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ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE INVESTIGATION

CASE NUMBER - IN-04-021
LOCATION - TEXAS
VEHICLE - 2003 CHEVROLET C1500 TAHOE
CRASH DATE - May 2004

Submitted:

August 28, 2007

Contract Number: DTNH22-01-C-07002

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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 2003 Chevrolet C1500 Tahoe, four-door utility vehicle, with manual safety belts and dual front advanced air bags, and a 2002 Chrysler Town & Country, extended minivan

16. *Abstract*
This report covers an on-site investigation of an air bag deployment crash that involved a 2003 Chevrolet Tahoe (case vehicle) and a 2002 Chrysler Town and Country minivan (other vehicle). This crash is of special interest because the case vehicle was equipped with multiple **A**dvanced **O**ccupant **P**rotection **S**ystem (**AOPS**) features, including certified advanced 208-compliant air bags, as well as an **E**vent **D**ata **R**ecorder (**EDR**) and the case vehicle's driver (41-year-old, female) sustained only minor soft tissue trauma as a result of the crash. The trafficway on which the case vehicle was traveling was a seven-lane, divided, city street, traversing in an east-west direction, and the case vehicle was approaching a four-leg intersection. On the eastern leg of the intersection, both the eastbound and westbound roadways had three through lanes, and the westbound roadway had a left-hand turn lane. The trafficway on which the Chrysler was traveling was a four-lane, undivided, city street, traversing in a north-south direction, and the Chrysler was approaching the same four-leg intersection. On the south leg of the intersection, there were two through lanes in both the north and south directions. The case vehicle was traveling west in the center westbound through lane. The Chrysler was traveling north in the outside northbound through lane. The crash occurred in the four-leg intersection of the two trafficways. The left front half of the case vehicle was impacted by the front of the Chrysler (i.e., 1st event). As a result, the case vehicle and the Chrysler were redirected toward the northwest corner of the intersection. During their west-northwestward movement, the case vehicle's left rear side slapped the right rear corner of the Chrysler (i.e., 2nd event). The Chrysler traveled off the northwest corner of the intersection and impacted an embedded steel post with its front right (i.e., 3rd event). The case vehicle continued in its west-northwesterly travel direction, traveling off the northwest corner of the intersection. The case vehicle and impacted a metal protective corner post (i.e., 4th event) with its front left. About the same time, the front right bumper collided with the southeast corner of a concrete bus bench (i.e., 5th event). Finally, a bus stop sign post impacted the right rear portion of the case vehicle as it continued forward. Both vehicles came to rest in the convenience store parking lot. Neither the case vehicle's driver nor the front right passenger supplemental restraint systems (air bags) deployed during the crash sequence. The driver was most likely seated with her seat track located in a position near the middle, and the tilt steering wheel was located in its center position. She was restrained by her available, active, three-point, integral lap-and-shoulder, safety belt system and sustained, according to her medical records, minor soft tissue injuries to the left side of her body.

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This investigation was brought to NHTSA's attention on or before June 18, 2004 by NASS CDS/GES sampling activities. This crash involved a 2003 Chevrolet Tahoe (case vehicle) and a 2002 Chrysler Town and Country minivan (other vehicle). The crash occurred in May 2004 at 6:52 a.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**dvanced **O**ccupant **P**rotection **S**ystem (**AOPS**) features, including certified advanced 208-compliant air bags, as well as an **E**vent **D**ata **R**ecorder (**EDR**) and the case vehicle's driver [41-year-old, White (Hispanic) female] sustained only minor soft tissue trauma as a result of the crash. This contractor inspected the scene and case vehicle on June 29, 2004 and downloaded the data from the onboard **EDR**. This contractor was unable to interview the case vehicle's driver. This report is based on the Police Crash Report, scene and case vehicle inspections, occupant kinematic principles, occupant medical records, and this contractor's evaluation of the evidence.

SUMMARY

The trafficway on which the case vehicle was traveling was a seven-lane, divided, city street, traversing in an east-west direction, and the case vehicle was approaching a four-leg intersection. On the eastern leg of the intersection, both the eastbound and westbound roadways had three through lanes, and the westbound roadway had a left-hand turn lane. The trafficway on which the Chrysler was traveling was a four-lane, undivided, city street, traversing in a north-south direction, and the Chrysler was approaching the same four-leg intersection. On the south leg of the intersection, there were two through lanes in both the north and south directions. At the time of the crash the light condition was daylight, the atmospheric condition was cloudy, and the road pavement was dry; see **CRASH DIAGRAM** at end.

The case vehicle was traveling west in the center westbound through lane. The Chrysler was traveling north in the outside northbound through lane. Based on the available information, the case vehicle's driver braked, attempting to avoid the crash. The crash occurred in the four-leg intersection of the two trafficways.

The left front half of the case vehicle was impacted by the front of the Chrysler (i.e., 1st event). Neither the case vehicle's driver nor the front right passenger supplemental restraint systems (air bags) deployed during the initial impact. As a result of the initial impact, the case vehicle and the Chrysler were redirected toward the northwest corner of the intersection.

During their west-northwestward movement toward the northwest corner of the intersection, the case vehicle's left rear side slapped the right rear corner of the Chrysler (i.e., 2nd event). The exact trajectory of the Chrysler toward final rest is unknown but, based on the available evidence, the Chrysler traveled off the northwest corner of the intersection and most likely impacted an embedded steel post with its front right (i.e., 3rd event). As a result the Chrysler most likely rotated approximately 180 degrees clockwise and came to rest in a convenience store lot on the northwest corner of the intersection, heading in an east-southeasterly direction.

The case vehicle continued in its west-northwesterly travel direction, traveling off the northwest corner of the intersection. The case vehicle most likely departed the northwest corner of the intersection, and its front left impacted a metal protective corner post (i.e., 4th event). About the same time, the front right bumper collided with the southeast corner of a concrete bus bench (i.e., 5th event). Once again, neither of the case vehicle's frontal air bags deployed. The case vehicle moved the bench clockwise as it continued along its west-northwest travel path. Furthermore, the bus stop sign post impacted the right rear portion (i.e., 6th event) of the case vehicle as the case vehicle continued forward. The case vehicle came to rest in the convenience store parking lot, heading northwest.

The 2003 Chevrolet Tahoe was a rear wheel drive (4x2), four-door sport utility vehicle (VIN: 1GNEC13Z33R------) and was **CERTIFIED ADVANCED 208-COMPLIANT**. The case vehicle was equipped with advanced driver and right front passenger supplemental restraint systems (air bags) which did not deploy as a result of the left front impact.

Based on the vehicle inspection the CDCs for the case vehicle were determined to be: **10-LYEW-3** (**300** degrees) for the initial (i.e., 1st event) and most severe impact, **09-LBEW-1** (**270** degrees) for the side slap impact (i.e., 2nd event), **12-FLEN-1** (**0** degrees) for the protective corner pole impact (i.e., 4th event), **12-FRLN-1** (**0** degrees) for the bench impact (i.e., 5th event); and **01-RZES-1** (**20** degrees) for the right sideswipe impact (i.e., 6th event). The WinSMASH reconstruction program, missing vehicle algorithm, was used on the case vehicle's highest severity, initial impact (i.e., 1st event). The case vehicle was towed due to damage.

The data downloaded from the case vehicle's **EDR** showed that the case vehicle was traveling at a speed of 77 km.p.h. (48 m.p.h.), the driver's seat belt status was buckled and, for the non-deployment event (1st event), the Delta V was 4.49 km.p.h. (2.79 m.p.h.) at the 150 millisecond mark of recorded data.

The 2002 Chrysler Town and Country was a front wheel drive, four-door minivan (VIN: 2C4GP44302R------). The Chrysler was equipped with four wheel, anti-lock brakes and redesigned driver and front right passenger air bags which deployed as a result this vehicle's impact.

The driver of the case vehicle (41-year-old, female) was most likely seated with her seat track located in a position near the middle, and the tilt steering wheel was located in its center position. She was restrained by her available, active, three-point, integral lap-and-shoulder, safety belt system and sustained, according to her medical records, minor soft tissue injuries to the left side of her body.

Chrysler's Occupants: According to the Police Crash Report, the Chrysler's driver [34-year-old, unknown race (Hispanic) female]; back left passenger [4-year-old, (unknown race and/or ethnic origin) male]; and back right passenger [9-year-old, (unknown race and/or ethnic origin) female] were all restrained by their available active, three-point, lap-and-shoulder, safety belt systems. The driver was transported by ambulance to the hospital. She sustained police-reported "A" (incapacitating) injuries, but her treatment status and exact injuries are unknown. The back left

and back right passengers refused transport to the hospital, and they did not sustain any police-reported injuries as a result of this crash.

CRASH CIRCUMSTANCES

Figure 1: Case vehicle's westbound travel path in center through lane of western roadway of divided city trafficway (case photo #01)

Figure 2: Case vehicle's westbound travel path in center through lane of western roadway near beginning of left-hand turn lane (case photo #01a)

Crash Environment: The trafficway on which the case vehicle was traveling was a seven-lane, divided, city street, traversing in an east-west direction, and the case vehicle was approaching a four-leg intersection (**Figure 1**). On the eastern leg of the intersection, both the eastbound and westbound roadways had three through lanes, and the westbound roadway had a left-hand turn lane (**Figure 2**). The trafficway on which the Chrysler was traveling was a four-lane, undivided, city street, traversing in a north-south direction, and the Chrysler was approaching the same four-leg intersection (**Figure 3**). On the south leg of the intersection, there were two through lanes in both the north and south directions.

Figure 3: Chrysler's northbound travel path in outside northbound lane approaching four-leg intersection (case photo #11)

The case vehicle's city roadway was straight and level at the area of impact. The pavement was bituminous but polished, and the width of the center westbound through lane was 3.0 meters (9.8 feet). The westbound roadway was bordered by barrier curbs with the curb on the south associated with an unprotected, raised concrete median (**Figure 2**). The median at the mouth of the intersection was approximately 1.1 meters (3.6 feet) wide, separating the east and westbound roadways. Pavement markings consisted of a single solid white lane line that separated the westbound left-hand turn lane from the inside through lane while the three through lanes were divided by dashed white lines (**Figure 2** above). In addition, no edge line was present on the north side and no centerline was present just prior to the southern median curb. The estimated

coefficient of friction was 0.65. Traffic controls consisted of three on-colors, pre-timed, vertically mounted traffic control signals that were located on the western leg of the intersection. One was mounted on a pole in the median, a second was mounted on a pole on the northwestern corner of the intersection, and the third was hanging from a traffic control arm over the center through lane (**Figure 4**). The speed limit was 56 km.p.h. (35 m.p.h.). No regulatory speed limit sign was posted near the crash site.

Figure 4: Case vehicle's westbound travel path in center through lane into four-leg intersection; arrow indicates approximate area of impact (case photo #03)

Figure 5: Chrysler's northern travel path in outside northbound lane just prior to four-leg intersection; Note: arrow shows approximate area of impact (case photo #13)

The Chrysler's city roadway was straight and level at the area of impact. The pavement was bituminous but polished, and the width of the outside northbound lane was 3.1 meters (10.2 feet). The north-south roadway was bordered by barrier curbs with associated concrete rain gutters. Pavement markings consisted of a double solid yellow centerline for both north and southbound traffic, and a single broken white lane line that separated the outside northbound through lane from the inside through lane. In addition, no edge lines were present (**Figure 3** above). The estimated coefficient of friction was 0.65. Traffic controls consisted of two on-colors, pre-timed, traffic control signals that were located on the northeast quadrant of the four-leg intersection. One signal was horizontally mounted on the signal pole and the other was vertically mounted a signal pole arm (**Figure 5**). The speed limit was 48 km.p.h. (30 m.p.h.). No regulatory speed limit sign was posted near the crash site.

Figure 6: Case vehicle's initial (1st event) left side damage from impact by front of Chrysler (case photo #27)

At the time of the crash the light condition was daylight, the atmospheric condition was cloudy, and the road pavement was dry. Traffic density was most likely light-to-moderate, and the crash scene area was a combination of urban residential and commercial; see **CRASH DIAGRAM** at end.

Pre-Crash: The case vehicle was traveling west in the center westbound through lane and intended to continue straight ahead (**Figure 4** above). The Chrysler was traveling north in the outside northbound through lane and intended to continue straight ahead (**Figure 5** above). Based on the available information, the case vehicle's driver braked, attempting to avoid the crash. The crash occurred in the four-leg intersection of the two trafficways.

Crash: The left front half (**Figure 6** above and **Figure 7**) of the case vehicle was impacted by the front of the Chrysler (i.e., 1st event). Neither the case vehicle's driver nor the front right passenger supplemental restraint systems (air bags) deployed during the initial impact. As a result of the initial impact, the case vehicle (**Figure 8**) and the Chrysler (**Figure 9**) were redirected toward the northwest corner of the intersection.

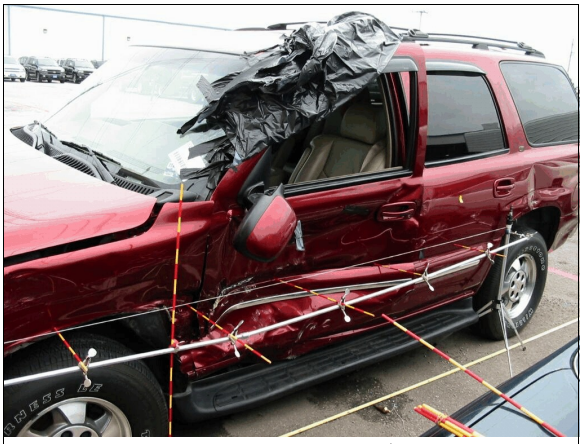

Figure 7: Case vehicle's initial (1st event) left side damage showing C_1 through C_5 crush positions with contour gauge positioned above sill level (case photo #29)

Figure 8: Case vehicle's post-crash travel path toward northwest corner of intersection viewed from center through lane at mouth of intersection (case photo #04)

Figure 9: Chrysler's west-northwest travel path toward northwest corner of intersection following initial impact with case vehicle (case photo #14)

Post-Crash: During their west-northwestward movement toward the northwest corner of the intersection, the case vehicle's left rear (**Figure 10** below) side slapped the right rear corner of the Chrysler (i.e., 2nd event). The exact trajectory of the Chrysler toward final rest is unknown but, based on the available evidence, the Chrysler traveled off the northwest corner of the intersection and most likely impacted an embedded steel post with its front right (i.e., 3rd event). As a result the Chrysler most likely rotated approximately 180 degrees clockwise and came to rest in a convenience store lot on the northwest corner of the intersection, heading in an east-southeasterly direction.

The case vehicle continued in its west-northwesterly travel direction, traveling off the northwest corner of the intersection (**Figure 11** below). Based on the crush damage to the case

vehicle, the most likely scenario is that after the case vehicle departed the northwest corner of the intersection, the front left impacted a metal protective corner post (**Figure 12**–4th event–Note: metal post was not present during scene inspection) while at about the same time the front right bumper collided with the southeast corner of a concrete bus bench (**Figure 11** and **Figure 13** below–5th event). Once again, neither of the case vehicle's frontal air bags deployed. The case vehicle moved the bench clockwise as it continued along its west-northwest travel path. Furthermore, the bus stop sign post (**Figure 14** below–Note: bus stop sign post has most likely been replaced since crash because current post shows no damage) impacted the right rear portion (**Figures 15** and **16** below–6th event) of the case vehicle as the case vehicle continued forward. The case vehicle came to rest in the convenience store parking lot, heading northwest (**Figure 17** below).

Figure 11: Case vehicle's follow-up impacts with post (arrow), bench, and bus stop sign post, and final rest position; Note: this contractor believes the southeast corner of the bench was on the south side of the bus stop sign post at time of crash (case photo #06)

CASE VEHICLE

The 2003 Chevrolet Tahoe was a rear wheel drive (4x2), five-passenger, four-door sport utility vehicle (VIN: 1GNEC13Z33R------) equipped with a 5.3L, V-8 engine and a four-speed

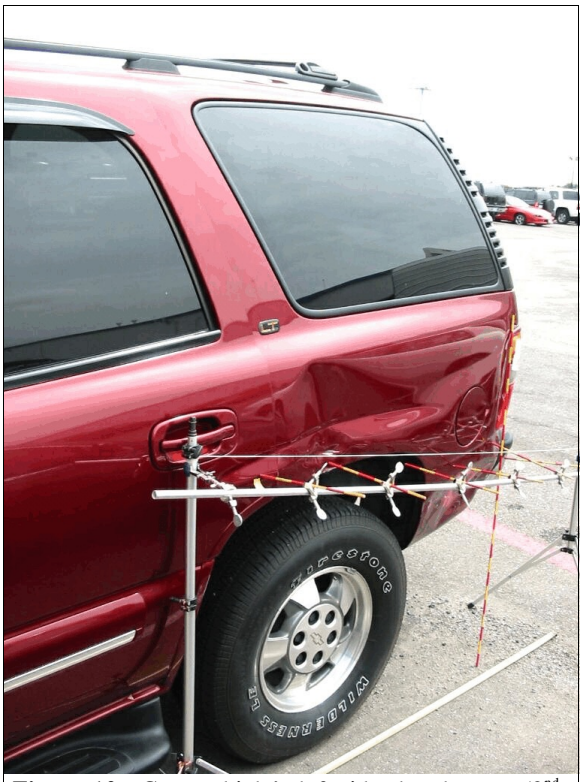

Figure 10: Case vehicle's left side slap damage (2nd event) from impact with Chrysler's right side (case photo #33)

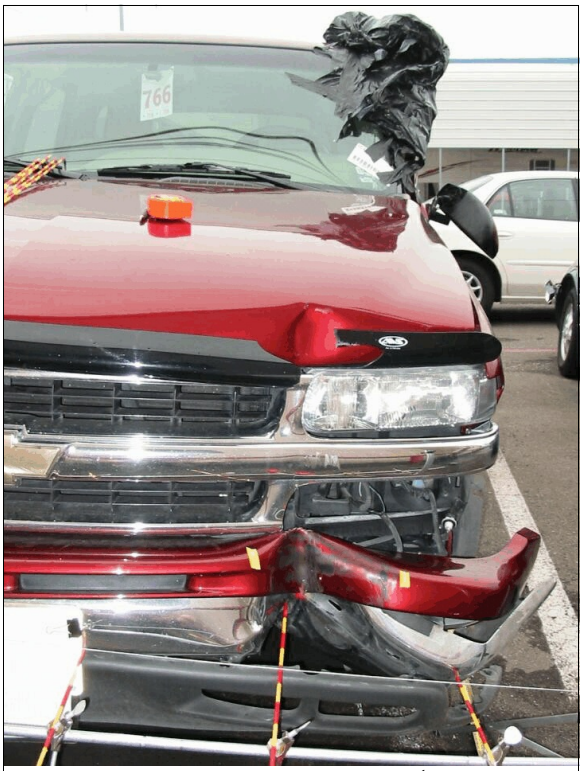

Figure 12: Case vehicle's impact (4th event) with protective corner post (case photo #22)

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. 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 (c) 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). Front seat back-mounted side impact air bags and power-adjustable pedals were optional for this model, but this vehicle was not so equipped. Finally, the case vehicle was also equipped with a LATCH system for securing child safety seats and an **E**vent **D**ata **R**ecorder (**EDR**).

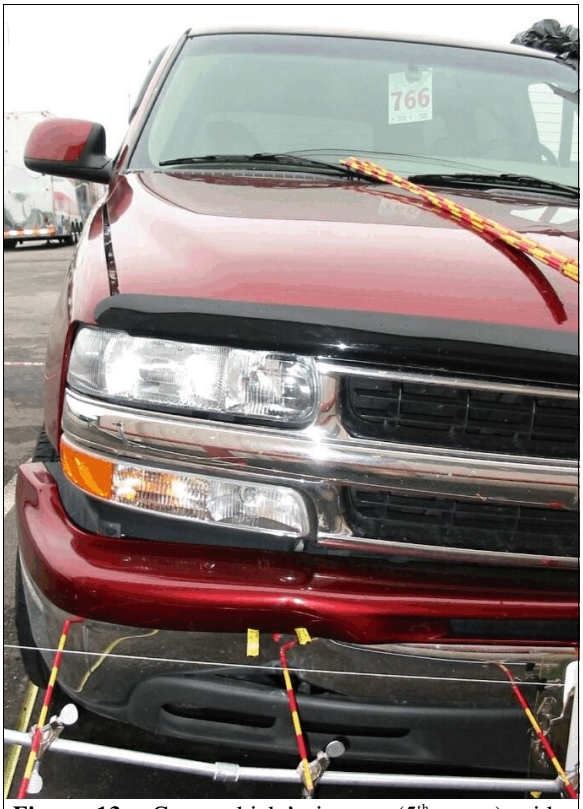

Figure 13: Case vehicle's impact (5th event) with corner of concrete bus bench (case photo #20)

Figure 14: East-southeast view from case vehicle's approximate final rest position; Note: arrow indicates approximate impact with post and this contractor believes southeast corner of bench was on south side of bus stop sign post at time of crash (case photo #08)

Figure 15: Case vehicle's right quarter panel damage (6th event) most likely from impact with bus stop sign post with contour gauge positioned above sill (case photo #40)

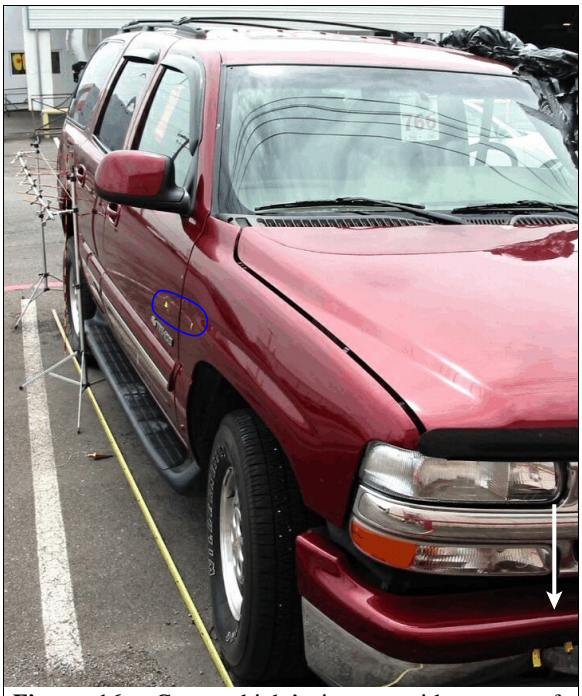

Figure 16: Case vehicle's impact with corner of concrete bus bench (arrow), unknown damage–current versus prior, near right "A"-pillar, and damage to right quarter panel from bus stop sign post (case photo #44)

Figure 17: Northwest corner of intersection showing case vehicle's impact with post–red arrow, case vehicle's approximate final rest location–blue arrows, and Chrysler's approximate final rest location–grape arrows (case photo #16)

Inspection of the vehicle's interior revealed adjustable front bucket seats with adjustable head restraints; a non-adjustable split back bench seat with adjustable head restraints for the back outboard seating positions; continuous loop, three-point, integrated lap-and-shoulder, safety belt systems at the front outboard and second seat center seating positions; and continuous loop, three-point, lap-and-shoulder, safety belts at the back outboard seating positions. The case vehicle was not equipped with any upper anchorage adjustors. 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 an advanced frontal air bag for the driver and front right passenger seating positions. Neither frontal air bag deployed as a result of any of the case vehicle's frontal decelerations.

CASE VEHICLE DAMAGE

Exterior Damage: The case vehicle's initial contact with the Chrysler (i.e., 1st event) involved the front half of the left side (**Figures 6** and **7** above). Direct damage began 87 centimeters (34.3 inches) forward of the left rear axle and extended 243 centimeters (95.7 inches) forward along the left side of the vehicle. The Field L measured 260 centimeters (102.4 inches). Residual maximum crush was measured as 22 centimeters (8.7 inches) at C_3 (**Figure 7** above). The case vehicle's left fender, left front wheel assembly, left front door, left outside rearview mirror, and a small area of the left rear door were

directly damage and crushed inward. As a result of the initial impact, there was induced damage to the left side of the windshield (cracked but in place), and the left front window's glazing was disintegrated.

The case vehicle's left side slap with the Chrysler (i.e., 2nd event) involved the rear half of the left side (**Figure 10** above). Direct damage began 31 centimeters (12.2 inches) forward of the left rear axle and extended 139 centimeters (54.7 inches) rearward. Residual maximum crush was measured as 4 centimeters (1.6 inches) at C_1 (**Figure 18**). The case vehicle's left quarter panel, left rear bumper, and left rear tail/stop light and turn signal assemblies were directly damaged and crushed inward. There was induced damage to the left rear door.

Figure 18: Case vehicle's left side slap damage (2nd event) viewed from left of back (case photo #36)

Figure 19: Overhead view of case vehicle's frontal impacts (i.e., post–blue arrows, bench–grape arrow) with contour gauge positioned at bumper level (case photo #23)

The case vehicle had two frontal impacts–4th and 5th events, and the damage (i.e., direct and induced) was distributed across the entire front (**Figures 12** and **13** above). The first frontal impact (i.e., 4th event) was with a metal sign post and involved the left portion of the bumper. Direct damage began 18 centimeters (7.1 inches) inward from the front left bumper corner and extended 25 centimeters (9.8 inches) rightward along the front bumper. Residual maximum crush was measured as 21 centimeters (8.3 inches) at C_2 (**Figure 19**). The case vehicle's front upper and lower bumper fascia, grille, hood, and left front headlight and turn signal assemblies were directly damaged and crushed rearward. There was induced damage to the entire front bumper. No remote buckling was noted. The second frontal impact (i.e., 5th event) was with the concrete bus bench and involved the right portion of the front bumper. Direct damage began 29 centimeters (11.4 inches) inward of the front right bumper corner and extended 6 centimeters (2.4 inches) leftward along the front bumper. Residual maximum crush was measured as 9 centimeters (3.5 inches) at C_5. The case vehicle's front right bumper fascia was directly damaged and crushed rearward. Once again, the entire front bumper sustained induced damage.

Figure 20: Case vehicle's right quarter panel damage (6th event) most likely from impact with bus stop sign post viewed from right of back (case photo #38)

The case vehicle's right sideswipe impact–6th event, with the bus stop sign post involved approximately the rear one-third of the right side (**Figure 15** above). Direct damage began 56 centimeters (22.0 inches) forward of the right rear axle and extended 156 centimeters (61.4 inches) rearward. Residual maximum crush was measured as 4 centimeters (1.6 inches) at C_2 and C_3 (**Figure 20** above). The case vehicle's right rear door, right quarter panel, and rear bumper were directly damaged and crushed inward. There was damage to the right front door, but it could not be determined if this damage was related to this crash or prior damage. There was no obvious induced damage or remote buckling noted as a result of this impact.

The table below shows the case vehicle's crush profiles.

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	243	22	260	0	10	22	15	7	0	67	74
in		95.7	8.7	102.4	0.0	3.9	8.7	5.9	2.8	0.0	26.4	29.1
cm	2	139	4	139	4	3	2	0	3	0	-184	-184
in		54.7	1.6	54.7	1.6	1.2	0.8	0.0	1.2	0.0	-72.4	-72.4
cm	4&5	25[1]	21	180	0	21[2]	4	3	9[3]	0	-57[4]	0
in		9.8	8.3	70.9	0.0	8.3	1.6	1.2	3.5	0.0	-22.4	0.0
cm	6	156	4	156	0	4	4	3	1	0	-169	-169
in		61.4	1.6	61.4	0.0	1.6	1.6	1.2	0.4	0.0	-66.5	-66.5

The wheelbase on the case vehicle's left side was shortened 3 centimeters (1.2 inches) while the right side was shortened 1 centimeter (0.4 inches). No obvious induced damage or remote buckling was noted to the remainder of the case vehicle's exterior. The 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 sustained a slight sidewall damage debeading it from the rim.

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[1] This direct damage width was for the pole impact. The direct damage width for the impact with the concrete bench was 6 centimeters (2.4 inches). Field L was 169 centimeters (66.5 inches), but the undeformed end width was 180 centimeters (70.9 inches).

[2] This crush measurement reflects the crush from the pole impact.

[3] This crush measurement reflects the crush from the impact with the concrete bench.

[4] This direct damage offset was for the pole impact. The direct damage offset for the impact with the concrete bench was +58 centimeters (+22.8 inches).

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	7	9	Sidewall cut	No	Yes
RF	221	32	241	35	6	8	None	No	No
LR	241	35	241	35	6	8	None	No	No
RR	228	33	241	35	6	8	None	No	No

Figure 21: Case vehicle's driver seating area viewed from right showing contact evidence on driver's door (yellow tape) and blood on driver's seat (case photo #51)

Figure 22: Close-up of possible body fluid and/or contact on case vehicle's driver door (case photo #52)

Figure 23: Close-up of area where case vehicle's driver door handle was broken off driver's door (case photo #55)

Figure 24: Broken off door handle from case vehicle's driver door (case photo #57)

Interior Damage: Inspection of the case vehicle's interior revealed contacts to the left front door (**Figure 21**). It appears as if there is some type of fluid on the left front door panel (**Figure 22**) and the door handle was broken off (**Figures 23** and **24**), most likely by the left hip or thigh of the

driver as she moved leftward along a path opposite the case vehicle's **300** degree Direction of Principal Force. Furthermore, blood stains were found on the front right portion of the driver's seat (**Figures 25** and **26**). The case vehicle sustained multiple intrusions the driver's seating area. There were lateral intrusions to the interior surface of the driver's door, the side panel forward of the left "A"-pillar, and to the left instrument panel/driver's knee bolster. Furthermore, there was a longitudinal intrusion to the toe pan area, and a vertical intrusion to the driver's knee bolster. The greatest intrusion was measured as 19 centimeters (7.5 inches) laterally to the driver's door. Finally, there was no evidence of compression of the energy absorbing shear capsules in the base of the steering column and no deformation to the steering wheel rim.

Figure 25: Blood stains on front right portion of case vehicle's driver seat (case photo #53)

Figure 26: Close-up of blood stains on front right and right front portions of case vehicle's driver seat (case photo #53a)

Damage Classification: Based on the vehicle inspection the CDCs for the case vehicle were determined to be: **10-LYEW-3** (**300** degrees) for the initial (i.e., 1st event) and most severe impact, **09-LBEW-1** (**270** degrees) for the side slap impact (i.e., 2nd event), **12-FLEN-1** (**0** degrees) for the protective corner pole impact (i.e., 4th event), **12-FRLN-1** (**0** degrees) for the bench impact (i.e., 5th event); and **01-RZES-1** (**20** degrees) for the right sideswipe impact (i.e., 6th event). The WinSMASH reconstruction program, missing vehicle algorithm, was used on the case vehicle's highest severity, initial impact (i.e., 1st event). The Total, Longitudinal, and Lateral Delta Vs are, respectively: 13.0 km.p.h. (8.1 m.p.h.), -6.5 km.p.h. (-4.0 m.p.h.), and +11.3 km.p.h. (+7.0 m.p.h.). Furthermore, the WinSMASH reconstruction program, missing vehicle algorithm, was used on the case vehicle's left side slap impact (i.e., 2nd event). The Total, Longitudinal, and Lateral Delta Vs are, respectively: 5.0 km.p.h. (3.1 m.p.h.), 0.0 km.p.h. (0.0 m.p.h.), and +5.0 km.p.h. (+3.1 m.p.h.). In addition, the WinSMASH reconstruction program, barrier algorithm, was used on the case vehicle's combined frontal impacts (i.e., 4th and 5th events). The calculated Total, Longitudinal, and Lateral Delta Vs for the combined effect of these two frontal impacts are, respectively: 17.0 km.p.h. (10.6 m.p.h.), -17.0 km.p.h. (-10.6 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). This barrier calculation is provided only for comparison purposes. In other words, the Delta Vs indicate the velocity change that would have resulted if the measured crush was a result of an impact with a rigid barrier. The frontal impacts do not fit the reconstruction model because (1) the crush pattern is a result of two impacts which had overlapping damage and (2) both objects yielded. Finally, no reconstruction program was used

on the case vehicle's right sideswipe impact because this impact was outside the scope of the program. This contractor's visually estimated Delta V for both frontal impacts and the right sideswipe impact is minor [2-13 km.p.h. (1-8 m.p.h.)]. The case vehicle was towed due to damage.

Figure 27: Vertical view of case vehicle's driver seating area showing non-deployed driver air bag, intrusion to lower instrument panel, and blood on front right edge of driver's seat (case photo #48)

Figure 28: Case vehicle's front right seating area showing non-deployed front right air bag, and no obvious contact evidence to instrument panels or greenhouse areas (case photo #50)

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with a Supplemental Restraint System (SRS) that contained advanced (i.e., dual stage inflators) frontal air bags at the driver and front right passenger positions. The driver's air bag was located in the steering wheel hub (**Figure 27**) and the front right passenger's air bag was located in the middle of the instrument panel (**Figure 28**). Neither of these air bags deployed in this crash's initial impact or in either of the subsequent frontal impacts because the case vehicle's crash sensing algorithm apparently determined that the developing longitudinal component of Delta-V would not be severe enough to require their deployment. This observation is supported for initial impact (i.e., 1st event) by the results of the WinSMASH reconstruction that is presented above. While the case vehicle's specific deployment threshold zone for the front air bags is not known, a typical range is 13 to 22 km.p.h. (8 to 14 m.p.h.) for unbelted occupants, and likely higher for belted occupants.

CRASH DATA RECORDING

This contractor believes that the data downloaded from the case vehicle's **EDR** was recorded during the case vehicle's initial impact (i.e., 1st event). The data show the vehicle's SIR warning lamp status, driver's seat belt buckle status, vehicle's speed and brake switch status for the five recorded sample periods preceding the **ALGORITHM ENABLE**, ignition cycles at non-deployment, time from algorithm enable to maximum **SDM** (i.e., ***SENSING AND DIAGNOSTIC MODULE***) recorded velocity change, and velocity change (i.e., Delta V). Downloaded data of interest indicated the following. The case vehicle was traveling at a speed of 77 km.p.h. (48 m.p.h.), the driver's seat belt status showed it was buckled,

and the Delta V was 4.49 km.p.h. (2.79 m.p.h.) at the 150 millisecond mark of recorded data; see **EVENT DATA RECORDER DATA** (**Figures 30** through **32** below. This contractor believes that the recorded Delta V seems reasonable considering the primary amount of deformation was to the case vehicle's left side.

CASE VEHICLE DRIVER KINEMATICS

The exact posture of the case vehicle's driver [41-year-old, White (Hispanic) female; of unknown height and weight] immediately prior to the crash is unknown, but she was most likely seated with her back against the seat back, her left foot on the floor, her right foot on the brake, and at least one of her hands on the steering wheel; however, the position of her hand(s) is unknown. Her seat track was located in a position near the middle [i.e., the front edge of her seat cushion was 64 centimeters (25.2 inches) from the left "B"-pillar], 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 her available, active, three-point, integral lap-and-shoulder, safety belt system. Inspection of the driver's seat belt webbing, shoulder belt guide, and latch plate showed only trace evidence (i.e., waffling) of loading (**Figure 29**).

Figure 29: Case vehicle's driver seat belt webbing showing loading evidence–waffling (case photo #61)

Based on the available evidence, the case vehicle's driver activated the brake, attempting to avoid the crash. As a result of this attempted avoidance maneuver and the use of her available safety belts, the driver's pre-impact body position most likely did not significantly change just prior to impact. The case vehicle's primary impact with the Chrysler enabled the case vehicle's driver to continue slightly forward and leftward along a path opposite the case vehicle's **300** degree Direction of Principal Force as the case vehicle decelerated. As a result, she loaded the interior surface of the intruding driver's door (**Figures 21** through **24** and **27** above) and was certainly contacted by the door's disintegrating glazing (**Figure 7** above). After this initial impact, the driver likely rebounded rightward and slightly rearward toward her seat back. The case vehicle's left side slap impact (i.e., 2nd event) with the Chrysler most likely enabled her to move leftward toward the case vehicle's **270** degree Direction of Principal force. As the vehicles separated, the driver most likely rebounded rightward toward the center console and slightly backward as the case vehicle continued forward toward the northwest corner of the intersection where the vehicle departed the roadway and jumped the curb. The front of the case vehicle impacted first a metal pole (i.e., 4th event) and shortly thereafter (i.e., 5th event) a concrete bench. These impacts enabled the driver to continue slightly forward along a path opposite the case vehicle's **0** degree Direction of Principal Force as the case vehicle decelerated. As a result, the driver most likely loaded her safety belts and may have contacted her steering wheel and hub. As the case vehicle

continued forward, the driver's posture most likely did not change. The case vehicle's right sideswipe contact with the bus stop sign pole most likely did not have any significant effect on the driver's posture. As the case vehicle came to rest, the driver most likely rebounded backward toward her seat back. Her use of her safety belts enabled her to remain near her pre-crash seating position throughout the crash sequence. Her exact posture at final rest is unknown.

CASE VEHICLE DRIVER INJURIES

The driver was transported by ambulance to the hospital. She sustained minor injuries and was treated and released. According to her medical records, the injuries sustained by the case vehicle's driver involved soft tissue trauma to her left side.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusions {soft tissue trauma} left side of chest	minor 490402.1,2	Left side interior surface, excluding hardware and/or armrest	Probable	Emergency room records
2	Contusions {soft tissue trauma} left side of abdomen	minor 590402.1,2	Left side interior hardware and/or armrest	Probable	Emergency room records
3	Contusions {soft tissue trauma} left arm, not further specified	minor 790402.1,2	Left side interior surface, excluding hardware and/or armrest	Probable	Emergency room records
4	Contusions {soft tissue trauma} left leg, not further specified	minor 890402.1,2	Left side interior surface, excluding hardware and/or armrest–forward of left "A"-pillar	Probable	Emergency room records

OTHER VEHICLE

Based on the VIN and manufacturer's specifications, the 2002 Chrysler Town and Country was a front wheel drive, seven-passenger, four-door extended minivan (VIN: 2C4GP44302R------) equipped with a 3.3L, V-6 engine and a four-speed automatic transmission. Braking was achieved by a power-assisted, front disc and rear drum, four-wheel, anti-lock system. The Chrysler's wheelbase was 303 centimeters (119.3 inches), and the odometer reading is unknown because the Chrysler was not inspected. Furthermore, the vehicle was equipped with redesigned driver and front right passenger air bags which deployed as a result this vehicle's impact.

Based on the available information, the vehicle was equipped with manual, three-point, lap-and-shoulder, safety belt systems for the front, second seat, and back outboard seating positions. The second seat center seat had a manual, two-point, lap belt. Standard interior equipment included bucket seats for the driver and front right passenger, and a non-adjustable second and back bench seats.

Damage Classification: With no available vehicle photographs, the CDCs for the Chrysler are not estimable. The WinSMASH reconstruction program, missing vehicle algorithm, was used on the Chrysler's highest severity impact (i.e., initial–1st event). The Total, Longitudinal, and Lateral Delta Vs are, respectively: 14.0 km.p.h. (8.7 m.p.h.), -12.1 km.p.h. (-7.5 m.p.h.), and -7.0 km.p.h. (-4.3 m.p.h.). In addition, the WinSMASH reconstruction program, missing vehicle algorithm, was used on the Chrysler's right side slap impact (i.e., 2nd event). The Total, Longitudinal, and Lateral Delta Vs are, respectively: 6.0 km.p.h. (3.7 m.p.h.), 0.0 km.p.h. (0.0 m.p.h.), and -6.0 km.p.h. (-3.7 m.p.h.). The Chrysler was towed due to damage.

Chrysler's Occupants: According to the Police Crash Report, the Chrysler's driver [34-year-old, unknown race (Hispanic) female]; back left passenger [4-year-old, (unknown race and/or ethnic origin) male]; and back right passenger [9-year-old, (unknown race and/or ethnic origin) female] were all restrained by their available active, three-point, lap-and-shoulder, safety belt systems. The driver was transported by ambulance to the hospital. She sustained police-reported "A" (incapacitating) injuries, but her treatment status and exact injuries are unknown. The back left and back right passengers refused transport to the hospital, and they did not sustain any police-reported injuries as a result of this crash.

1GNEC13Z33Rxxxxxx System Status At Non-Deployment	
SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	BUCKLED
Ignition Cycles At Non-Deployment	5224
Ignition Cycles At Investigation	5226
Maximum SDM Recorded Velocity Change (MPH)	-3.05
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	145
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)	0.00	-0.31	-0.62	-0.93	-1.55	-1.55	-1.55	-1.86	-1.86	-2.17	-2.48	-2.79	-2.79	-2.79	-2.79

PRE-CRASH DATA				
Seconds Before AE	**Vehicle Speed (MPH)**	**Engine Speed (RPM)**	**Percent Throttle**	**Brake Switch Circuit Status**
-5	47	1920	36	OFF
-4	48	1472	42	OFF
-3	48	1344	0	OFF
-2	48	1280	13	OFF
-1	48	1088	0	ON

Figure 30: Case vehicle's non-deployment data including: pre-crash speed, brake switch status, restraint system status, time (in milliseconds) from algorithm enable to maximum SDM recorded velocity change, and the case vehicle's change in velocity (Delta V) over the first 150 milliseconds post algorithm enablement

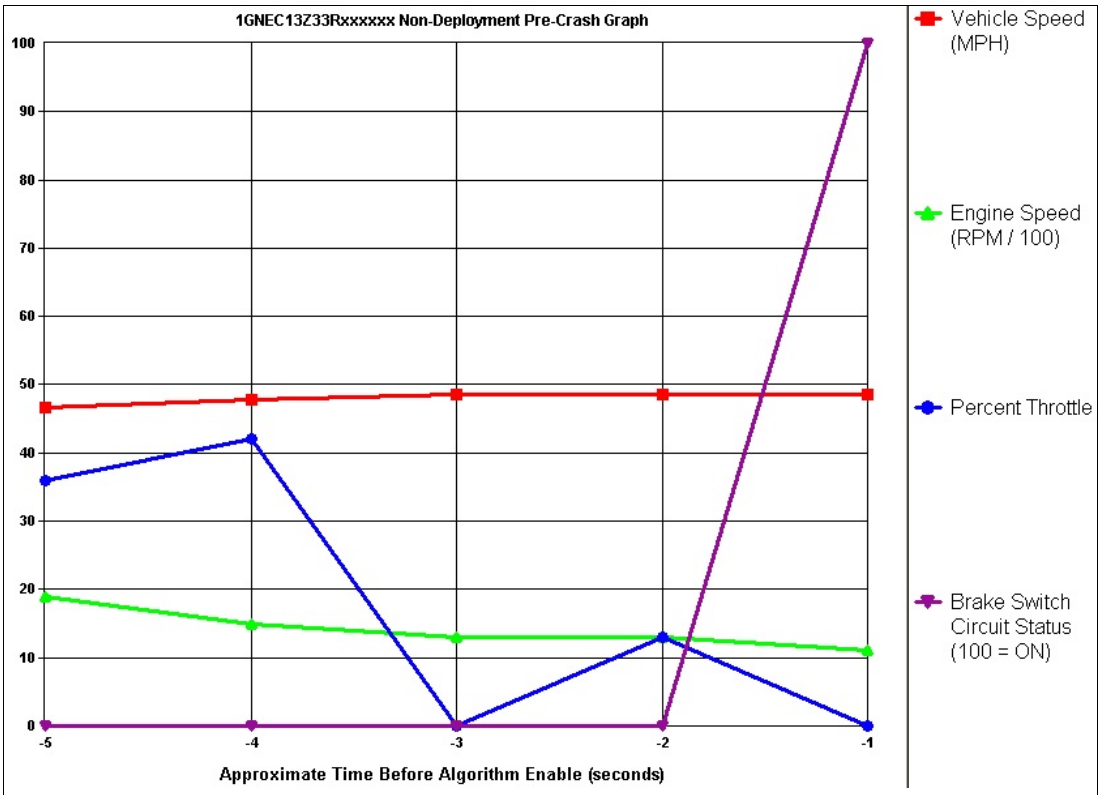


Figure 31: Case vehicle's pre-crash speed and brake switch circuit status showing that the vehicle's speed was recorded at 77 km.p.h. (48 m.p.h.) when the brake was activated approximately 1 second prior to algorithm enable.

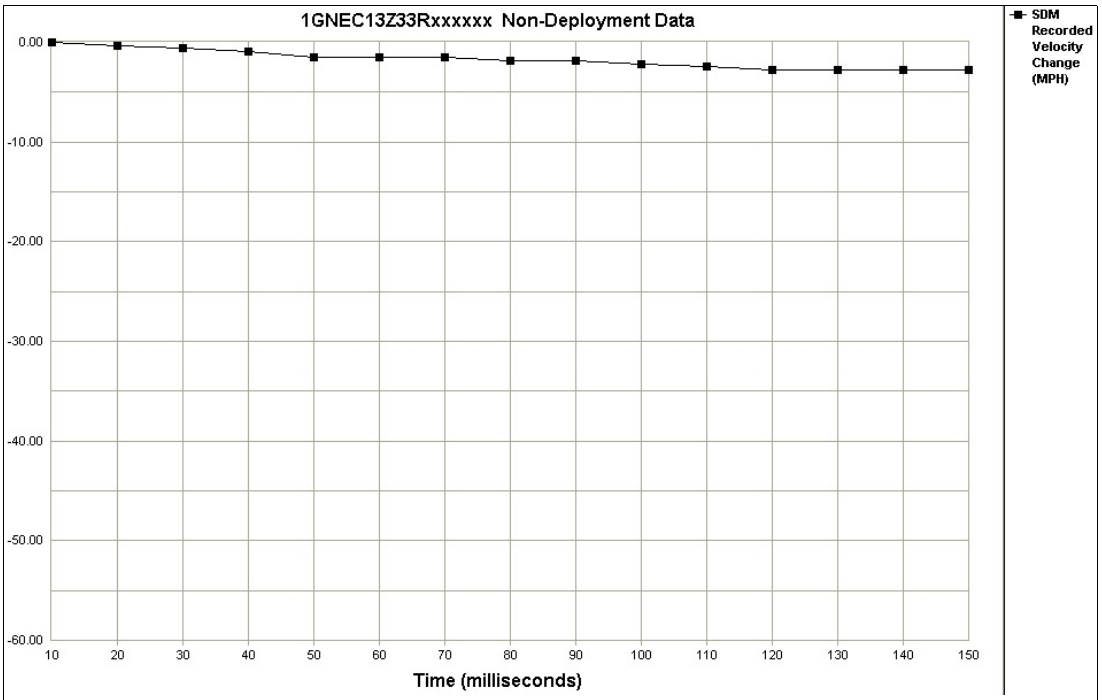
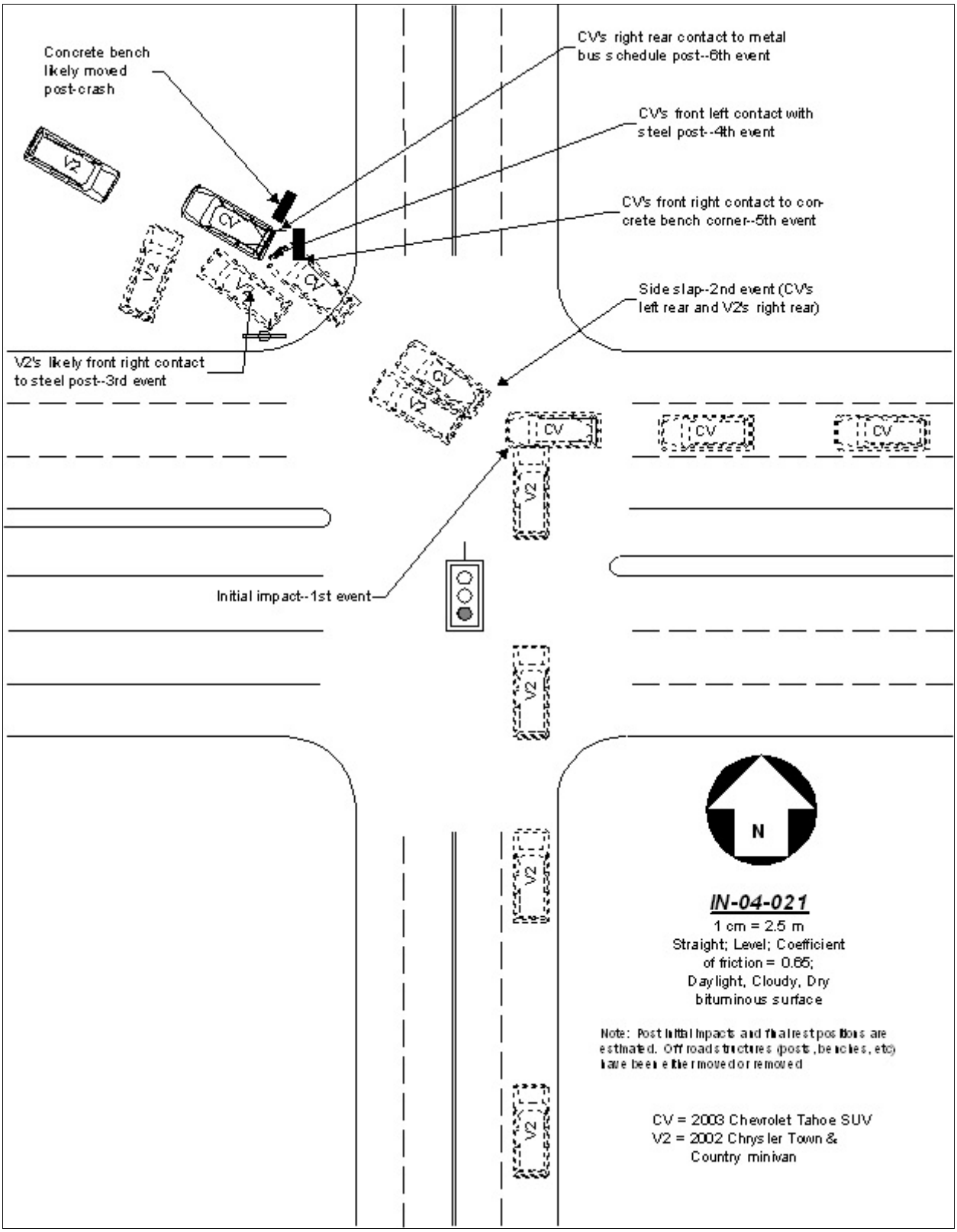


Figure 32: The case vehicle sustained a velocity change of approximately 4.5 km.p.h. (2.8 m.p.h.) during the first 150 milliseconds after the algorithm was enabled; maximum velocity change was recorded as 4.9 km.p.h. (3.1 m.p.h.) at 145 milliseconds


Concrete bench likely moved post-crash
CV's right rear contact to metal bus schedule post--6th event
CV's front left contact with steel post--4th event
CV's front right contact to concrete bench corner--5th event
Side slap--2nd event (CV's left rear and V2's right rear)
V2's likely front right contact to steel post--3rd event
Initial impact--1st event
CV
V2
N
IN-04-021
1 cm = 2.5 m
Straight; Level; Coefficient of friction = 0.65;
Daylight, Cloudy, Dry
bituminous surface
Note: Post initial impacts and final rest positions are estimated. Off roads tructures (posts, beacles, etc) have been either moved or removed
CV = 2003 Chevrolet Tahoe SUV
V2 = 2002 Chrysler Town & Country minivan