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ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE INVESTIGATION

CASE NUMBER - IN-03-036
LOCATION - TEXAS
VEHICLE - 2003 CHEVROLET TAHOE
CRASH DATE - June 2003

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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On-site air bag deployment investigation involving a 2003 Chevrolet Tahoe, four-door sport utility vehicle, with manual safety belts and dual front advanced air bags, a 2000 Hyundai Elantra GLS, and a 1994 Ford F150 pickup

16. *Abstract*
This report covers an on-site investigation of an air bag deployment crash that involved a 2003 Chevrolet Tahoe (case vehicle), a 2000 Hyundai Elantra (1st other vehicle), and a 1994 Ford F150 pickup truck (2nd other vehicle). This crash is of special interest because the case vehicle was equipped with multiple Advance Occupant Protection System (**AOPS**) features, including advanced 208-compliant air bags, as well as an Event Data Recorder (**EDR**) and the case vehicle's driver (46-year-old, male) sustained only minor soft tissue injuries as a result of the crash. The trafficway on which all three vehicles were traveling was a four-lane, undivided, state roadway, traversing in a east-northeasterly and west-southwesterly direction, and all three vehicles were approaching a four-leg intersection. On both the eastern and western legs of the intersection, the undivided roadway had two through lanes in both the eastern and western directions. The case vehicle was traveling west-southwest in the outside lane. The Hyundai had been traveling east-northeast in the inside through lane and attempted to make a left-hand turn onto the northern leg of the intersecting roadway. The Ford was also traveling west-southwest in the outside lane and was following the case vehicle. The crash occurred in the outside southwesterly lane, within the four-leg intersection of the two roadways. The front left corner of the case vehicle impacted the front of the Hyundai, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. After the initial impact, the case vehicle and the Hyundai side slapped. Next, the case vehicle continued forward and rightward, and traveled onto the right roadside. The case vehicle rolled over, coming to rest on its right side heading southwestward. The Ford veered sharply to the right and avoided contacting both vehicles, but its right outsides rearview mirror contacted a fixed object. The case vehicle's driver was seated with his seat track located between its middle and rearmost positions, and the tilt steering wheel was located in its center position. He was restrained by his available, active, three-point, integral lap-and-shoulder, safety belt system and sustained, according to his interview and his medical records, a minor laceration over his right posterolateral scalp; contusions on the left side of his neck, across his abdomen, and to his right knee; and a strained right lower leg muscle. The front right passenger (29-year-old, male) was seated, asleep, lying fully reclined, with his seat track located between its middle and rearmost positions and was not using his available, active, three-point, integral lap-and-shoulder, safety belt system. He sustained, according to the interview with the case vehicle's driver and his medical records, a minor contusion below his right eye and abrasions and contusions to both knees.

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This on-site investigation was brought to NHTSA's attention on August 7, 2003 by Nationwide Insurance Company. This crash involved a 2003 Chevrolet Tahoe (case vehicle), a 2000 Hyundai Elantra (1st other vehicle), and a 1994 Ford F150 pickup truck (2nd other vehicle). The crash occurred in June 2003, at 1:31 p.m., in Texas and was investigated by the applicable county sheriff department. This crash is of special interest because the case vehicle was equipped with multiple **A**dvance **O**ccupant **P**rotection **S**ystem (AOPS) features, including advanced 208-compliant air bags, as well as an **E**vent **D**ata **R**ecorder (EDR) and the case vehicle's driver [46-year-old, White (non-Hispanic) male] sustained only minor soft tissue injuries as a result of the crash. This contractor inspected the scene and vehicles on August 15, 2003 and downloaded the data from the EDR technology. This contractor interviewed the driver for the case vehicle on August 26, 2003. This report is based on the Police Crash Report, an interview with the case vehicle's driver, scene and vehicle inspections, occupant kinematic principles, occupant medical records, and this contractor's evaluation of the evidence.

SUMMARY

Crash Environment: The trafficway on which all three vehicles were traveling was a four-lane, undivided, state roadway, traversing in a east-northeasterly and west-southwesterly direction, and all three vehicles were approaching a four-leg intersection. On both the eastern and western legs of the intersection, the undivided roadway had two through lanes in both the east-northeasterly and west-southwesterly directions. At the time of the crash the light condition was daylight, the atmospheric condition was cloudy, and the roadway pavement was dry. Traffic density was not determined, and the site of the crash was rural and a combination of commercial and undeveloped; see **CRASH DIAGRAM** at end.

Pre-Crash: The case vehicle was traveling west-southwest in the outside lane and was approaching a four-leg intersection, intending to proceed straight ahead. The Hyundai had been traveling east-northeast in the inside through lane and attempted to make a left-hand turn onto the northern leg of the intersecting roadway. The Ford was also traveling west-southwest in the outside lane and was following the case vehicle. Based on the interview with the case vehicle's driver and the **EDR** data, the driver steered slightly to the right, attempting to avoid the crash. The crash occurred in the outside southwesterly lane, within the four-leg intersection of the two roadways.

Crash: The front left corner of the case vehicle impacted the front of the Hyundai, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. Based on the downloaded **EDR** data, only one stage of the multi-stage air bags was activated. The case vehicle was not equipped with a cutoff switch for the front right passenger supplemental restraint (air bag).

Post-Crash: After the initial impact, the case vehicle sustained a minor side slap impact to its left back as it continued forward, while being redirected rightward, and traveled off the right edge of the road. In addition, the case vehicle most likely rotated counterclockwise as it traveled westward onto the northern roadside. When the case vehicle encountered the soft dirt of the northern

roadside's surface, it began to roll onto its right side. In this contractor's opinion, the case vehicle had most likely rolled between one and two quarter turns to its right when the case vehicle encountered an earthen embankment which caused the case vehicle to roll back to its left where it came to rest on its right side heading southwestward. The Hyundai was most likely redirected southwestward and rotated counterclockwise as a result of its impact with the case vehicle. The Hyundai most likely came to rest on the roadway, but its exact location and heading angle are unknown. According to the Police Crash Report, the driver of the Ford steered sharply to the right and avoided contacting both the case vehicle and the Hyundai, but as a result of his steering maneuver, the right outside rearview mirror of the Ford contacted a STOP sign on the western corner of the intersection. The final rest position of the Ford is unknown.

Case Vehicle: The 2003 Chevrolet C1500 Tahoe was a rear wheel drive (4x2), four-door, large sport utility vehicle (VIN: 1GNEC13Z53R------) and was **CERTIFIED ADVANCED 208-COMPLIANT**. The case vehicle was equipped with dual stage driver and front right passenger air bags as well as a front right passenger sensing system, driver and front right passenger seat back-mounted side impact air bags, LATCH system features, and four wheel, anti-lock brakes. Although power-adjustable pedals were an option, the case vehicle was not so equipped. In addition, the case vehicle was also equipped with an **E**vent **D**ata **R**ecorder (EDR).

Vehicle Exterior: The case vehicle's initial contact with the Hyundai involved the front with the damage distributed on approximately the left half. Direct damage began at the front left bumper corner and extended 77 centimeters (30.3 inches) inward along the front bumper. Residual maximum crush was measured as 54 centimeters (21.2 inches) at C_1. The wheelbase on the case vehicle's left side was shortened 35 centimeters (13.8 inches) while the right side was extended 3 centimeters (1.2inches). The case vehicle's front bumper, bumper fascia, grille, hood, radiator, left headlight and turn signal assemblies, left fender, and left front wheel assembly were directly damaged and crushed rearward. As the Hyundai wrapped around the case vehicle's left front side, the left fender and left front door were crushed inward as well. The side slap impact resulted in minor direct damage to the left quarter panel. As a result of the rollover, there was direct damage to the right fender, right front door, right quarter panel, right "A"-pillar, and right roof side rail. The right "A"-pillar, in particular, was crushed both vertically downward and laterally inward. There was induced damage to the right headlight and turn signal assemblies, the left front and rear doors, the hood, roof, and right rear door. The windshield was holed and the left and right front and second left and right back windows were disintegrated.

The vehicle manufacturer's recommended tire size was: P265/70R16, and the case vehicle tires were the recommended size. The case vehicle's tire data are shown in the table below. In addition, the case vehicle's left front tire was damaged, deflated, and physically restricted.

Tire	*Measured Pressure*		*Recommend Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kPa	psi	kPa	psi	milli-meters	32nd of an inch			
LF	0	0	241	35	8	10	Rim separation	Yes	Yes

Tire	*Measured Pressure*		*Recommend Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kPa	psi	kPa	psi	milli-meters	32nd of an inch			
RF	241	35	241	35	9	11	None	No	No
LR	241	35	241	35	8	10	None	No	No
RR	234	34	241	35	8	10	None	No	No

Exterior Damage: Based on the vehicle inspection, the CDCs for the case vehicle were determined to be: **11-FYEW-3** (**340** degrees), **09-LBMW-1** (**270** degrees), and **00-RDA0-2.** The WinSMASH reconstruction program, missing vehicle algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 18.0 km.p.h. (11.2 m.p.h.), -16.9 km.p.h. (-10.5 m.p.h.), and +6.2 km.p.h. (+3.9 m.p.h.). In light of the **EDR** results (presented below), this reconstruction is borderline and the results appear low. The case vehicle was towed due to damage.

Vehicle Interior: Inspection of the case vehicle's interior revealed a scuff on the left side of the driver's knee bolster, near the driver's door and a major blood stain/smear starting from the driver's visor and continuing along the ceiling toward the right roof side rail. In addition, there was blood on the kernels of the case vehicle's collapsed windshield glazing.

Supplemental Restraints: The case vehicle's driver air bag was located in the steering wheel hub. An inspection of the air bag module's cover flaps and the air bag's fabric revealed that the cover flaps opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flaps. The driver's air bag was designed with two tethers, each approximately 15 centimeters (5.9 inches) in width. The driver's air bag had two vent ports, approximately 3.5 centimeters (1.4 inches) in diameter, located at the 10:30 and 1:30 clock positions. The deployed driver's air bag was round with a diameter of 61 centimeters (24.0 inches). An inspection of the driver's air bag fabric revealed minor circumferential blood stains scattered on the front surface of the air bag's fabric.

The front right passenger's air bag was located in the middle of the instrument panel. An inspection of the front right air bag module's cover flap and the air bag's fabric revealed that the cover flap opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flaps. The front right passenger's air bag was designed with one tether, approximately 34 centimeters (13.4 inches) in width. The front right air bag had two vent ports, approximately 3.5 centimeters (1.4 inches) in diameter, located at the 9:30 and 2:30 clock positions. The deployed front right air bag was nearly square with a height of approximately 48 centimeters (18.9 inches) and a width of approximately 49 centimeters (19.3 inches). An inspection of the front right passenger's air bag fabric revealed two minor blood stains in the left lower quadrant of the front surface of the air bag's fabric.

The case vehicle's front seat back-mounted side impact air bags did not deploy as a result of this crash.

Crash Data Recording: The data downloaded from the case vehicle's **EDR** showed the vehicle's SIR warning lamp status, driver's seat belt buckle status, brake switch status for the five recorded sample periods preceding the **ALGORITHM ENABLE**, ignition cycles at deployment, time from algorithm enable to deployment (i.e., air bag deployments) for both of the system's first and second stages, and velocity change (i.e., Delta V). Downloaded data of interest indicated the following. The case vehicle was traveling at a speed of 105 km.p.h. (65 m.p.h.), the driver's seat belt status showed it was buckled, the second stage of the multi-stage air bags was not activated, and the Delta V reached a value of 29.43 km.p.h. (18.29 m.p.h.) at the 110 millisecond mark of recorded data; see **EVENT DATA RECORDER DATA** below. This contractor believes that the recorded Delta V seems reasonable considering the amount of deformation to the case vehicle's front.

1st Other Vehicle: The 2000 Hyundai Elantra GLS was a front wheel drive, four-door sedan (VIN: KMHJF35F4YU------). The Hyundai was equipped with redesigned driver and front right passenger air bags that deployed as a result this vehicle's impact.

Exterior Damage: With no available vehicle photographs, the CDCs for the Hyundai are not estimable. The WinSMASH reconstruction program, missing vehicle algorithm, was used on the Hyundai's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 35.0 km.p.h. (21.7 m.p.h.), -22.5 km.p.h. (-14.0 m.p.h.), and -26.8 km.p.h. (-16.7 m.p.h.). The Hyundai was towed due to damage.

2nd Other Vehicle: The 1994 Ford F150 was a rear wheel drive (4x2), two-door, super cab pickup truck (VIN: 1FTEX15Y6RK------). The Ford pickup was equipped with driver only air bag that did not deploy as a result this vehicle's impact.

Exterior Damage: With no available vehicle photographs, the CDC for the Ford is not estimable. According to the Police Crash Report, the Ford did not contact either the case vehicle or the Hyundai and sustained only a minor scrape to its right outside rearview mirror that occurred during its evasive maneuver. The Ford was driven from the scene.

Case Vehicle's Driver: Immediately prior to the crash the case vehicle's driver [46-year-old, White (non-Hispanic) male; 173 centimeters and 113 kilograms (68 inches, 250 pounds)] was seated in a reclined posture with his back against the seat back, and both of his feet on the floor. It should be noted that during the interview, the driver stated he had disengaged the cruise control prior to the intersection and braked. This is unlikely because the data from the **EDR** download shows a steady speed and no braking prior to impact. Therefore, in this contractor's opinion, the driver's right foot was either on the floor, or the driver was moving his right foot toward the brake pedal just prior to the impact. The driver was unsure but thought that both of his hands were on the steering wheel at the time of the crash. His seat track was located between its middle and rearmost positions, the seat back was slightly reclined, and the tilt steering wheel was located in its center position.

The case vehicle's driver was restrained by his available, active, three-point, integral lap-and-shoulder, safety belt system; the belt system was not equipped with a pretensioner. Furthermore, there was reported belt pattern bruising to the driver's left neck area, and the inspection of the driver's seat belt webbing and latch plate showed blood stains on the shoulder portion of his safety belt providing strong indications of usage.

The case vehicle's driver may have steered slightly to the right just prior to the crash. As a result of this attempted avoidance maneuver and the use of his available safety belts, the driver may have moved slightly to his left just prior to impact. The case vehicle's primary impact with the Hyundai enabled the case vehicle's driver to continue forward, leftward, and slightly upward along a path opposite the case vehicle's **340** degree Direction of Principal Force as the case vehicle decelerated. As a result of the initial impact, the driver loaded his safety belts and contacted his deploying driver air bag. Furthermore, as the case vehicle was redirected to its right and began to rotate counterclockwise from the initial impact, the driver rebounded from the combination of his safety belts and deploying air bag backward toward the center of his seat back. The side slap impact had little or negligible effect on the driver's kinematics. The case vehicle continued to rotate counterclockwise as it traveled westward onto the northern roadside, where it began to roll onto its right side. The driver's upper body moved to the right and most likely slipped out from underneath his shoulder belt while the hips and lower body remained restrained by the lap belt. There is no clear evidence of any contact by the driver during the rollover sequence; although, the driver's upper extremities may well have come in contact with the driver's sun visor, roof, and/or the front right passenger. The exact posture of the case vehicle's driver at final rest is unknown, but he was most likely held in the driver's seat by his lap belt with his extremities toward the right side of the vehicle which was against the ground. At some point during the collision, the driver sustained a significant laceration to the right side of his scalp. According to the driver, he unbuckled his safety belts, moved toward the front right seating position, and extricated himself from the vehicle without assistance. It is most likely that the driver's hands/arms came in contact with his scalp wound and, that during the extrication process, the significant blood evidence on the case vehicle's interior was most likely deposited as a result of his extrication efforts.

The driver was transported by ambulance to the hospital. He sustained minor injuries and was treated and released. According to his interview and his medical records, the injuries sustained by the case vehicle's driver included: a laceration over his right posterolateral scalp; contusions on the left side of his neck, across his abdomen, and to his right knee; and a strained right lower leg muscle. It is most likely that the driver's head laceration was caused when the driver contacted the center instrument panel. The neck and abdominal contusions was a direct result of the shoulder and lap portions of his safety belt system, respectively.

Case Vehicle's Front Right Passenger: The case vehicle's front right passenger [29-year-old, White (non-Hispanic) male; 175 centimeters and 75 kilograms (59 inches, 165 pounds)] was seated, asleep, lying in a fully reclined posture with his back against the seat back and his feet on the floor; however, the exact position of his hands is unknown. His seat track was located between its middle and rearmost positions, and the seat back was fully reclined.

The case vehicle's front right passenger was not using his available, active, three-point, integral lap-and-shoulder, safety belt system; the belt system was not equipped with a pretensioner. Furthermore, there was no mention by the driver of any belt pattern bruising and/or abrasions to the front right passenger's body, and the inspection of the front right passenger's seat belt webbing and latch plate showed no evidence of loading.

The front right passenger was transported by ambulance to the hospital. He sustained minor injuries and was treated and released. According to the interview with the case vehicle's driver and his medical records, the front right passenger sustained a minor contusion below his right eye and abrasions and contusions to both knees from contacting the glove compartment door.

Hyundai's Occupants: According to the Police Crash Report, the Hyundai's driver [85-year-old, White (non-Hispanic) male] and front right passenger [81-year-old, White (non-Hispanic) female] were restrained by their available, active, three-point, lap-and-shoulder, safety belt system. Both the driver and front right passenger were transported by ambulance to the hospital. The driver sustained police-reported "C" (possible) injuries as a result of this crash. The front right passenger indicated that she was injured, but no injury assessment for the front right passenger was included on the Police Crash Report.

Ford's Occupants: According to the Police Crash Report, the Ford's driver [22-year-old, White (Hispanic) male] was restrained by his available, active, three-point, lap-and-shoulder, safety belt system. The driver was not transported by ambulance to the hospital, and he did not sustain any injuries as a result of this crash.

Figure 1: Case vehicle's west-southwesterly travel path in outside lane approaching four-leg intersection where impact occurred (case photo #01)

Figure 2: Hyundai's east-northeasterly path of travel in inside northeastern lane approaching four-leg intersection (case photo #05)

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which all three vehicles were traveling was a four-lane, undivided, state roadway, traversing in a east-northeasterly (**Figure 1**) and west-southwesterly direction (**Figure 2**), and all three vehicles were approaching a four-leg intersection. On both the eastern and western legs of the intersection, the undivided roadway had two through lanes in both the east-northeasterly and west-southwesterly directions. The state highway was straight and level [i.e., actual slope was 0.8%, positive to the west-southwest (an upgrade in the case vehicle's direction of travel–**Figure 1**) and 0.8%, negative to the east-northeast for the Hyundai and the Ford pickup–**Figure 2**] at the area of impact. The

pavement was bituminous but traveled and polished, and the width of the outside western through lane was 3.3 meters (10.8 feet) while the width of the inside eastern lane was 3.4 meters (11.2 feet). The shoulders were minimally improved (i.e., bituminous), with an estimated 0.3 meter (1 foot) wide paved shoulder followed by a gravel and then grassy area adjacent to roadway on both the northern and southern sides of the road (**Figures 1** and **2** above). The roadway was not bordered by curbs. Pavement markings consisted of a double solid yellow centerline for both the eastern and western travel directions, and the lanes were divided by dashed white lines. In addition, solid white edge lines were present. The estimated coefficient of friction was 0.60 for the case vehicle's direction of travel and 0.70 for the east-northeasterly direction, traveled by Hyundai and the Ford pickup. Traffic controls consisted of three flashing yellow/red traffic control signal lights located overhead and positioned approximately at the double solid yellow center lines and over each of the dash white lane lines. The statutory speed limit was 113 km.p.h. (70 m.p.h.). No regulatory speed limit sign was posted near the crash site. At the time of the crash the light condition was daylight, the atmospheric condition was cloudy, and the roadway pavement was dry. Traffic density was not determined, and the site of the crash was rural and a combination of commercial and undeveloped; see **CRASH DIAGRAM** at end.

Figure 3: Hyundai's northern travel path from inside northeastern lane across west-southwestern lanes toward northwesterly leg of intersection; Note: arrow indicates approximate point of impact (case photo #06)

Pre-Crash: The case vehicle was traveling west-southwest in the outside lane and was approaching a four-leg intersection, intending to proceed straight ahead. The Hyundai had been traveling east-northeast in the inside through lane and attempted to make a left-hand turn onto the northern leg of the intersecting roadway (**Figure 3**). The Ford was also traveling west-southwest in the outside lane and was following the case vehicle. Based on the interview with the case vehicle's driver and the **EDR** data, the driver steered slightly to the right, attempting to avoid the crash. The crash occurred in the outside southwesterly lane, within the four-leg intersection of the two roadways.

Figure 4: Case vehicle's frontal damage viewed at bumper level with contour gauge present (case photo #09)

Crash: The front left corner (**Figure 4** and **Figure 5** below) of the case vehicle impacted the front of the Hyundai, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. Based on the downloaded **EDR** data, only one stage of the multi-stage air bags was activated. The case vehicle was not equipped with a cutoff switch for the front right passenger supplemental restraint (air bag).

Figure 5: Case vehicle's front and rollover damage viewed from left of front; Note: contour gauge present at bumper level and yellow tape (arrow) indicates end of direct damage area along bumper from impact with Hyundai (case photo #11)

Figure 6: Side slap damage to case vehicle's left quarter panel viewed from left of back; Note: disintegrated glazing (case photo #17)

Figure 7: Close-up of case vehicle's left quarter panel showing side slap damage approximately between gas tank filler cap and window sill; Note: disintegrated glazing (case photo #16)

Figure 8: Case vehicle's final rest area on northwest roadside (case photo #03)

Post-Crash: After the initial impact, the case vehicle sustained a minor side slap impact to its left back as it continued forward (**Figures 6** and **7**), while being redirected rightward, and traveled off the right edge of the road. In addition, the case vehicle most likely rotated counterclockwise as it traveled westward onto the northern roadside (**Figure 8**). When the case vehicle encountered the soft dirt of the northern roadside's surface, it began to roll onto its right side. In this contractor's opinion, the case vehicle had most likely rolled between one and two quarter turns to its right when the case vehicle encountered an earthen embankment which caused the case vehicle to roll back to its left where it came to rest on its right side heading southwestward (**Figure 9** below). The Hyundai was most likely redirected southwestward and rotated counterclockwise as a result of its impact with the case vehicle. The Hyundai most likely came to rest on the roadway, but its exact location and heading angle are unknown. According to the Police Crash Report, the driver of the Ford steered sharply to the right and avoided contacting both the case vehicle and the Hyundai, but as a result of his steering maneuver, the right outside rearview mirror of the Ford contacted a **STOP** sign on the western corner of the intersection. The final rest position of the Ford is unknown. Please note, the **STOP** sign allegedly contacted by the Ford can be

observed near a wooden street light pole (i.e., see **Figures 1** and **2** above, and **Figure 9**). In this contractor's opinion, the reported contact to the regulatory sign is unlikely, but a contact to the wooden utility pole cannot be ruled out.

Figure 9: Eastward view of case vehicle's off-road travel path from beyond final rest position (case photo #04)

CASE VEHICLE

The 2003 Chevrolet C1500 Tahoe was a rear wheel drive (4x2), five-passenger, four-door large sport utility vehicle (VIN: 1GNEC13Z53R------) equipped with a 5.3L, V-8 engine and a four-speed automatic transmission. Braking was achieved by a power-assisted, front and rear disc, four-wheel, anti-lock system. The case vehicle's wheelbase was 295 centimeters (116.0 inches), and the odometer reading at inspection is unknown because the case vehicle was equipped with an electronic odometer.

The case vehicle was **CERTIFIED ADVANCED 208-COMPLIANT** and was equipped with dual stage driver and front right passenger air bag inflators and driver and front right passenger seat belt buckle switch sensors. Furthermore, there was an occupant detection and automatic air bag suppression system for the front right passenger seating position. In addition, the case vehicle was equipped with front seat back-mounted side impact air bags. The various sensors in the case vehicle's advanced occupant restraint system analyze a combination of factors including the predicted crash severity and driver and front right passenger seat belt usage to determine the front air bag inflation level appropriate for the severity of the crash. For the front right seating position, an occupant pressure sensor and a seat belt tension sensor provide data to the electronic control module. The electronic control module (a) compares the seat pressure and seat belt tension data to threshold values, (b) determines if the front right air bag should be suppressed or enabled, and ©) communicates the decision to the air bag control module. The air bag will be suppressed when the seat pressure is at or below the established threshold ***or*** there is above normal tension on the safety belt (e.g., a secured child seat). The air bag will be enabled if the pressure is above the threshold ***and*** the seat belt tension is normal (e.g., a restrained adult occupant) or below (e.g., unrestrained occupant). The crash sensors in the side of the case vehicle analyze side impact forces and deploy the seat back-mounted side impact air bags to provide added protection to passengers seated along the side of the vehicle. The case vehicle was equipped with height adjustable head restraints for all outboard positions and LATCH system features. Although power-adjustable pedals were an option, the case vehicle was not so equipped. Finally, the case vehicle was also equipped with an **E**vent **D**ata **R**ecorder (**EDR**).

Inspection of the vehicle's interior revealed adjustable front bucket seats with adjustable head restraints; a non-adjustable split back bench seat with folding backs and adjustable head restraints for the back outboard seating positions and an integral head restraint for the back center seating position; and continuous loop, three-point, lap-and-shoulder, safety belt systems at all five front and back positions. The front seat belt systems were integral and thus there were no manually

operated, upper anchorage adjusters. The vehicle was equipped with knee bolsters for both the driver and front right passenger. There was a scuff on the driver's knee bolster to the left of the steering column. The front right knee bolster did not show any evidence of occupant contact or deformation. Automatic restraint was provided by a Supplemental Restraint System (SRS) that consisted of a frontal air bag for the driver and front right passenger seating positions. In addition, the vehicle was equipped with front, seat back-mounted, side impact air bags. Both frontal air bags deployed as a result of the case vehicle's frontal impact with the Hyundai. The case vehicle's seat back-mounted side impact air bags did not deploy in this crash.

Figure 10: Elevated reference line view from left of case vehicle's front bumper damage with contour gauge present at bumper level; Note: yellow tape (arrow) indicates length of direct damage along bumper and deformation to left front wheel assembly (case photo #12)

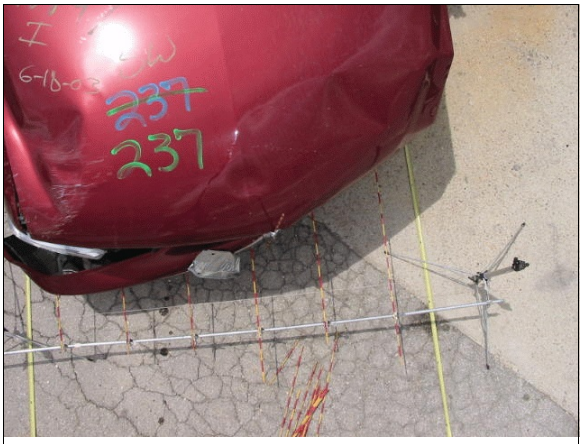


Figure 11: Overhead view of case vehicle's frontal damage with contour gauge set at bumper level (case photo #27)

CASE VEHICLE DAMAGE

Exterior Damage: The case vehicle's initial contact with the Hyundai involved the front with the damage distributed on approximately the left half. Direct damage began at the front left bumper corner and extended 77 centimeters (30.3 inches) inward along the front bumper (**Figure 10**). Residual maximum crush was measured as 54 centimeters (21.2 inches) at C_1 (**Figure 11**). The table below shows the case vehicle's crush profile.

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	77	54	180	54	20	13	1	0	0	-37	0
in		30.3	21.3	70.9	21.3	7.9	5.1	0.4	0.0	0.0	-14.6	0.0

The wheelbase on the case vehicle's left side was shortened 35 centimeters (13.8 inches) while the right side was extended 3 centimeters (1.2inches). The case vehicle's front bumper, bumper fascia, grille, hood, radiator, left headlight and turn signal assemblies, left fender, and left front wheel assembly were directly damaged and crushed rearward (**Figures 4** and **5** above and **Figure 10**). As the Hyundai wrapped around the case vehicle's left front side, the left fender and

left front door were crushed inward as well (**Figure 12**). The side slap impact resulted in minor direct damage to the left quarter panel (**Figures 6** and **7** above). As a result of the rollover, there was direct damage to the right fender, right front door, right quarter panel, right "A"-pillar, and right roof side rail (**Figure 13**). The right "A"-pillar, in particular, was crushed both vertically downward and laterally inward. There was induced damage to the right headlight and turn signal assemblies, the left front and rear doors, the hood, roof, and right rear door. The windshield was holed and the left and right front and second left and right back windows were disintegrated.

Figure 12: Inward crush to case vehicle's left fender and left front door which occurred when Hyundai wrapped around during initial impact; Note: driver's integrated, lap-and-shoulder safety belt system (case photo #15)

Figure 13: Elevated view from right of front showing case vehicle's right side and top rollover damage (case photo #25)

The vehicle manufacturer's recommended tire size was: P265/70R16, and the case vehicle tires were the recommended size. The case vehicle's tire data are shown in the table below. In addition, the case vehicle's left front tire was damaged, deflated, and physically restricted.

Tire	*Measured Pressure*		*Recommend Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kPa	psi	kPa	psi	milli-meters	32nd of an inch			
LF	0	0	241	35	8	10	Rim separation	Yes	Yes
RF	241	35	241	35	9	11	None	No	No
LR	241	35	241	35	8	10	None	No	No
RR	234	34	241	35	8	10	None	No	No

Figure 14: Case vehicle's driver seating area showing deployed driver air bag, collapsed windshield's glazing, and blood splatter on driver's sun visor and across roof (case photo #31)

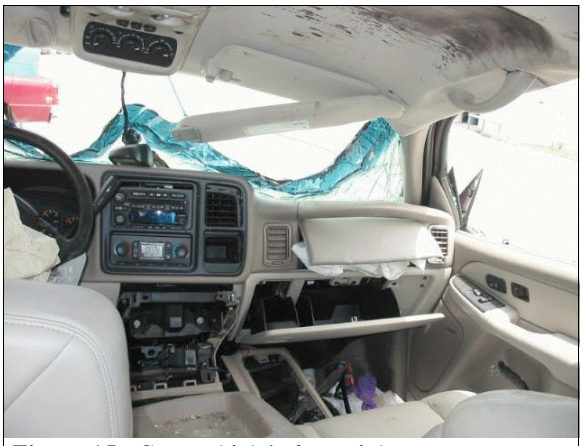


Figure 15: Case vehicle's front right passenger seating area showing deployed front right passenger air bag, distorted front right sun visor, opened glove box door, and blood splatter across roof (case photo #33)

Figure 16: Scuff on left side of case vehicle's driver knee bolster near interior surface of driver's door (case photo #46)

Figure 17: Blood stained on underneath surface of case vehicle's driver sun visor (case photo #48)

Interior Damage: Inspection of the case vehicle's interior (**Figures 14** and **15**) revealed a scuff on the left side of the driver's knee bolster, near the driver's door (**Figure 16**) and a major blood stain/smear starting from the driver's visor (**Figure 17**) and continuing along the ceiling toward the right roof side rail (**Figure 18**). In addition, there was blood on the kernels of the case vehicle's collapsed windshield glazing (**Figure 19** below).

Damage Classification: Based on the vehicle inspection, the CDCs for the case vehicle were determined to be: **11-FYEW-3** (**340** degrees), **09-LBMW-1** (**270** degrees), and **00-RDA0-2.** The

Figure 18: Blood splatter and significant area of blood stain transversely oriented across case vehicle's ceiling; Note: stain primarily over front right seating position (case photo #28a)

WinSMASH reconstruction program, missing vehicle algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 18.0 km.p.h. (11.2 m.p.h.), -16.9 km.p.h. (-10.5 m.p.h.), and +6.2 km.p.h. (+3.9 m.p.h.). In light of the **EDR** results (presented below), this reconstruction is borderline and the results appear low. The case vehicle was towed due to damage.

Figure 19: Case vehicle's collapsed windshield glazing showing (yellow tape) blood stains on glazing (case photo #49)

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with a Supplemental Restraint System (SRS) that contained dual stage frontal air bags at the driver and front right passenger positions. In addition, the vehicle was equipped with front, seat back-mounted, side impact air bags. Both frontal air bags deployed as a result of the frontal impact with the Hyundai (**Figures 14** and **15** above). Based on the downloaded **EDR** data, only one stage of the multi-stage air bags was activated. The case vehicle's front seat back-mounted side impact air bags did not deploy as a result of this crash (**Figure 20**). The case vehicle's driver air bag was located in the steering wheel hub. The module cover consisted of symmetrical, essentially mirror-imaged, "I"-configuration cover flaps made of a medium thickness vinyl. Both the left and right flaps were trapezoidal in shape with overall dimensions of 15 centimeters (5.9 inches) at the top horizontal seam, 10 centimeters (3.9 inches) at the bottom horizontal seam, and 12 centimeters (4.7 inches) vertically along the seam that separated the two flaps. An inspection of the air bag module's cover flaps and the air bag's fabric revealed that the cover flaps opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flaps. The driver's air bag was designed with two tethers, each approximately 15 centimeters (5.9 inches) in width. The driver's air bag had two vent ports, approximately 3.5 centimeters (1.4 inches) in diameter, located at the 10:30 and 1:30 clock positions. The deployed

Figure 20: Latch plate for case vehicle's driver safety belt and location of driver's non-deployed seat back-mounted side impact air bag (case photo #45)

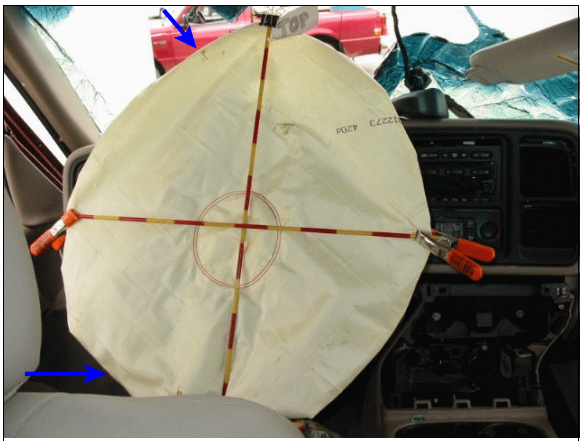


Figure 21: Case vehicle's deployed driver air bag showing blood spots scattered around the right perimeter of the bag's front surface between the 11 and 7 o'clock positions (case photo #37)

driver's air bag was round with a diameter of 61 centimeters (24.0 inches). The distance between the mid-center of the driver's seat back, as positioned at the time of the vehicle inspection, and the front surface of the air bag's fabric at full excursion was 32 centimeters (12.6 inches). An inspection of the driver's air bag fabric revealed minor circumferential blood stains scattered on the front surface of the air bag's fabric (**Figure 21** above).

The front right passenger's air bag was located in the middle of the instrument panel. There was a single, essentially rectangular, modular cover flap. The cover flap was made of a thick semi-pliable vinyl, thicker than the vinyl on the driver's module. The flap's dimensions were 39 centimeters (15.4 inches) at the lower horizontal seam and 14.5 centimeters (5.7 inches) along both vertical seams. The profile of the case vehicle's instrument panel was flush with the leading edge of the cover flap. An inspection of the front right air bag module's cover flap and the air bag's fabric revealed that the cover flap opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flaps. The front right passenger's air bag was designed with one tether, approximately 34 centimeters (13.4 inches) in width. The front right air bag had two vent ports, approximately 3.5 centimeters (1.4 inches) in diameter, located at the 9:30 and 2:30 clock positions. The deployed front right air bag was nearly square with a height of approximately 48 centimeters (18.9 inches) and a width of approximately 49 centimeters (19.3 inches). The distance between the mid-center of the front right seat back, as positioned at the time of the vehicle inspection–seat was reclined, and the front surface of the air bag's fabric at full excursion was 52 centimeters (20.5 inches). An inspection of the front right passenger's air bag fabric revealed two minor blood stains in the left lower quadrant of the front surface of the air bag's fabric (**Figures 22** and **23**).

Figure 22: Case vehicle's deployed front right passenger air bag showing two blood spots (arrows) on left lower quadrant of bag's front surface (case photo #50)

Figure 23: Close-up of blood spot at 6 o'clock position on front surface of case vehicle's deployed front right passenger bag (case photo #51)

CRASH DATA RECORDING

Crash Data Recording: The data downloaded from the case vehicle's **EDR** showed the vehicle's SIR warning lamp status, driver's seat belt buckle status, brake switch status for the five recorded sample periods preceding the **ALGORITHM ENABLE**, ignition cycles at deployment, time from algorithm enable to deployment (i.e., air bag deployments) for both of the system's first and second stages, and velocity change (i.e., Delta V). Downloaded data of interest indicated the

following. The case vehicle was traveling at a speed of 105 km.p.h. (65 m.p.h.), the driver's seat belt status showed it was buckled, the second stage of the multi-stage air bags was not activated, and the Delta V reached a value of 29.43 km.p.h. (18.29 m.p.h.) at the 110 millisecond mark of recorded data; see **EVENT DATA RECORDER DATA** (**Figures 25** through **27**) below. This contractor believes that the recorded Delta V seems reasonable considering the amount of deformation to the case vehicle's front.

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash the case vehicle's driver [46-year-old, White (non-Hispanic) male; 173 centimeters and 113 kilograms (68 inches, 250 pounds)] was seated in a reclined posture with his back against the seat back, and both of his feet on the floor. It should be noted that during the interview, the driver stated he had disengaged the cruise control prior to the intersection and braked. This is unlikely because the data from the **EDR** download shows a steady speed and no braking prior to impact. Therefore, in this contractor's opinion, the driver's right foot was either on the floor, or the driver was moving his right foot toward the brake pedal just prior to the impact. The driver was unsure but thought that both of his hands were on the steering wheel at the time of the crash. His seat track was located between its middle and rearmost positions, the seat back was slightly reclined, and the tilt steering wheel was located in its center position.

Based on this contractor's vehicle inspection and supported by the EDR data, the case vehicle's driver was restrained by his available, active, three-point, integral lap-and-shoulder, safety belt system; the belt system was not equipped with a pretensioner. Furthermore, there was reported belt pattern bruising to the driver's left neck area, and the inspection of the driver's seat belt webbing and latch plate showed blood stains on the shoulder portion of his safety belt providing strong indications of usage (**Figure 24**).

Figure 24: Blood stains on shoulder portion of case vehicle's driver safety belt (case photo #43)

The case vehicle's driver may have steered slightly to the right just prior to the crash. As a result of this attempted avoidance maneuver and the use of his available safety belts, the driver may have moved slightly to his left just prior to impact. The case vehicle's primary impact with the Hyundai enabled the case vehicle's driver to continue forward, leftward, and slightly upward along a path opposite the case vehicle's **340** degree Direction of Principal Force as the case vehicle decelerated. As a result of the initial impact, the driver loaded his safety belts and contacted his deploying driver air bag. Furthermore, as the case vehicle was redirected to its right and began to rotate counterclockwise from the initial impact, the driver rebounded from the combination of his safety belts and deploying air bag backward toward the center of his seat back. The side slap impact had little or negligible effect on the driver's kinematics. The case vehicle continued to rotate counterclockwise as it traveled westward onto the northern roadside, where it began to roll onto its right side. The driver's upper body moved to the right and most likely slipped out from

underneath his shoulder belt while the hips and lower body remained restrained by the lap belt. There is no clear evidence of any contact by the driver during the rollover sequence; although, the driver's upper extremities may well have come in contact with the driver's sun visor, roof, and/or the front right passenger. The exact posture of the case vehicle's driver at final rest is unknown, but he was most likely held in the driver's seat by his lap belt with his extremities toward the right side of the vehicle which was against the ground. At some point during the collision, the driver sustained a significant laceration to the right side of his scalp. According to the driver, he unbuckled his safety belts, moved toward the front right seating position, and extricated himself from the vehicle without assistance. It is most likely that the driver's hands/arms came in contact with his scalp wound and, that during the extrication process, the significant blood evidence on the case vehicle's interior was most likely deposited as a result of his extrication efforts.

CASE VEHICLE DRIVER INJURIES

The driver was transported by ambulance to the hospital. He sustained minor injuries and was treated and released. According to his interview and his medical records, the injuries sustained by the case vehicle's driver included: a laceration over his right posterolateral scalp; contusions on the left side of his neck, across his abdomen, and to his right knee; and a strained right lower leg muscle. It is most likely that the driver's head laceration was caused when the driver contacted the center instrument panel. The neck and abdominal contusions was a direct result of the shoulder and lap portions of his safety belt system, respectively.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Laceration, 4 cm (1.6 in) right scalp[1], over posterolateral parietal bone	minor 190602.1,1	Center instrument panel and below	Possible	Emergency room records
2	Contusion {bruise}, 12.7 x 2.5 cm (5 x 1 in), left neck	minor 390402.1,2	Torso portion of safety belt system	Certain	Emergency room records
3	Contusion {seat belt sign} across lower abdomen	minor 590402.1,8	Lap portion of safety belt system	Probable	Emergency room records
4	Contusion, slight, right knee, not further specified	minor 890402.1,1	Knee bolster, driver's, right of steering column	Probable	Emergency room records
5	Strain {stretched} right lower leg muscle {Achilles tendon}	minor 840602.1,1	Floor, foot controls	Probable	Interviewee (same person)

[1] According to the interview with the case vehicle's driver this lesion was 7.6 cm (3 in) and it was situated below and rearward of right ear.

The case vehicle's front right passenger [29-year-old, White (non-Hispanic) male; 175 centimeters and 75 kilograms (59 inches, 165 pounds)] was seated, asleep, lying in a fully reclined posture with his back against the seat back and his feet on the floor; however, the exact position of his hands is unknown. His seat track was located between its middle and rearmost positions, and the seat back was fully reclined.

The case vehicle's front right passenger was not using his available, active, three-point, integral lap-and-shoulder, safety belt system; the belt system was not equipped with a pretensioner. Furthermore, there was no mention by the driver of any belt pattern bruising and/or abrasions to the front right passenger's body, and the inspection of the front right passenger's seat belt webbing and latch plate showed no evidence of loading.

The case vehicle's driver may have steered slightly to the right just prior to the crash. As a result of this attempted avoidance maneuver and the nonuse of his available safety belts, the reclined front right passenger may have moved slightly to his left just prior to impact. The case vehicle's primary impact with the Hyundai enabled the case vehicle's front right passenger to continue forward, leftward, and upward–especially his torso, along a path opposite the case vehicle's **340** degree Direction of Principal Force as the case vehicle decelerated. As a result of the initial impact, the front right passenger's knees loaded the glove compartment door and his torso contacted his deploying front right passenger air bag. Furthermore, as the case vehicle was redirected to its right and began to rotate counterclockwise from the initial impact, the front right passenger rebounded from the combination of the vehicle's interior surface and his deploying air bag backward toward the center of his seat back. The side slap impact had little or negligible effect on the front right passenger's kinematics. The case vehicle continued to rotate counterclockwise as it traveled westward onto the northern roadside, where it began to roll onto its right side. The front right passenger's body moved to the right and most likely loaded the interior surface of the right front door, right front window frame, and/or right roof side rail. There is no clear evidence of any contact by the front right passenger during the rollover sequence; although, the front right passenger's upper extremities may well have come in contact with the front right passenger's sun visor, roof, and/or the driver. According to his medical records, the case vehicle's front right passenger ended up in the back seat, but his exact posture at final rest is unknown. According to the case vehicle's driver and his medical records, the front right passenger extricated himself from the vehicle without assistance.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The front right passenger was transported by ambulance to the hospital. He sustained minor injuries and was treated and released. According to the interview with the case vehicle's driver and his medical records, the front right passenger sustained a minor contusion below his right eye and abrasions and contusions to both knees from contacting the glove compartment door.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusion with slight swelling right face, under right eye	minor 290402.1,1	Unknown contact mechanism	Unknown	Emergency room records
2	Abrasions bilateral knees, not further specified	minor 890202.1,3	Glove compartment door	Probable	Emergency room records
3	Contusions {bruises}, 7.6 cm (3 in), diameter to bilateral knees	minor 890402.1,3	Glove compartment door	Probable	Emergency room records

1ST OTHER VEHICLE

Based on the VIN and manufacturer's specifications, the 2000 Hyundai Elantra GLS was a front wheel drive, five-passenger, four-door sedan (VIN: KMHJF35F4YU------) equipped with a 2.0L, I-4 engine and either the standard five-speed manual or the optional four-speed automatic transmission. Four-wheel, anti-lock brakes are an option for this model, but it is unknown if the Hyundai was so equipped. Braking was achieved by a power-assisted, front disc and rear drum system. The Hyundai's wheelbase was 255 centimeters (100.4 inches), and the odometer reading is unknown because the Hyundai's interior was not inspected.

The Hyundai was equipped with redesigned driver and front right passenger air bags that deployed as a result this vehicle's impact. Furthermore, there were manual, three-point, lap-and-shoulder, safety belt systems for the front and back outboard seating positions. The restraint type for the back center seat is unknown. The interior was equipped with bucket seats for the driver and front right passenger, and the back bench seat was non-adjustable.

Damage Classification: With no available vehicle photographs, the CDCs for the Hyundai are not estimable. The WinSMASH reconstruction program, missing vehicle algorithm, was used on the Hyundai's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 35.0 km.p.h. (21.7 m.p.h.), -22.5 km.p.h. (-14.0 m.p.h.), and -26.8 km.p.h. (-16.7 m.p.h.). This collision fits the reconstruction model but, based on the case vehicle's Delta V, the calculated longitudinal Delta V appears to be low. The Hyundai was towed due to damage.

Hyundai's Occupants: According to the Police Crash Report, the Hyundai's driver [85-year-old, White (non-Hispanic) male] and front right passenger [81-year-old, White (non-Hispanic) female] were restrained by their available, active, three-point, lap-and-shoulder, safety belt system. Both the driver and front right passenger were transported by ambulance to the hospital. The driver sustained police-reported "C" (possible) injuries as a result of this crash. The front right passenger indicated that she was injured, but no injury assessment for the front right passenger was included on the Police Crash Report.

Based on the VIN and manufacturer's specifications, the 1994 Ford F150 was a rear wheel drive (4x2), six-passenger, two-door super cab pickup truck (VIN: 1FTEX15Y6RK------) equipped with a 4.9L, I-6 engine and either the standard five-speed manual or the optional four-speed automatic transmission. Braking was achieved by a power-assisted, front disc and rear drum, two-wheel, rear anti-lock system; four-wheel, anti-lock brakes were not available. The Ford's wheelbase was 353 centimeters (138.8 inches), and the odometer reading is unknown because the Ford's interior was not inspected.

The vehicle was equipped with an air bag for the driver's seat position only and manual, three-point, lap-and-shoulder, safety belt systems for at least the front outboard seating positions. The remainder of the vehicle's restraints are unknown. The standard interior was a three-passenger, adjustable bench seat in the front and a non-adjustable, back bench seat. Front captains chairs were optional as well as rear jump seats.

Damage Classification: With no available vehicle photographs, the CDC for the Ford is not estimable. According to the Police Crash Report, the Ford did not contact either the case vehicle or the Hyundai and sustained only a minor scrape to its right outside rearview mirror that occurred during its evasive maneuver. The Ford was driven from the scene.

Ford's Occupants: According to the Police Crash Report, the Ford's driver [22-year-old, White (Hispanic) male] was restrained by his available, active, three-point, lap-and-shoulder, safety belt system. The driver was not transported by ambulance to the hospital, and he did not sustain any injuries as a result of this crash.

1GNEC13Z53R	System Status At Deployment
SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	BUCKLED
Ignition Cycles At Deployment	1176
Ignition Cycles At Investigation	1178
Maximum SDM Recorded Velocity Change (MPH)	-18.57
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	107.5
Driver First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	12.5
Driver Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	N/A
Passenger First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	12.5
Passenger Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	N/A
Time Between Non-Deployment And Deployment Events (sec)	N/A
Frontal Deployment Level Event Counter	1
Event Recording Complete	Yes
Multiple Events Associated With This Record	No
One Or More Associated Events Not Recorded	No

Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Recorded Velocity Change (MPH)	-0.62	-1.86	-4.03	-4.96	-8.37	-11.16	-13.02	-14.57	-16.43	-17.98	-18.29	N/A	N/A	N/A	N/A

PRE-CRASH DATA				
Seconds Before AE	**Vehicle Speed (MPH)**	**Engine Speed (RPM)**	**Percent Throttle**	**Brake Switch Circuit Status**
-5	65	1728	0	OFF
-4	65	1728	0	OFF
-3	65	1728	0	OFF
-2	65	1728	0	OFF
-1	65	1728	0	OFF

Figure 25: Case vehicle's at deployment data including: pre-crash speed, brake switch status, restraint system status, and activation data for vehicle's dual inflation air bags, and the case vehicle's change in velocity (Delta V) over the first 110 milliseconds post deployment

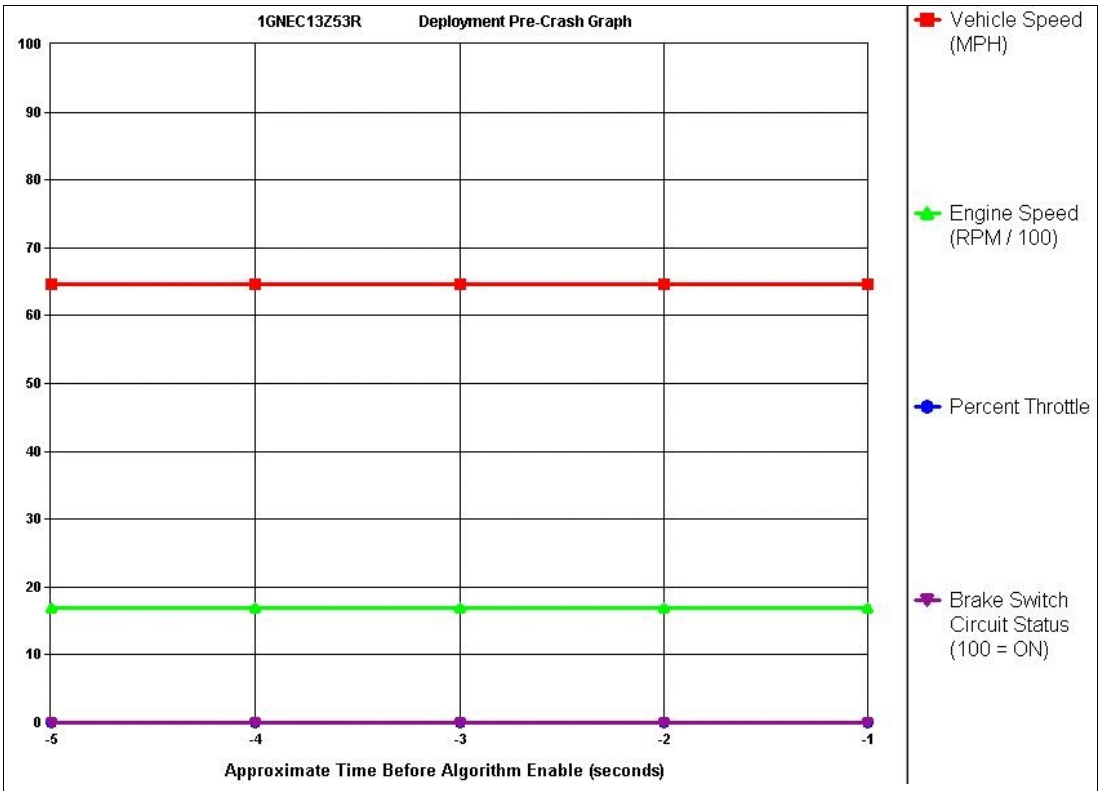


Figure 26: Case vehicle's pre-crash speed and throttle and brake switch circuit status showing that the vehicle's speed was recorded at 105 km.p.h. (65 m.p.h.) and that there was 0% throttle and the brake switch was OFF at the five recorded sample periods.

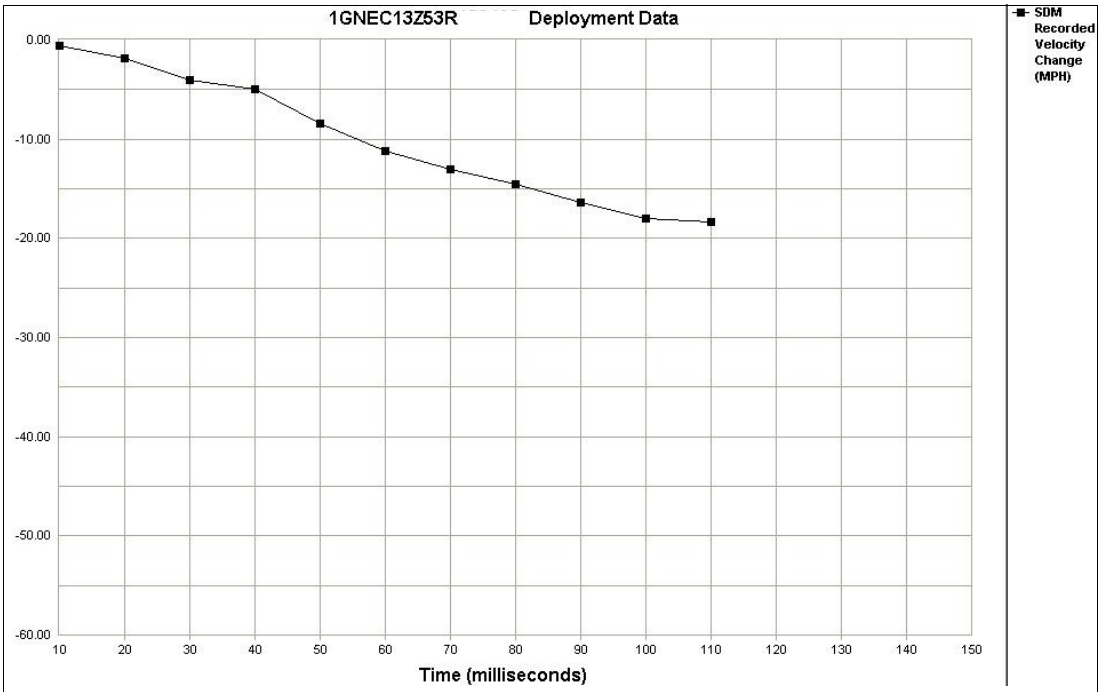
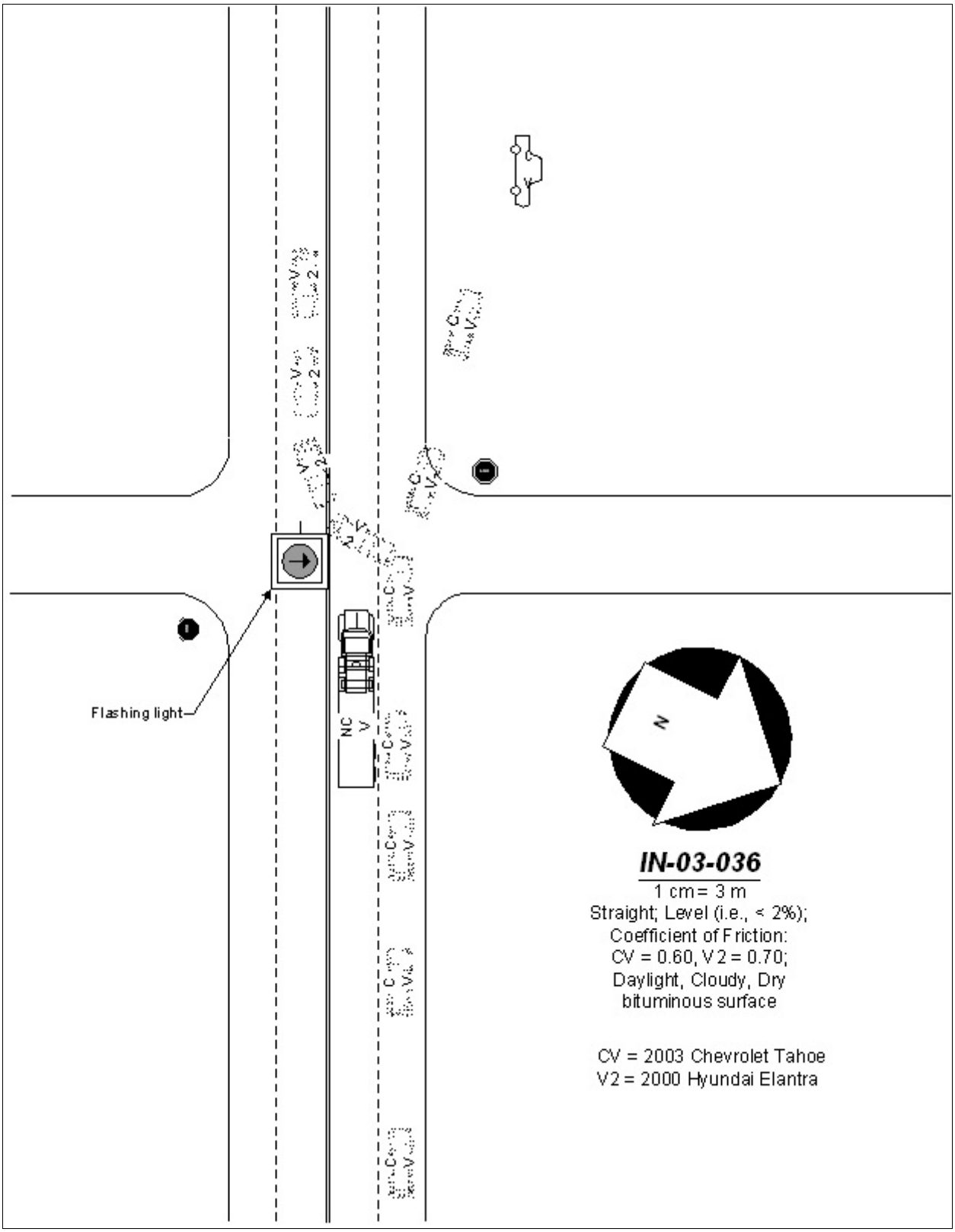


Figure 27: The case vehicle sustained a velocity change of approximately 29.4 km.p.h. (18.3 m.p.h.) during the first 110 milliseconds after the crash was detected


Flashing light
N
IN-03-036
1 cm = 3 m
Straight; Level (i.e., < 2%);
Coefficient of Friction:
CV = 0.60, V2 = 0.70;
Daylight, Cloudy, Dry
bituminous surface
CV = 2003 Chevrolet Tahoe
V2 = 2000 Hyundai Elantra