and into the front seat center console. As a result of the impact, the passenger continued forward and moved slightly rightward along a path opposite the case vehicle's 10 degree direction of principal force as the case vehicle decelerated, and she was projected between the front seat backs and impacted her left lower leg on the front seat center console and her face on the center instrument panel bruising her lower left leg and abrading her lower lip. The back center passenger landed on the floor in the front right passenger area. She was removed from the floor by the back left passenger following the crash.

CASE VEHICLE BACK CENTER PASSENGER INJURIES

The back center passenger was transported by private conveyance to the hospital and was treated and released. The table below shows the back center passenger's injuries and injury contact mechanisms.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Abrasion, small, lower lip with swelling	minor 290202.1,8	Center instrument panel	Probable	Emergency room records
2	Contusion {bruise} left lower leg near ankle	minor 890402.1,2	Front seat center console	Probable	Interviewee (driver)

OTHER VEHICLE

The 1995 Ford F-150 was a rear wheel drive, two-door pickup truck (VIN: 1FTCF15Y5SN------) equipped with a 4.9L, six cylinder engine and a manual transmission. The Ford was not equipped with air bags.

Exterior Damage: The Ford's impact with the case vehicle involved the left rear portion of the truck bed and the left corner of the back bumper (**Figure 14**). The direct damage began at the left corner of the back bumper and extended 85 centimeters along the left side of the truck bed and fender. Crush values could not be obtained because the left side of the truck bed and the fender were made of fiberglass. The fiberglass in the contact area had fractured and broken away from the vehicle as a result of the crash.

The Ford's recommended tire size was: P235/75R15. The Ford was equipped with tires of this size on the front end; however, the rear tires were size 33x12.50-15LT. The case vehicle's tire data are shown in the table below.

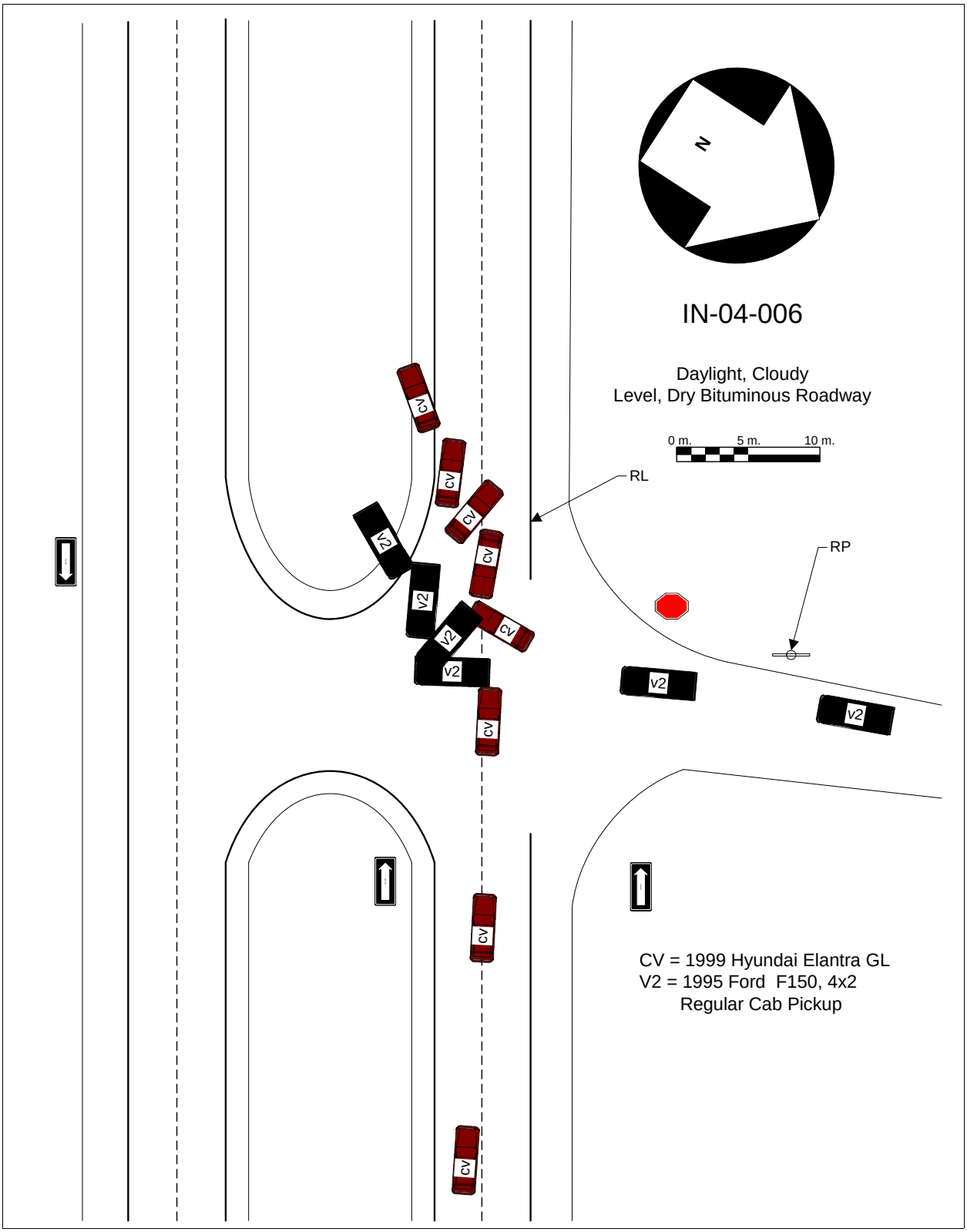
Tire	*Measured Pressure*		*Recommend Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kpa	psi	kpa	psi	milli-meters	32nd of an inch			
LF	159	23	228	33	2	2	None	No	No
RF	228	33	228	33	1	1	None	No	No
LR	76	11	283	41	1	1	None	No	No
RR	131	19	283	41	4	5	None	No	No

Exterior Damage: Based on the vehicle inspection, the CDC for the Ford was determined to be: **09-LBEW-3** (**280** degrees). The Ford was towed due to damage.

The WinSMASH reconstruction program, could not be used to determine the Ford's Delta V because of the underride nature of the crash, and the Ford's damaged area was made of fiberglass and an appropriate stiffness category could not be assigned. Based on the damage to both vehicles the Ford's Delta V was estimated to be minor [2-13 km.p.h. (1-8 m.p.h.).

Ford's Occupants: According to the Police Crash Report, the Ford's driver [46-year-old, White (non-Hispanic) male] was restrained by his manual, three-point, lap-and-shoulder, safety belt system. The driver was transported by ambulance to the hospital with unknown injuries.

Figure 14: Overview of damage to left rear side of Ford from impact with the case vehicle


N
IN-04-006
Daylight, Cloudy
Level, Dry Bituminous Roadway
0 m.
5 m.
10 m.
RL
RP
CV = 1999 Hyundai Elantra GL
V2 = 1995 Ford F150, 4x2
Regular Cab Pickup