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ON-SITE AIR BAG INVESTIGATION

CASE NUMBER - IN99-076
LOCATION - ILLINOIS
VEHICLE - 1991 CHEVROLET CORSICA LT
CRASH DATE - June, 1999

Submitted:

February 15, 2000

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National Highway Traffic Safety Administration
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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

Technical Report Documentation Page

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15. *Supplementary Notes*
On-site air bag deployment investigation involving a 1991 Chevrolet Corsica LT, four-door sedan, with manual safety belts and driver's air bag, which ran-off-road striking a fixed object (i.e., a guy wire)

16. *Abstract*

This report covers an on-site investigation of an air bag deployment crash that involved a 1991 Chevrolet Corsica LT (case vehicle) which ran-off-road striking a fixed object (i.e., the guy wire of a utility pole). This crash is of special interest because the case vehicle's unrestrained, short-statured, driver (19-year-old female) sustained a fatal injury from her deploying driver air bag. The case vehicle had just backed out of her driveway (i.e., an eastward to northward backing maneuver) onto a two-lane, undivided, city street and was heading south. The driveway (on the west side of the roadway) was just north of a four-leg intersection. She accelerated forward in the southbound lane through the intersection but subsequently drove off the southwest corner of the intersection, and the crash occurred. The case vehicle's front right bumper impacted a guy wire used to support a utility pole, causing the case vehicle's driver (only) supplemental restraint (air bag) to deploy. The case vehicle rotated approximately 35 degrees clockwise coming to rest primarily off the roadway heading southwest. The case vehicle's driver was seated with her seat track located in its forward-most position, and the tilt steering wheel was located between its middle and down-most positions. She was not wearing her available, active, three-point, lap-and-shoulder, safety belt system and sustained, according to her medical records, fatal injuries which included: a contused cervical spinal cord at C_2 with a fracture at C_2 and dislocation below C_2, a brainstem hemorrhage; a nonanatomic brain injury; mild cerebral edema; bilateral lung contusions; a laceration to the right lobe of her liver; a dislocated right shoulder; a laceration under her chin; contusions to her head, upper lip, right upper chest, and left knee; and abrasions to her chin, lower neck, right chest (above and below her right breast), right shoulder, anterior right upper arm, right thumb, left wrist and left hand.

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TABLE OF CONTENTS

IN99-076

This on-site investigation was brought to NHTSA's attention on June 30, 1999 by the police chief of the investigating agency. This crash involved a 1991 Chevrolet Corsica LT (case vehicle) and a guy wire used to support a utility pole. The crash occurred in June, 1999, at 1:13 a.m., in Illinois and was investigated by the applicable city police department. This crash is of special interest because the case vehicle's unrestrained, short-statured, driver [19-year-old, White (non-Hispanic) female] sustained a fatal injury from her deploying driver air bag. This contractor inspected the scene and case vehicle on July 7, 1999. This report is based on the Police Crash Report, interviews with the investigating police officer and the county's forensic pathologist, scene and vehicle inspections, occupant kinematic principles, occupant medical records, and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle had just backed out of her driveway (i.e., an eastward to northward backing maneuver) onto a two-lane, undivided, city street and was heading south, intending to continue traveling south. The driveway (on the west side of the roadway) was just north of a partially controlled four-leg intersection (i.e., there were STOP signs for the east and west legs). At the time of the crash the case vehicle's driver was under the influence (i.e., 0.19 mg/dl according to her emergency room records) and upset after an argument with her boyfriend. Possibly as a result she accelerated forward in the southbound lane through the intersection but subsequently drove off the southwest corner of the four-leg intersection. The case vehicle's driver made no known avoidance maneuvers prior to the crash. The crash occurred off the southwest corner of the intersection (see **CRASH DIAGRAM** below). The measured distance from the driveway to the point of impact was 23.2 meters (76 feet).

The case vehicle's front right bumper impacted a guy wire used to support a utility pole, causing the case vehicle's driver (only) supplemental restraint (air bag) to deploy. The case vehicle rotated approximately 35 degrees clockwise coming to rest primarily off the roadway heading southwest.

The case vehicle's driver [152 centimeters and 52 kilograms (60 inches, 115 pounds)] was not wearing her available, active, three-point, lap-and-shoulder, safety belt system. In addition, there was no evidence of belt pattern bruising and/or abrasions to the driver's body, and the inspection of the driver's seat belt webbing, "D"-ring, and latch plate showed no evidence of loading.

The case vehicle's driver made no known pre-crash avoidance maneuvers. As a result and independent of the nonuse of her available safety belts, her pre-impact body position did not change just prior to impact. The case vehicle's impact with the guy wire resulted in the case vehicle's driver continuing forward and slightly upward as the case vehicle decelerated. The impact with the guy wire resulted in the air bag deploying late during the duration of the impact. This late deployment occurred due to the prolonged change in time [Delta T (i.e., ramp versus spike)] relative to the change in speed (magnitude of Delta V). This delay enabled the driver to impact the steering wheel hub, load the steering column, and contribute to the compression of the

steering column's shear capsule prior to the air bag module's deployment. As the driver moved forward, her right hand most likely slipped off of the steering wheel's rim. As a result, she deposited a right hand print on the dash, just above and slightly to the right of the steering wheel. When the air bag deployed, the air bag module's top cover flap caught the driver underneath her chin on the right side on the flap's upward excursion. Through a combination of the driver's forward leaning posture, the upward motion of the air bag module's top cover flap, and the inflation of the air bag, the driver was first lifted upwards into the sun visor and then propelled rearwards and back to the right. During the air bag's inflation, her right hand was most likely propelled upwards where it contacted the rearview mirror, tilting and cracking it. At final rest the driver's back was against her seat back with her head and upper torso leaning to the right.

The driver was transported by ambulance to the hospital. She sustained fatal injuries and was pronounced dead 2 hours and 50 minutes post-crash. According to her medical records, the injuries sustained by the case vehicle's driver included: a contused cervical spinal cord at C_2 with a fracture at C_2 and dislocation below C_2, a brainstem hemorrhage; a nonanatomic brain injury; mild cerebral edema; bilateral lung contusions; a laceration to the right lobe of her liver; a dislocated right shoulder; a laceration under her chin; contusions to her head, upper lip, right upper chest, and left knee; and abrasions to her chin, lower neck, right chest (above and below her right breast), right shoulder, anterior right upper arm, right thumb, left wrist and left hand.

The case vehicle was a front wheel drive 1991 Chevrolet Corsica LT, four-door sedan (VIN: 1G1LT53G3MY------). The case vehicle was not equipped with anti-lock brakes. The case vehicle was towed, but not due to damage. Based on the vehicle inspection the CDC for the case vehicle was determined to be: **12-FREN-1 (0)** [residual maximum crush was 6 centimeters (2.4 inches) and was located between C_5 and C_6]. The WinSMASH reconstruction program, barrier algorithm, was used on the case vehicle's highest severity impact, bearing in mind the yielding object nature of this impact. The maximum Total, Longitudinal, and Lateral Delta Vs are, respectively: 12.0 km.p.h. (7.5 m.p.h.), -12 .0 km.p.h. (-7.5 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.).

This result seems low if we assume that the driver's contact with the steering wheel caused the column to become completely separated from the shear capsule's slip plates [5.5 centimeters (2.2 inches)]; however, the driver's pre-deployment contact with the steering wheel hub was compounded by the deployment of the air bag which may have caused the steering column's compression as the air bag was forced by the resistance it encountered from the driver to expand towards the steering column. This contractor cannot say with certainty the relative proportion of steering column collapse attributed to loading versus the expansion of the air bag. It should be noted that the case vehicle had been bought used, and its crash history is unknown. The case vehicle's driver had owned the vehicle for less than a year prior to this crash.

The case vehicle's contact with the guy wire resulted in a narrow vertical direct damage pattern that wrapped around the front end from the undercarriage to the hood of the vehicle. Direct damage was a measured distance of 5 centimeters (2.0 inches). Field L was a measured distance of 127 centimeters (50.0 inches) extending from bumper corner to bumper corner. The

right half of the front bumper was noticeably deformed with the hood and grille also being deformed rearward.

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 air bag revealed that the cover flaps opened at the designated tear points; although, there was evidence to indicate that the air bags deployment was momentarily impeded. Furthermore, there appeared to be cloth transfers on the driver air bag module's cover flaps. The driver's air bag was designed without any tethers. The driver's air bag had two vent ports, approximately 1.5 centimeters (0.6 inches) in diameter, located at the 9 and 3 o'clock positions. The deployed driver's air bag was elliptical with a height of approximately 58 centimeters (22.8 inches) and a width of approximately 66 centimeters (26.0 inches). The front bottom half of the air bag had a significant area of blood smears on it. In addition, there was contact evidence readily apparent [i.e., a 3 x 9 centimeter (1.2 x 3.5 inch) area of skin transfer] on the backside of the driver's air bag near the 3 o'clock position.

Immediately prior to the crash, the case vehicle's driver was presumably seated in an upright posture with her back against the seat back, her left foot on the floor, her right foot on the accelerator, and both hands on the steering wheel; however, the exact positions of her hands on the rim are unknown. Her seat track was located in its forward-most position, her seat back was upright, and the tilt steering wheel was located between its middle and down-most positions.

CRASH CIRCUMSTANCES

The case vehicle had just backed out of her driveway (i.e., an eastward to northward backing maneuver) onto a two-lane, undivided, city street and was heading south, intending to continue traveling south. The driveway (on the west side of the roadway) was just north of a partially controlled four-leg intersection. At the time of the crash the case vehicle's driver was under the influence (i.e., 0.19 mg/dl according to her emergency room records) and upset after an argument with her boyfriend. Possibly as a result she accelerated forward in the southbound lane (**Figure 1**) through the intersection but subsequently drove off the southwest corner of the four-leg intersection, narrowly missing a utility pole (**Figure 2**). The case vehicle continued in a south-southwesterly direction off the roadway an additional 7.4 meters (24.4 feet). The case vehicle's driver made no known avoidance maneuvers prior to the crash (**Figure 3** below). The crash occurred off the southwest corner of the intersection (see **CRASH DIAGRAM** below). The measured distance from the driveway to the point of impact was 23.2 meters (76 feet).

Figure 1: Case vehicle's intended travel path southward as she began to accelerate forward after backing out of driveway (case photo #01)

Figure 2: Case vehicle's travel path through the four-leg intersection and off the west (right) side of the road toward the guy wire (case photo #03)

The city roadway was straight and level (i.e., actual slope was 0.3%, positive to the south) at the area of impact. However, as the case vehicle passed through the intersection it traveled first up (1.5% slope, positive to the south) and then down (5.9% slope, negative to the south) the crown of the crossing east/west roadway. The pavement was bituminous, but traveled and worn. The travel lanes were not separated by any lane markings. The roadway was 3.3 meters (10.8 feet) wide, and the shoulders were not improved (i.e., bordered by grassy lawns). The grassy drainage ditch off the west side of the roadway, just prior to the guy wire, was 1.3 meter (4.4 feet) wide and had a slope of 10.9%, negative to the west. The estimated coefficient of friction of the roadway was approximately 0.75%. The only traffic controls were regulatory STOP (Manual on Uniform Traffic Control Devices, R1-1) signs on the east and west legs of the intersection. No regulatory speed limit sign was posted near the crash site. The legal speed limit was 40 km.p.h. (25 m.p.h.). At the time of the crash the light condition was dark, but illuminated by overhead street lamps at the area of the crash, the atmospheric condition was clear, and the road pavement was dry. There was no other traffic present, and the site of the crash was strictly residential.

The case vehicle's front right bumper (**Figures 4** and **5**) impacted a guy wire used to support a utility pole (**Figures 6** and **7** below) and momentarily continued forward prior to reaching maximum engagement which caused the case vehicle's driver (only) supplemental restraint (air bag) to deploy. At maximum engagement, the case vehicle's front right snagged on the guy wire, and the case vehicle rotated approximately 35 degrees clockwise coming to rest primarily off the west side of the road on the grass heading southwest. The case vehicle was towed from the scene but not due to damage.

Figure 3: Guy wire impacted by case vehicle which was located off the west (right) side of the road (case photo #05)

Figure 4: Case vehicle's frontal damage from impact with guy wire viewed from right of front (case photo #10)

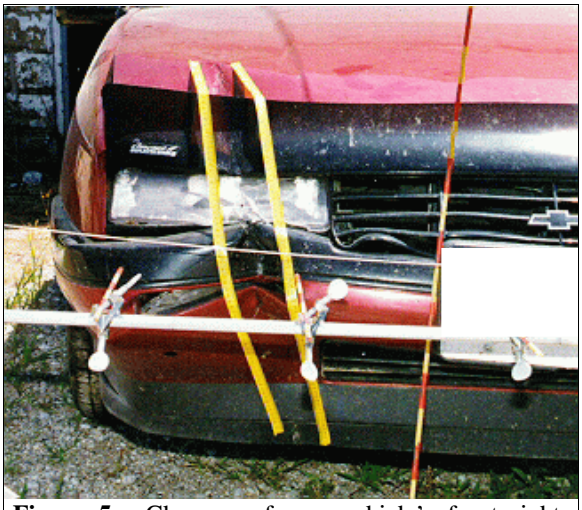


Figure 5: Close-up of case vehicle's front right deformation from impact with guy wire; Note: yellow tape highlights guy wire's vertical interaction (case photo #15)

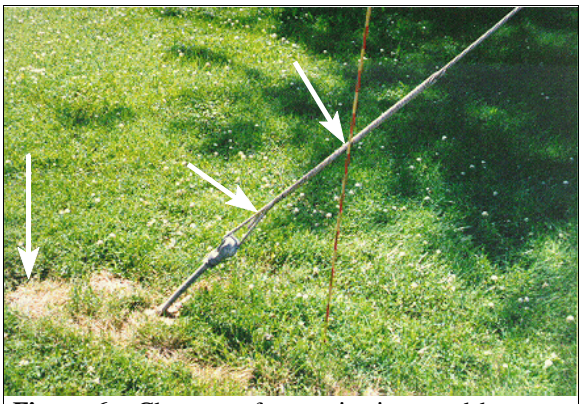


Figure 6: Close-up of guy wire impacted by case vehicle; Notes: left arrow highlights location of guy wire post-impact; guy wire was partially up-rooted from ground by impact and was subsequently reburied; center arrows show width of damage on guy wire from impact with case vehicle (case photo #06)

Figure 7: Close-up of guy wire section damaged by impact with case vehicle (case photo #07)

Figure 8: Case vehicle's front seating area, view from right front door, showing deployed driver (only) air bag (case photo #33)

CASE VEHICLE

The case vehicle was a front wheel drive 1991 Chevrolet Corsica LT , five-passenger, four-door sedan (VIN: 1G1LT53G3MY------) equipped with power-assisted, rack-and-pinion steering, a 2.2L, TBI, L-4 engine, and a three-speed automatic transmission. Braking was achieved by a power-assisted, four wheel disc braking system. The case vehicle was not equipped with anti-lock brakes. The case vehicle's wheelbase was 263 centimeters (103.4 inches), and the odometer reading at inspection was 144,561 kilometers (89,826 miles).

The interior of the case vehicle was equipped with adjustable front bucket seats with integral head restraints, manual, three-point, lap-and-shoulder safety belt systems in the four outboard seating positions, and a manual, two-point, lap belt in the back center seating position. The vehicle was equipped with a knee bolster for the driver only. The back seat was a bench seat without head restraints. The case vehicle was not equipped with manually operated height adjusters for the "D"-rings. Automatic restraint was provided by a Supplemental Restraint System (SRS) that consisted of a frontal air bag for only the driver's seating position (**Figure 8**).

CASE VEHICLE DAMAGE

The case vehicle's impact with the guy wire resulted in a narrow vertical direct damage pattern that wrapped around the front end from the undercarriage to the hood of the vehicle (**Figure 9** below). The measured width of direct damage was a distance of 5 centimeters (2.0 inches). Field L was a measured distance of 127 centimeters (50.0 inches), extending from bumper corner to bumper corner. Direct damage on the hood extended 24 centimeters (9.5 inches) rearward from the leading edge. The right half of the front bumper was noticeably

deformed with the hood and grille also being deformed rearward. The case vehicle's wheelbase remained unchanged from the crash.

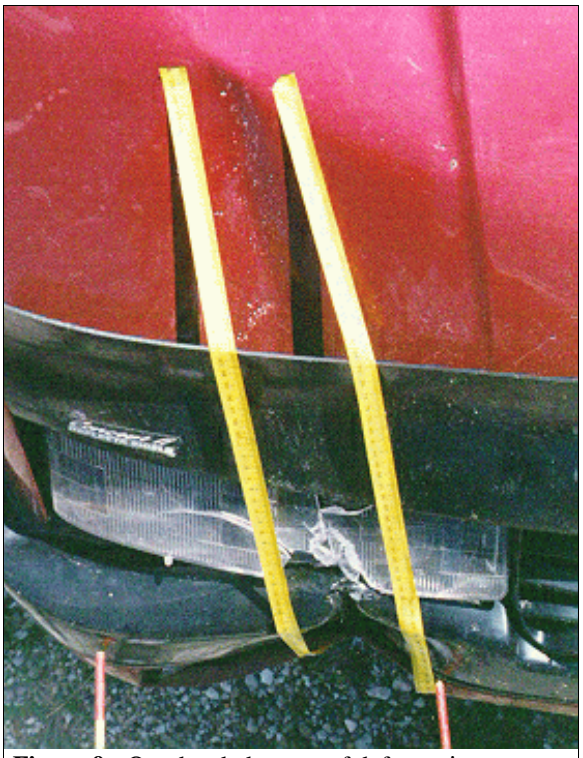


Figure 9: Overhead close-up of deformation to case vehicle's front right bumper, bug deflector, and hood from impact with guy wire (case photo #16)

Figure 10: Vertical view of case vehicle's driver seating area showing cracked (arrow) rearview mirror, probable occupant contact to sun visor, and blood evidence on driver air bag (case photo #28)

An examination of the case vehicle's interior revealed that the rearview mirror was askew (**Figure 10**), most likely from contact by the driver's hand as her hand was propelled upwards during the air bag's inflation. In addition, the energy absorbing steering column showed significant evidence of compression; although, the steering wheel rim showed no apparent deformation. The shear capsules were separated a measured distance of 5.5 centimeters (2.2 inches). The driver's sun visor and roof above the sun visor showed evidence of skin transfers (**Figure 10**). The top of the instrument panel, just above and to the right of the steering wheel rim, had what appeared to be four finger imprints from the case vehicle's driver (**Figure 11**). Further, the left side of the driver's knee bolster was scuffed and indented from contact with the driver's left knee. And finally, the driver air bag module's

Figure 11: Right hand print deposited on dash by case vehicle's driver when she loaded the steering column during the crash sequence (case photo #31)

cover flaps had cloth transfers on them (**Figure 12**).

Figure 12: Close-up of cloth transfers deposited on case vehicle driver air bag module's cover flaps; Note: edge of top cover flap struck driver in upper right anterior neck (case photo #22)

Based on the vehicle inspection the CDC for the case vehicle was determined to be: **12-FREN-1 (0)** [residual maximum crush was 6 centimeters (2.4 inches) and was located between C_5 and C_6]. The WinSMASH reconstruction program, barrier algorithm, was used on the case vehicle's highest severity impact, bearing in mind the yielding object nature of this impact. The maximum Total, Longitudinal, and Lateral Delta Vs are, respectively: 12.0 km.p.h. (7.5 m.p.h.), -12 .0 km.p.h. (-7.5 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.).

This result seems low if we assume that the driver's contact with the steering wheel caused the column to become completely separated from the shear capsule's slip plates [5.5 centimeters (2.2 inches)]; however, the driver's pre-deployment contact with the steering wheel hub was compounded by the deployment of the air bag which may have caused the steering column's compression as the air bag was forced by the resistance it encountered from the driver to expand backwards toward the steering column. This contractor cannot say with certainty the relative proportion of steering column collapse attributed to loading versus the backward expansion of the air bag.

It should be noted that the case vehicle had been bought used, and its crash history is unknown. The case vehicle's driver had owned the vehicle for less than a year prior to this crash. The case vehicle was towed, but not due to damage.

AUTOMATIC RESTRAINT SYSTEM

As previously mentioned, the 1991 Chevrolet Corsica LT was equipped with a SRS that consisted of a frontal air bag at the driver position only. The case vehicle's driver air bag was located in the steering wheel hub. The module cover consisted of asymmetrical "H"-configuration cover flaps made of thick vinyl with overall dimensions of 20 centimeters (7.9 inches) at the horizontal seam and 9 centimeters (3.5 inches) vertically for the upper flap and 6 centimeters (2.4 inches) vertically for the lower flap. An inspection of the air bag module's cover flaps and air bag revealed that the cover flaps opened at the designated tear points; although, there was evidence to indicate that the air bags deployment was momentarily impeded. Furthermore, there appeared to be cloth transfers on the driver air bag module's cover flaps (**Figure 12**). The driver's air bag was designed without any tethers. The driver's air bag had two vent ports, approximately 1.5 centimeters (0.6 inches) in diameter, located at the 9 and 3 o'clock positions. The deployed driver's air bag was elliptical with a height of approximately 58 centimeters (22.8 inches) and a width of approximately 66 centimeters (26.0 inches). The measured distance from the steering wheel hub to the center of the driver's seat back was approximately 45 centimeters (17.7 inches).

An inspection of the case vehicle's driver air bag revealed a significant area of blood smears on the front bottom half of the air bag (**Figure 13**). Also present were purple striations from the back side of the cover flaps as the driver was restricting the air bag's deployment. The vast majority of the striations were on the back right half of the air bag, but some striations were also found between the 6 and 7 o'clock areas on the bottom lower portion of the front of the air bag. In addition, there was contact evidence readily apparent [i.e., a 3 x 9 centimeter (1.2 x 3.5 inch) area of skin transfer] on the backside of the driver's air bag near the 3 o'clock position (**Figure 14**).

Figure 13: Case vehicle's driver air bag with blood evidence to bottom half; Note: steering wheel turned 90 degrees counterclockwise (case photo #25)

Figure 14: Close-up of skin transfer to backside of case vehicle's driver air bag (case photo #27)

Fifty-nine (59) days post-crash a General Motors (GM) analyst inspected the case vehicle and downloaded information that was recorded on the case vehicle's Diagnostic Energy Reserve Module (DERM). The DERM revealed that the system was clean (i.e., no faults or warning codes) at the time of the deployment. According to GM, the case vehicle had a early version of the DERM, and this version was not capable of recording the maximum Delta V that the case vehicle sustained. The location of the DERM is unknown. For additional information, see the **DIAGNOSTIC ENERGY RESERVE MODULE** section below.

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash, the case vehicle's unrestrained, short stature, driver [19-year-old, White (non-Hispanic) female] was presumably seated in an upright posture with her back against the seat back, her left foot on the floor, her right foot on the accelerator, and both hands on the steering wheel; however, the exact positions of her hands on the rim are unknown. Her seat track was located in its forward-most position, her seat back was upright, and the tilt steering wheel was located between its middle and down-most positions.

The case vehicle's driver [152 centimeters and 52 kilograms (60 inches, 115 pounds)] was not wearing her available, active, three-point, lap-and-shoulder, safety belt system. In addition, there was no evidence of belt pattern bruising and/or abrasions to the driver's body, and the inspection of the driver's seat belt webbing, "D"-ring, and latch plate showed no evidence of loading.

The case vehicle's driver made no known pre-crash avoidance maneuvers. As a result and independent of the nonuse of her available safety belts, her pre-impact body position did not change just prior to impact. The case vehicle's impact with the guy wire resulted in the case vehicle's driver continuing forward and slightly upward as the case vehicle decelerated. The impact with the guy wire resulted in the air bag deploying late during the duration of the impact. This late deployment occurred due to the prolonged change in time [Delta T (i.e., ramp versus spike)] relative to the change in speed (magnitude of Delta V). This delay enabled the driver to impact the steering wheel hub (**Figure 12** above), load the steering column, and contribute to the compression of the steering column's shear capsule prior to the air bag module's deployment. As the driver moved forward, her right hand most likely slipped off of the steering wheel's rim. As a result, she deposited a right hand print on the dash, just above and slightly to the right of the steering wheel (**Figure 13** above). When the air bag deployed, the air bag module's top cover flap caught the driver underneath her chin on the right side on the flap's upward excursion. Through a combination of the driver's forward leaning posture, the upward motion of the air bag module's top cover flap, and the inflation of the air bag, the driver was first lifted upwards into the sun visor (**Figure 10** above) and then propelled rearwards and back to the right. During the air bag's inflation, her right hand was most likely propelled upwards where it contacted the rearview mirror, tilting and cracking it. At final rest the driver's back was against her seat back with her head and upper torso leaning to the right.

CASE VEHICLE DRIVER INJURIES

The driver was transported by ambulance to the hospital. She sustained fatal injuries and was pronounced dead 2 hours and 50 minutes post-crash. According to her medical records, the injuries sustained by the case vehicle's driver included: a contused cervical spinal cord at C_2 with a fracture at C_2 and dislocation below C_2, a brainstem hemorrhage; a nonanatomic brain injury; mild cerebral edema; bilateral lung contusions; a laceration to the right lobe of her liver; a dislocated right shoulder; a laceration under her chin; contusions to her head, upper lip, right upper chest, and left knee; and abrasions to her chin, lower neck, right chest (above and below her right breast), right shoulder, anterior right upper arm, right thumb, left wrist and left hand.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusion[1] cervical spinal cord at C_2 with fracture (not further specified) at C_2 and dislocation {separation/displacement} below C_2	640236.6 untreatable	Driver module's cover flap	Probable	Autopsy
2	Hemorrhage, small, in brainstem at medulla and/or pons	140210.5 critical	Air bag, driver's	Certain	Autopsy

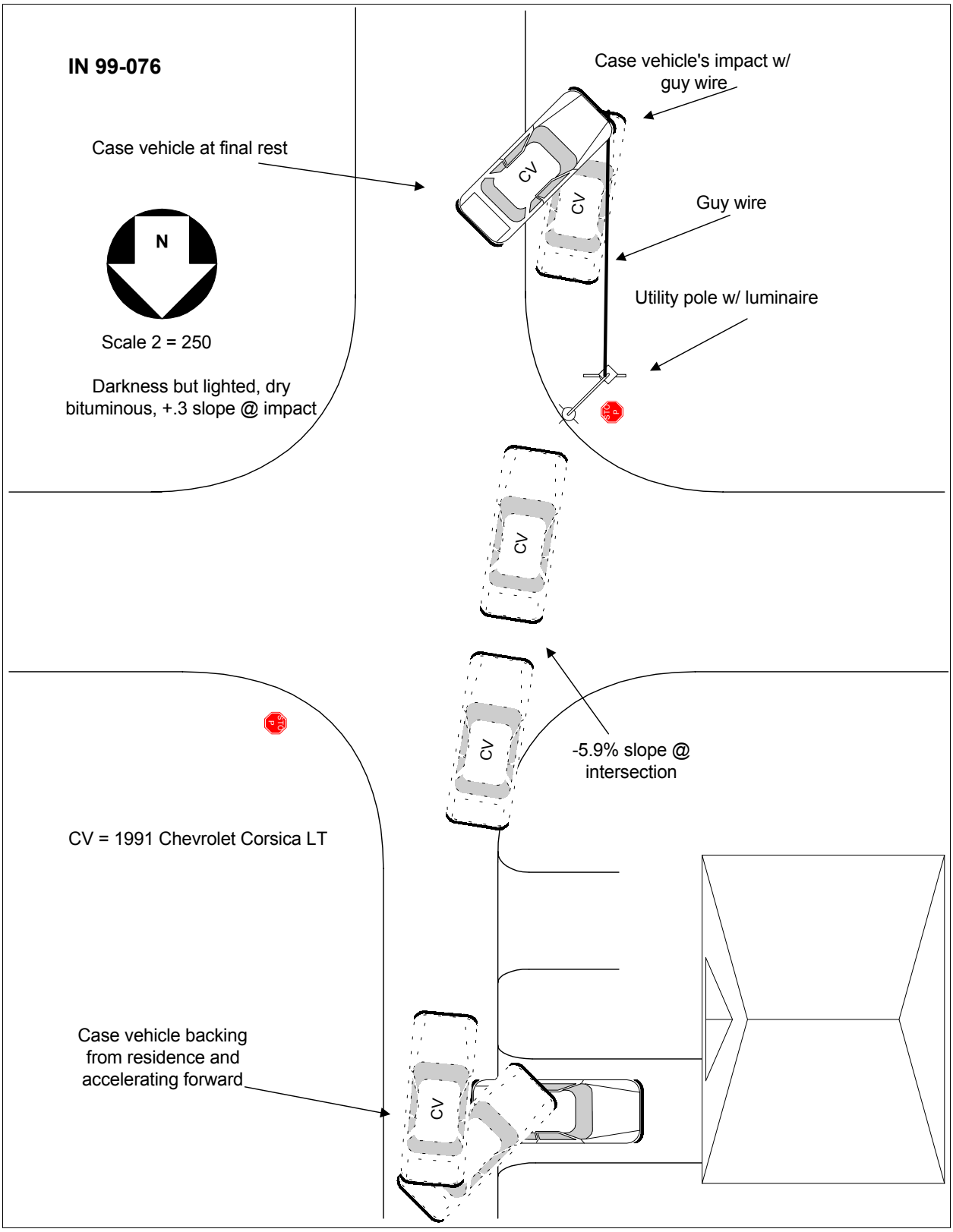
[1] The lesion to the cervical spinal cord was variously described in the autopsy as "visible damage", "shredded", "crushed", and "contusional". In addition, there was hemorrhage along the spinal cord at the atlanto-occipital fascia and extensive hemorrhage in the neck. Further, it was highly suspected (i.e., probable, presumed) that the vertebral arteries in the neck region at the fracture site were lacerated {damaged}, but the damage could not be demonstrated due to the extensive injury in this area.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
3	Nonanatomic brain injury with loss of consciousness and unresponsive to painful stimuli	160824.5 critical	Air bag, driver's	Certain	Emergency room records
4	Edema, mild, cerebrum involving expansion of white matter and bloating of gray-white junction [Aspect = Unknown]	140670.3 serious	Air bag, driver's	Certain	Autopsy
5	Contusions bilateral lungs involving apex of left upper lobe, lateral left lower lobe, lateral right lower lobe with bilateral hemothoraces[2]: 250 ml right and 200 ml left pleural cavities	441410.4 severe	Air bag, driver's	Probable	Autopsy
6	Laceration liver posterior right lobe, not further specified[3]	541820.2 moderate	Steering wheel rim	Probable	Autopsy
7	Dislocation {separation} right shoulder with internal hemorrhage	751030.2 moderate	Air bag, driver's	Possible	Autopsy
8	Contusion apex {crest} of head	190402.1 minor	Roof, driver's side	Probable	Autopsy
9	Contusion left upper lip	290402.1 minor	Sun visor, driver's	Probable	Autopsy
10 11	Abrasion under chin Laceration under chin	290202.1 290602.1 minor	Driver module's cover flap	Certain	Autopsy
12	Abrasions lower neck, more extensive on right side	390202.1 minor	Air bag, driver's	Certain	Autopsy
13	Abrasions anterior right upper chest including below right clavicle and below right breast	490202.1 minor	Air bag, driver's	Certain	Autopsy
14	Contusion right upper chest below right clavicle	490402.1 minor	Air bag, driver's	Certain	Autopsy
15	Abrasion right shoulder and anterior right upper arm	790202.1 minor	Air bag, driver's	Certain	Autopsy
16	Abrasion base of right thumb	790202.1 minor	Air bag, driver's	Certain	Autopsy

[2] The origin of the pleural hemorrhages is unclear.

[3] There was one liter of hemoperitoneum, but the origin of the hemorrhage is uncertain; although, the liver laceration was contributory.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
17	Abrasions x 4, two dorsal left wrist and two dorsal left hand, including proximal 4th finger	790202.1 minor	Left instrument panel and below	Probable	Autopsy
18	Contusion over left knee	890402.1 minor	Left instrument panel and below	Probable	Autopsy


IN 99-076
Case vehicle's impact w/ guy wire
Case vehicle at final rest
N
Scale 2 = 250
Darkness but lighted, dry bituminous, +.3 slope @ impact
Guy wire
Utility pole w/ luminaire
CV
-5.9% slope @ intersection
CV = 1991 Chevrolet Corsica LT
Case vehicle backing from residence and accelerating forward

Fifty-nine (59) days post-crash, General Motors Engineering Safety Center inspect the case vehicle and obtained and deciphered the stored information therein. GM vehicles are equipped with either a DERM (Diagnostic Energy Reserve Module) or SDM (Sensing and Diagnostic Module). In this specific crash the case vehicle was equipped with an DERM.

According to the GM analysis, the DERM is capable of recording any air bag warnings that have been detected (pre- or post-crash) and when the warnings first appeared. This early version of the DERM was not capable of recording the maximum Delta V the case vehicle sustained during its deployment event (crash). The DERM also provides numerous bits of information that neither has any meaning nor is of any use to this investigation.

The DERM recorded and stored a CRASH EVENT which contains the following information:

- The SIR Warning Light was OFF at the time of the deployment (i.e., no malfunctions).
- The SIR Warning Light was not ON prior to the crash (i.e., no malfunctions).
- There were five SIR systems codes stored in memory; however, all of these codes were stored post-crash, and thus, there were no malfunctions.
- SIR deployment requires simultaneous closure of two out of three vehicle sensors. The arming sensor closed first.
- The crash occurred on ignition cycle number 16,499.
- This was the first Deployment Crash Event for this vehicle.