INDIANA UNIVERSITY
TRANSPORTATION RESEARCH CENTER
School of Public and Environmental Affairs
222 West Second Street
Bloomington, Indiana 47403-1501
(812) 855-3908 Fax: (812) 855-3537

ON-SITE ADVANCED OCCUPANT PROTECTION SYSTEM INVESTIGATION

CASE NUMBER - IN-03-013
LOCATION - TEXAS
VEHICLE - 2003 LINCOLN NAVIGATOR
CRASH DATE - March 2003

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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 advanced occupant protection system investigation involving a 2003 Lincoln Navigator, four-door sport utility vehicle, with manual safety belts and dual front redesigned air bags, and a 2000 Pontiac Bonneville SE, four-door sedan

16. *Abstract*

This report covers an on-site investigation of an air bag deployment crash that involved a 2003 Lincoln Navigator (case vehicle) and a 2000 Pontiac Bonneville SE (other vehicle). This crash is of special interest because the case vehicle was equipped with multiple Advance Occupant Protection System (AOPS) features, including pretensioners and a safety canopy system, and the case vehicle's driver (19-year-old, female) sustained only minor soft tissue injuries from contacting her deploying driver air bag. The trafficway on which both vehicles were traveling was a five-lane, divided, city street, traversing in a north-northwesterly and south-southeasterly direction, and the case vehicle was approaching a four-leg intersection. Both the northern and southern roadways had two through lanes and offsetting left-hand turn lanes. The case vehicle was traveling in the inside through lane of the southern roadway. The Pontiac had been traveling in the left-hand turn lane of the northern roadway and was making a left-hand turn. The crash occurred in the inside southern lane, within the four-leg intersection of the two trafficways. The front of the case vehicle impacted the right rear of the Pontiac, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle's driver was seated with her seat track located between its middle and rearmost positions, and the tilt steering wheel was located in its middle position. She was restrained by her available, active, three-point, lap-and-shoulder, safety belt system and sustained, according to her interview, minor soft injuries which included a small cut on the outside of her upper arm, just above her elbow, and a 5 centimeter (2.0 inch) diameter abrasion between her left wrist and elbow. Her abrasion most likely resulted from her deploying air bag.

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BACKGROUND

IN-03-013

This on-site investigation was brought to NHTSA's attention on March 25, 2003 by NASS CDS sampling activities. This crash involved a 2003 Lincoln Navigator (case vehicle) and a 2000 Pontiac Bonneville SE (other vehicle). The crash occurred in March 2003, at 12:10 p.m., in Texas and was investigated by the applicable city police 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 pretensioners and a safety canopy system, and the case vehicle's driver [19-year-old, White (non-Hispanic) female] sustained only minor soft tissue injuries from contacting her deploying driver air bag. This contractor inspected the scene and case vehicle on March 31, 2003. This contractor interviewed the driver of the case vehicle on April 23, 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, and this contractor's evaluation of the evidence.

SUMMARY

Crash Environment: The trafficway on which both vehicles were traveling was a five-lane, divided, city street, traversing in a north-northwesterly and south-southeasterly direction, and the case vehicle was approaching a four-leg intersection. On both the northern and southern legs of the intersection, both the northern and southern roadways had two through lanes. On the northern leg, the southern roadway had a left-hand turn lane and, similarly, on the southern leg, the northern roadway also had a left-hand turn lane. At the time of the crash the light condition was daylight, the atmospheric condition was clear, and the roadway pavement was dry. Traffic density was not determined, and the site of the crash was primarily urban residential; see **CRASH DIAGRAM** at end.

Pre-Crash: The case vehicle was traveling south-southeast in the inside through lane of the southern roadway intended to proceed straight ahead. The Pontiac had been traveling north-northwest in the left-hand turn lane of the northern roadway and was making a left-hand turn, intending to travel west-southwestward on an intersecting eastern-western trafficway. The case vehicle's driver braked, attempting to avoid the crash. The crash occurred in the inside southern lane, within the four-leg intersection of the two trafficways.

Crash: According to the Police Crash Report and the case vehicle's driver, the front of the case vehicle impacted the right rear of the Pontiac, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy.

Post-Crash: As a result of the impact, the case vehicle continued southward post-impact and came to rest in the inside lane of the southern roadway, within the four-leg intersection, heading southward. The Pontiac rotated approximately 140 degrees clockwise while traveling in a west-southwesterly direction. The Pontiac came to rest on the western leg of the intersection in the mouth of the western roadway, heading in an northeasterly direction.

Case Vehicle: The 2003 Lincoln Navigator was a rear wheel drive (4x2), four-door, sport utility vehicle (VIN: 5LMFU27R83L------). Based on the available information, the case vehicle was

equipped with four wheel, anti-lock brakes, dual stage driver and front right passenger air bag inflators and buckle-mounted seat belt pretensioners. In addition, the case vehicle was equipped with adjustable driver pedals, driver seat position sensor, LATCH system features (i.e., **L**ower **A**nchors and **T**ethers for **CH**ildren), and a safety canopy system. Traction and stability control were optional for this vehicle.

Vehicle Exterior: Based on the partial vehicle inspection (i.e., the vehicle was partially repaired) and the available photographs taken before repairs were started, the CDC for the case vehicle was estimated as: **11-FZEW-1** (**340** degrees). The WinSMASH reconstruction program, missing vehicle algorithm– based on the estimated CDC from photographs, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 15.0 km.p.h. (9.3 m.p.h.), -14.1 km.p.h. (-8.8 m.p.h.), and +5.1 km.p.h. (+3.2 m.p.h.). The case vehicle was towed due to damage.

Exterior Damage: The case vehicle's contact with the Pontiac involved the front with the damage distributed on approximately the right half. Direct damage was not measured but, based on the available photographs, it began at the front right bumper corner and extended along the front bumper to the approximate center of the vehicle. Because the vehicle was being repaired, maximum crush was not measured, and it could not be determined if the case vehicle's wheelbase was altered from the crash. However, measurements of the case vehicle's wheelbase, track width, and overhangs were in line with manufacturer's specifications. Based on the repair facility photographs, the case vehicle's front bumper fascia, grille, hood, right fender, and right headlight, fog light, and turn signal assemblies were directly damaged and crushed rearward. The hood and right fender both sustained induced damage as well. The vehicle manufacturer's recommended tire size was: P255/70R18, but tire size P275/65R18 was optional; the case vehicle was equipped with tire size: P255/70R18. In addition, none of the case vehicle's tires were damaged, deflated, or physically restricted.

Vehicle Interior: Inspection of the case vehicle's interior revealed that there was no evidence of occupant contact on the interior surfaces of the case vehicle. Furthermore, there was no evidence of intrusion to the case vehicle's interior, no evidence of compression to the energy absorbing shear capsules in the steering column, and no deformation to the steering wheel rim.

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 13.5 centimeters (5.3 inches) in width. The driver's air bag had two vent ports, approximately 3 centimeters (1.2 inches) in diameter, located at the 11 and 1 o'clock positions. The deployed driver's air bag was round with a diameter of 52 centimeters (20.5 inches). An inspection of the driver's air bag fabric revealed no contact evidence readily apparent on 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 flap. The front right passenger's air bag was designed without any tethers. The front right air bag had two vent ports, approximately 6 centimeters (2.4 inches) in diameter, located at the 9:30 and 2:30 clock positions. The deployed front right air bag was rectangular with a height of approximately 58 centimeters (22.8 inches) and a width of approximately 52 centimeters (20.5 inches). An inspection of the front right passenger's air bag fabric revealed no contact evidence readily apparent on the front right air bag's fabric. The case vehicle's side curtain air bags did not deploy. It is unknown if the second stage of either frontal air bag was activated, but based on the calculated Delta Vs it is unlikely that the second stage was used.

Other Vehicle: The 2000 Pontiac Bonneville SE was a front wheel drive, four-door sedan (VIN: 1G2HX54K2Y4------). The Pontiac was equipped with redesigned driver and front right passenger air bags and front seat back-mounted side impact air bags. According to the Police Crash Report, none of the vehicle's air bags deployed as a result this vehicle's impact.

Exterior Damage: With no available vehicle photographs and no inspection, the CDC for the Pontiac is not estimable. The Pontiac was towed due to damage.

Case Vehicle's Driver: Immediately prior to the crash the case vehicle's driver [19-year-old, White (non-Hispanic) female; 165 centimeters and 64 kilograms (65 inches, 140 pounds)] was seated in an upright posture with her back against the seat back, her left foot on the floor, her right foot on the brake, and both hands on the steering wheel with her arms outstretched bracing in anticipation of the impact. Her 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 middle position. The case vehicle was equipped with a telescoping steering column, and the steering wheel was located in its rearmost position at the time of the vehicle inspection. The exact position of the adjustable pedals is unknown but based on the driver's short stature and the location of the seat track, the pedals were almost certainly extended rearward from their normal position.

The case vehicle's driver was restrained by her available, active, three-point, lap-and-shoulder, safety belt system; the belt system was equipped with a buckle-mounted pretensioner. There was no mention by the driver of belt pattern bruising and/or abrasions to her body, and the inspection of the driver's seat belt webbing, "D"-ring, and latch plate revealed no evidence of loading on any of these belt system components. Furthermore, the inspection revealed that the pretensioner had actuated, and the piston's movement was measured as 3.5 centimeters (1.4 inches). As a means of comparison, the buckle-mounted pretensioner for the front right safety belt system had not actuated, the piston had not moved, and the spacing was measured as 7 centimeters (2.8 inches). There was no occupant in the front right seating position, which taken in conjunction with the air bag's deployment, indicates that the case vehicle was not equipped with any sort of occupant sensing system for that position.

The case vehicle's driver braked, attempting to avoid the crash. As a result of this attempted avoidance maneuver and the use of her available safety belts, the driver most likely moved slightly forward just prior to impact. The case vehicle's impact with the Pontiac enabled the case vehicle's

driver to continue forward and slightly leftward and 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 impact, the driver loaded her safety belts and contacted her deploying driver air bag. Because the case vehicle continued straight ahead post-crash, the driver's loading on her safety belts and her interaction with the deploying air bag were most likely minimized, which is consistent with the lack of physical evidence on both her safety belt and the fabric of her air bag. As the case vehicle continued forward, the driver most likely rebounded backwards toward her seat back as a result of her loading her safety belt and interacting with the air bag. The driver does not recall her exact posture at final rest, but she was most likely seated near her pre-crash position. The driver was able to exit her vehicle without any assistance.

The driver was not transported by ambulance to the hospital. She sustained only minor injuries as a result of the crash and indicated in her interview that she did not subsequently seek any medical treatment. The self-reported injuries sustained by the case vehicle's driver included a small cut on the outside of her upper arm, just above her elbow, and a 5 centimeter (2.0 inch) diameter abrasion between her left wrist and elbow. Her abrasion most likely resulted from her deploying air bag.

Pontiac's Occupants: According to the Police Crash Report, the Pontiac's driver [37-year-old, Black (unknown if Hispanic) female] and back center passenger [10-year-old, (unknown race and/or ethnic origin) male] were restrained by their available, active, three-point, lap-and-shoulder, safety belt systems. Neither occupant was transported by ambulance to the hospital, and they did not sustain any injuries as a result of this crash.

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which both vehicles were traveling was a five-lane, divided, city street, traversing in a north-northwesterly and south-southeasterly direction, and the case vehicle was approaching a four-leg intersection (**Figure 1**). On both the northern and southern legs of the intersection, both the northern and southern roadways had two through lanes. On the northern leg, the southern roadway had a left-hand turn lane and, similarly, on the southern leg, the northern roadway also had a left-hand turn lane. The city roadway was straight and level [i.e., actual slope was 1.6%, positive (an upgrade) in the case vehicle's southern direction of travel, or 0.8%, negative (a downgrade) in the Pontiac's northern direction of travel] just prior to the area of impact. The pavement was new-to-traveled concrete and, for the case vehicle, the width of the inside southern roadway's through lane was 3.4 meters (11.2 feet) and, for the Pontiac, the width of the northern roadway's left-hand turn lane was 3.8 meters (12.5 feet). Both the southern and northern roadways were bordered by barrier curbs

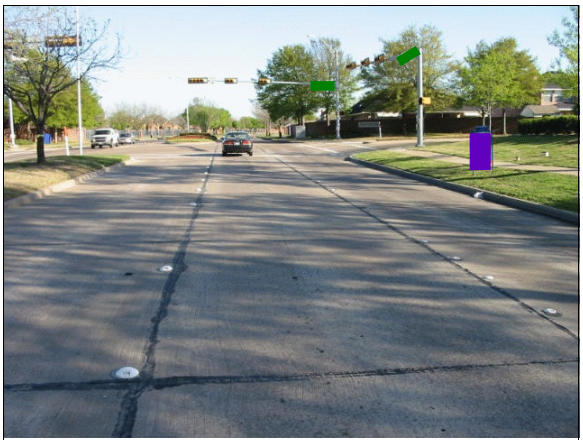


Figure 1: Case vehicle's south-southeastward travel path in inside southern through lane approaching four-leg intersection (case photo #01)

(**Figure 1** above and **Figure 2**). The shoulders were not improved (i.e., grass) and existed outside the concrete curbs. Both the northern and southern roadways were divided by a raised (i.e., curbed) grassy median. For the southern roadway the median was approximately 6.0 meters (19.7 feet) in width while the northern roadway's median was 5.9 meters (19.4 feet) in width. Pavement markings consisted of white raised pavement markers (**Figure 1** above), which were used to separate the through lanes and the left-hand turn lanes from the through lanes (**Figure 2**) on both the northern and southern roadways. Furthermore, no edge lines were present. The estimated coefficient of friction was 0.80. Traffic controls consisted of regulatory on-colors, pre-timed, horizontal mounted traffic control signals located on all four legs of the four-leg intersection. The left-hand turn signals were accompanied by regulatory **LEFT TURN YIELD ON GREEN** signs (Manual on Uniform Traffic Control Devices, R10-12) on both the northern and southern legs of the intersection (**Figures 2** and **3**). The statutory speed limit was 64 km.p.h. (40 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 clear, and the roadway pavement was dry. Traffic density was not determined, and the site of the crash was urban residential; see **CRASH DIAGRAM** at end.

Figure 2: Pontiac's north-northwestward travel path in northern left-hand turn lane prior to turning left at four-leg intersection (case photo #04)

Figure 3: Case vehicle's south-southeastward travel path into intersection in inside southern through lane and area of impact (case photo #01a)

Pre-Crash: The case vehicle was traveling south-southeast in the inside through lane of the southern roadway intended to proceed straight ahead. The Pontiac had been traveling north-northwest in the left-hand turn lane (**Figure 2**) of the northern roadway and was making a left-hand turn, intending to travel west-southwestward on an intersecting eastern-western trafficway. The case vehicle's driver braked, attempting to avoid the crash. The crash occurred in the inside southern lane, within the four-leg intersection of the two trafficways (**Figure 3**).

Crash: According to the Police Crash Report, the case vehicle's driver, and the available photographs, the front (**Figures 4** and **5** below) of the case vehicle impacted the right rear of the Pontiac, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy.

Figure 4: Repair facility photo of case vehicle's frontal damage viewed from right of front, showing damage primarily to front right corner (case photo #16)

Figure 5: Repair facility photo of case vehicle's frontal damage viewed from left of front, showing that direct damage involved primarily front right half (case photo #10)

Post-Crash: As a result of the impact, the case vehicle continued southward post-impact and came to rest in the inside lane of the southern roadway, within the four-leg intersection, heading southward. The Pontiac rotated approximately 140 degrees clockwise while traveling in a west-southwesterly direction. The Pontiac came to rest on the western leg of the intersection in the mouth of the western roadway, heading in an northeasterly direction.

CASE VEHICLE

The 2003 Lincoln Navigator was a rear wheel drive (4x2), seven-passenger, four-door sport utility vehicle (VIN: 5LMFU27R83L------) equipped with a 5.4L, V-8 engine and a four -speed electronic automatic transmission with overdrive and overdrive lockout. Braking was achieved by a power-assisted, front and rear disc, four-wheel, four channel anti-lock system with electronic brake distribution (**EBD**) and panic assist feature. The case vehicle's wheelbase was 302 centimeters (118.8 inches), and the odometer reading at inspection was 29,680 kilometers (18,442 miles).

Based on the available information, the case vehicle was equipped with dual stage driver and front right passenger air bag inflators with buckle-mounted seat belt pretensioners and energy management belt retractors and a Safety Canopy™ system with side curtain air bags with rollover sensors for front and second row outboard passengers. In addition, the case vehicle was equipped with power-adjustable driver pedals with memory feature, front safety belt usage sensors, driver seat position sensor, child safety seat latches and tether attachment points (i.e., LATCH system), and a Personal Safety System™. This System monitors belt usage and uses a front crash severity sensor as well as a driver's seat position sensor to determine the appropriate force of air bag deployment. Traction and stability control were optional for this vehicle but it is unknown if this vehicle was so equipped.

Inspection of the vehicle's interior revealed adjustable front bucket seats with adjustable head restraints for the front and second seating areas; a non-adjustable split back bench seat with folding

backs and adjustable head restraints for the back outboard seating positions; and continuous loop, three-point, lap-and-shoulder, safety belt systems at all seven front, second seat, and back positions. The exact position adjustment for any of the six adjustable head restraints was not determined. The front and second seat belt systems were equipped with manually operated, upper anchorage adjusters for the "D"-rings. There was no upper anchorage adjustment for the back outboard seats, and the back center seat had a integral safety belt. The driver and second seat right seating position's upper anchorage adjuster were located in the down-most position, the front right seating position's adjuster was located in the middle position, and the second seat left seating position's adjuster was located in the upmost position. The vehicle was equipped with knee bolsters for both the driver and front right seating positions, neither of which showed 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 side curtain inflatable air bags which extend from each of the roof side rails. Both frontal air bags deployed as a result of the case vehicle's frontal impact with the Pontiac, but neither side inflatable curtain deployed.

CASE VEHICLE DAMAGE

Exterior Damage: The case vehicle's contact with the Pontiac involved the front with the damage distributed on approximately the right half (**Figures 4** and **5** above). Direct damage was not measured but, based on the available photographs, it began at the front right bumper corner and extended along the front bumper to the approximate center of the vehicle (**Figure 6**). Because the vehicle was being repaired, maximum crush was not measured, and it could not be determined if the case vehicle's wheelbase was altered from the crash. However, measurements of the case vehicle's wheelbase, track width, and overhangs were in line with manufacturer's specifications. Based on the repair facility photographs, the case vehicle's front bumper fascia, grille, hood, right fender, and right headlight, fog light, and turn signal assemblies were directly damaged and crushed rearward. The hood and right fender both sustained induced damage as well.

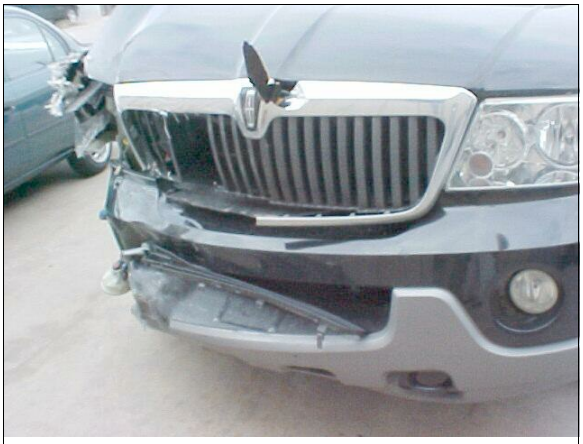


Figure 6: Close-up repair facility photo of case vehicle's frontal damage viewed from left of front, showing direct damage involving approximately front right half (case photo #09)

The vehicle manufacturer's recommended tire size was: P255/70R18, but tire size P275/65R18 was optional; the case vehicle was equipped with tire size: P255/70R18. The case vehicle's tire data are shown in the table below. In addition, none of the case vehicle's tires were damaged, deflated, or physically restricted.

Tire	*Measured Pressure*		*Recommend Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kPa	psi	kPa	psi	milli-meters	32nd of an inch			
LF	255	37	241	35	6	8	None	No	No
RF	248	36	241	35	7	9	None	No	No
LR	269	39	241	35	7	9	None	No	No
RR	234	34	241	35	7	9	None	No	No

Interior Damage: Inspection of the case vehicle's interior (**Figures 7** and **8**) revealed that there was no evidence of occupant contact on the interior surfaces of the case vehicle. Furthermore, there was no evidence of intrusion to the case vehicle's interior, no evidence of compression to the energy absorbing shear capsules in the steering column, and no deformation to the steering wheel rim.

Figure 7: Case vehicle's driver seating area showing no obvious occupant contact evidence on steering wheel, instrument panel, or greenhouse areas (case photo #20)

Figure 8: Case vehicle's front right seating area showing deployed front right air bag and no evidence of occupant contact on instrumental panel, windshield glazing, or greenhouse areas (case photo #26)

Damage Classification: Based on the partial vehicle inspection (i.e., the vehicle was partially repaired) and the available photographs taken before repairs were started, the CDC for the case vehicle was estimated as: **11-FZEW-1** (**340** degrees). The WinSMASH reconstruction program, missing vehicle algorithm– based on the estimated CDC from photographs, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 15.0 km.p.h. (9.3 m.p.h.), -14.1 km.p.h. (-8.8 m.p.h.), and +5.1 km.p.h. (+3.2 m.p.h.). The case vehicle was towed due to damage.

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 side curtain inflatable air bags which extend from each of the roof side rails (**Figure 9**). Both frontal air bags deployed as a result of the frontal impact with the Pontiac (**Figures 7** and **8** above). It is unknown if the second stage of either frontal air bag was activated, but based on the calculated Delta Vs it is unlikely that the second stage was used. The case vehicle's side inflatable curtain did not deploy as a result of the case vehicle's frontal impact with the Pontiac. 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 medium, pliable vinyl with overall dimensions of 12.5 centimeters (4.9 inches) at the horizontal seam and 8 centimeters (3.1 inches) vertically for the upper flap and 10 centimeters (3.9 inches) vertically for the lower flap. 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 13.5 centimeters (5.3 inches) in width. The driver's air bag had two vent ports, approximately 3 centimeters (1.2 inches) in diameter, located at the 11 and 1 o'clock positions. The deployed driver's air bag was round with a diameter of 52 centimeters (20.5 inches). An inspection of the driver's air bag fabric revealed no contact evidence readily apparent on the air bag's fabric (**Figure 10**). 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 34 centimeters (13.4 inches).

Figure 9: Air bag label on case vehicle's left roof side rail indicating present of vehicle's safety canopy system (case photo #23)

Figure 10: Case vehicle's deployed driver air bag showing no apparent evidence of occupant contact (case photo #29)

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 vinyl, thicker than the vinyl on the driver's module. The flap's dimensions were 45.5 centimeters (17.9 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 flap. The front right passenger's air bag was designed without any tethers. The front right air bag had two vent ports, approximately 6 centimeters (2.4 inches) in diameter, located at the 9:30 and 2:30 clock positions. The deployed front right air bag was rectangular with a height of approximately 58 centimeters (22.8 inches) and a width of approximately 52 centimeters (20.5 inches). An inspection of the front right passenger's air bag fabric revealed no contact evidence readily apparent on the front right air bag's fabric (**Figure 11**). The distance between the mid-center of the front right 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 16 centimeters (6.3 inches).

Figure 11: Case vehicle's deployed front right air bag showing no occupant contact evidence (case photo #33)

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash the case vehicle's driver [19-year-old, White (non-Hispanic) female; 165 centimeters and 64 kilograms (65 inches, 140 pounds)] was seated in an upright posture with her back against the seat back, her left foot on the floor, her right foot on the brake, and both hands on the steering wheel with her arms outstretched bracing in anticipation of the impact. Her 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 middle position. The case vehicle was equipped with a telescoping steering column, and the steering wheel was located in its rearmost position at the time of the vehicle inspection. The exact position of the adjustable pedals is unknown but based on the driver's short stature and the location of the seat track, the pedals were almost certainly extended rearward from their normal position.

The case vehicle's driver was restrained by her available, active, three-point, lap-and-shoulder, safety belt system; the belt system was equipped with a buckle-mounted pretensioner. There was no mention by the driver of belt pattern bruising and/or abrasions to her body, and the inspection of the driver's seat belt webbing, "D"-ring, and latch plate revealed no evidence of loading on any of these belt system components. Furthermore, the inspection revealed that the pretensioner had actuated (**Figure 12**), and the piston's movement was measured as 3.5 centimeters (1.4 inches). As a means of comparison, the buckle-mounted pretensioner for the front right safety belt system had not actuated, the piston had not moved, and the spacing was measured as 7 centimeters (2.8 inches). There

Figure 12: Buckle-mounted pretensioner for case vehicle's driver showing pretensioner actuated (case photo #22)

was no occupant in the front right seating position, which taken in conjunction with the air bag's deployment, indicates that the case vehicle was not equipped with any sort of occupant sensing system for that position.

The case vehicle's driver braked, attempting to avoid the crash. As a result of this attempted avoidance maneuver and the use of her available safety belts, the driver most likely moved slightly forward just prior to impact. The case vehicle's impact with the Pontiac enabled the case vehicle's driver to continue forward and slightly leftward and 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 impact, the driver loaded her safety belts and contacted her deploying driver air bag. Because the case vehicle continued straight ahead post-crash, the driver's loading on her safety belts and her interaction with the deploying air bag were most likely minimized, which is consistent with the lack of physical evidence on both her safety belt and the fabric of her air bag. As the case vehicle continued forward, the driver most likely rebounded backwards toward her seat back as a result of her loading her safety belt and interacting with the air bag. The driver does not recall her exact posture at final rest, but she was most likely seated near her pre-crash position. The driver was able to exit her vehicle without any assistance.

CASE VEHICLE DRIVER INJURIES

The driver was not transported by ambulance to the hospital. She sustained only minor injuries as a result of the crash and indicated in her interview that she did not subsequently seek any medical treatment. The self-reported injuries sustained by the case vehicle's driver included a small cut on the outside of her upper arm, just above her elbow, and a 5 centimeter (2.0 inch) diameter abrasion between her left wrist and elbow. Her abrasion most likely resulted from her deploying air bag.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Abrasion, 5 cm (2.0 in) diameter, between left wrist and elbow	minor 790202.1,2	Air bag, driver's	Probable	Interviewee (same person)
2	Laceration {cut}, small, outside left upper arm, just above elbow	minor 790600.1,2	Unknown contact mechanism	Unknown	Interviewee (same person)

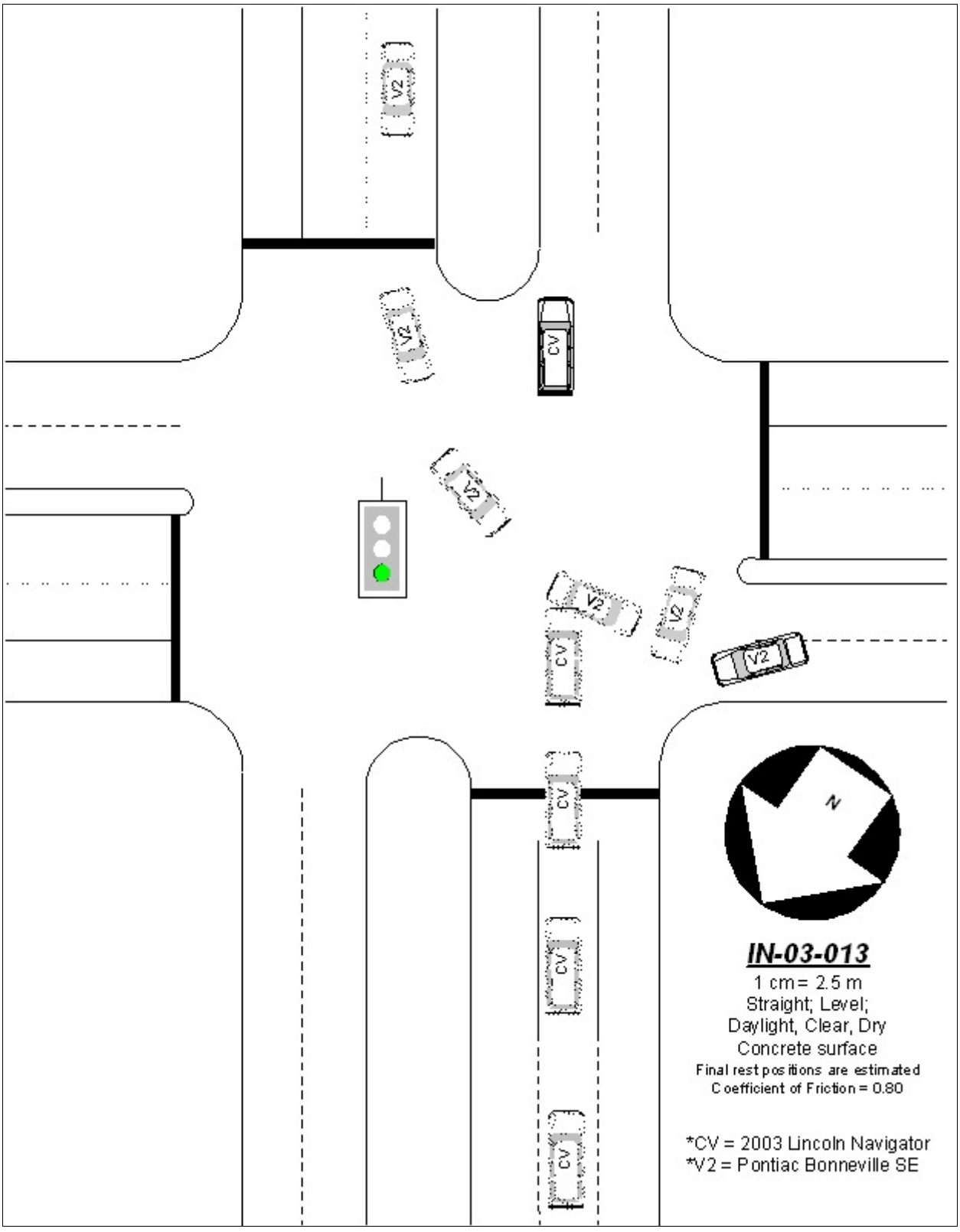
OTHER VEHICLE

Based on the VIN and manufacturer's specifications, the 2000 Pontiac Bonneville SE was a front wheel drive, six-passenger, four-door sedan (VIN: 1G2HX54K2Y4------) equipped with a 3.8L, V-6 engine and a four -speed automatic transmission. Four-wheel, anti-lock brakes are standard for this model. The Pontiac's wheelbase was 285 centimeters (112.2 inches), and the odometer reading is unknown because the Pontiac was not inspected.

The Pontiac was equipped with redesigned driver and front right passenger air bags and front seat back-mounted side impact air bags. According to the Police Crash Report, none of the vehicle's air bags deployed as a result this vehicle's impact. Furthermore, the vehicle was equipped with manual, three-point, lap-and-shoulder, safety belt systems for the front outboard and all three back seating positions. The front center seat had a manual, two-point, lap belt.

Exterior Damage: With no available vehicle photographs and no inspection, the CDC for the Pontiac is not estimable. The WinSMASH reconstruction program, missing vehicle algorithm, was used on the Pontiac's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 24.0 km.p.h. (14.9 m.p.h.), -18.4 km.p.h. (-11.4 m.p.h.), and -15.4 km.p.h. (-9.6 m.p.h.). The Pontiac was towed due to damage.

Pontiac's Occupants: According to the Police Crash Report, the Pontiac's driver [37-year-old, Black (unknown if Hispanic) female] and back center passenger [10-year-old, (unknown race and/or ethnic origin) male] were restrained by their available, active, three-point, lap-and-shoulder, safety belt systems. Neither occupant was transported by ambulance to the hospital, and they did not sustain any injuries as a result of this crash.


V2
V2
CV
V2
V2
V2
V2
CV
CV
CV
CV
N
IN-03-013
1 cm = 2.5 m
Straight; Level;
Daylight, Clear, Dry
Concrete surface
Final rest positions are estimated
Coefficient of Friction = 0.80
*CV = 2003 Lincoln Navigator
*V2 = Pontiac Bonneville SE