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SCI/NASS COMBINATION SIDE AIR BAG NON-DEPLOYMENT INVESTIGATION

CASE NUMBER - 2007-11-162K
LOCATION - Michigan
VEHICLE - 2001 FORD TAURUS SE
CRASH DATE - October 2007

Submitted:

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

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

Technical Report Documentation Page

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16. *Abstract* This report covers a SCI/NASS Combination Investigation of a crash involving a 2001 Ford Taurus sedan (case vehicle) that was impacted on the left side by a 2005 Dodge Stratus. This crash is of special interest because the Ford's seat back-mounted side impact air bag did not deploy. The Ford's driver (49-year-old male) sustained severe thoracic and serious abdominal injuries and was hospitalized for ten days. The Ford's front right passenger (47-year-old female) sustained a moderate pelvis injury and was hospitalized for two days. There were no other occupants in the Ford. The crash occurred at the three-leg intersection of a north-south two-lane local road and an east-west five-lane highway. The Ford had been traveling south in the southbound lane of the local road, approaching the three-leg intersection, and the driver had stopped at the stop sign with the intention of turning left to travel east on the highway. The Dodge was traveling west in the outside westbound lane on the highway, approaching the three-leg intersection and intending to pass through the intersection and continue west. Starting from a stop, the Ford began the intended left turn, entering the intersection across the Dodge's path. The Dodge's driver observed the Ford and braked without lockup. There is no evidence that the Ford's driver attempted any avoidance maneuver. The Ford's left side was impacted by the Dodge's front, causing the Dodge's driver and front right passenger air bags to deploy. No air bags deployed in the Ford. The Ford rotated counterclockwise, the Dodge rotated slightly clockwise and the Ford's left fender impacted the Dodge's left side. The Ford slid a short distance to the southwest and came to rest heading southeast in the inside westbound travel lane of the highway. The Dodge slid a short distance westward and came to rest heading northwest in the outside westbound lane of the highway. Both vehicles were towed due to disabling damage.			
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BACKGROUND

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This crash was brought to the National Highway Traffic Safety Administration's attention by National Automotive Sampling System-Crashworthiness Data System (NASS-CDS) sampling activities in November 2007 and was assigned as a Special Crash Investigation-NASS combination case on January 17, 2008. The crash involved a 2001 Ford Taurus (case vehicle) and a 2004 Dodge Stratus. The crash occurred in October 2007 at 7:08 p.m., in Michigan, and was investigated by the applicable county sheriff. This crash is of special interest because the Ford sustained an impact on its left side and the driver's seat back-mounted side impact air bag did not deploy. The Ford's driver (49-year-old male) sustained severe thoracic and serious abdominal injuries and was hospitalized for ten days. The Ford's front right passenger (47-year-old female) sustained a moderate pelvis injury and was hospitalized for two days. There were no other occupants in the Ford. This contractor received the completed version of the NASS-CDS case from the NASS Zone Center on July 22, 2008. This crash was also investigated by another research contractor on behalf of the automotive industry. With that contractor's cooperation, some of their investigative materials were used in this report.

SUMMARY

This crash occurred in the three-leg intersection of an undivided highway and a local road in a suburban commercial-residential area. Starting from a stop, the Ford began a left turn from the local road onto the highway, entering the intersection across the Dodge's path. The Ford's left side was impacted by the Dodge's front. This impact caused the Dodge's frontal air bags to deploy. However, neither the frontal nor the side air bags in the Ford deployed. The Ford rotated counterclockwise, the Dodge rotated slightly clockwise and the Ford's left fender impacted the Dodge's left side. Both vehicles slid a short distance and came to rest on the highway. Both vehicles were towed due to disabling damage.

CRASH CIRCUMSTANCES

Crash Environment: The crash occurred in the three-leg intersection of a five-lane U.S. highway and a two-lane local road. The highway was oriented in an east-west direction at the crash site, with two travel lanes in each direction separated by a continuous center left turn lane. The travel lanes were delineated by dashed white lane lines and the center left turn lane was separated from the travel lanes by continuous yellow lines on either side. The local road was oriented in a north-south direction and intersected the highway from the north, with one travel lane in each direction separated by a double yellow line. The speed limit for both roadways was 80 km.p.h. (50 m.p.h.). Traffic on the local road was controlled by a stop sign at the intersection and there were no controls for traffic on the highway. The surrounding area was suburban commercial-residential. The surface of both roadways was travel-worn asphalt, free of defects. At the time of the crash it was dark but lighted with no adverse atmospheric conditions, the road surfaces were dry and traffic density was light. See the Crash Diagram at the end of this report.

Pre-Crash: The Ford had been traveling south in the southbound lane of the local road, approaching the three-leg intersection, and the driver had stopped at the stop sign with the intention of turning left to travel eastward on the highway (**Figure 1**). The Dodge was traveling west in the outside westbound lane on the highway, approaching the three-leg intersection and intending to pass through the intersection and continue west (**Figure 2**). Starting from a stop, the Ford began the intended left turn, entering the intersection across Dodge's path. The Dodge's driver observed the Ford and braked without lockup. There was no evidence that the Ford's driver attempted any avoidance maneuver.

Figure 1: Ford's southbound approach toward stop and intended left turn

Figure 2: Dodge's westbound approach

Crash: The crash occurred within the intersection. The Ford's left side was impacted by the Dodge's front (event #1), causing the Dodge's driver and front right passenger air bags to deploy. No air bags deployed in the Ford. The Ford rotated counterclockwise, the Dodge rotated slightly clockwise and the Ford's left fender impacted the Dodge's left side (event #2).

Post-Crash: The Ford slid a short distance to the southwest and came to rest heading southeast in the inside westbound travel lane on the highway. The Dodge slid a short distance westward and came to rest heading northwest in the outside westbound lane on the highway.

CASE VEHICLE: 2001 FORD TAURUS SE

The case vehicle was a 2001 Ford Taurus SE front wheel drive, 4-door, 5-passenger sedan (VIN: 1FAHP56S31A------), equipped with a 3.0 liter, V6 gasoline engine and an automatic transmission with a console-mounted selector lever. Four-wheel anti-lock brakes were an option for this model, but it is not known if the case vehicle was so equipped. The Ford was equipped with dual-stage frontal air bags, seat back-mounted side impact air bags, buckle stalk safety belt pretensioners for the two front seat positions, and manual lap-and-shoulder safety belt systems for all 5 seat locations. This vehicle was also equipped with an Event Data Recorder (EDR), but the vehicle's damage was such that the module could not be accessed or downloaded. The odometer reading was 107,799 kilometers (66,985 miles). Its specification wheelbase was 276 centimeters (108.5 inches). The Ford was towed due to disabling damage.

CASE VEHICLE DAMAGE

Figure 3: Ford's front and right side

Figure 4: Ford's front and left side

Exterior Damage: The Ford's first impact involved direct contact to all structures below the belt line on the two left side doors, extending from the left A-pillar to the left C-pillar (**Figures 3 - 6**). The two doors, the B-pillar and the sill were crushed laterally. This direct contact damage caused the two door window frames to deform outward. There was also induced displacement of the roof side rail, buckling of the roof and minor damage on the left quarter panel. The two left side doors were jammed shut. The glazing in the two left door windows disintegrated and the windshield was cracked along its junction with the left A-pillar and the header. The wheelbase was shortened by 4 centimeters (1.6 inches) on the left and lengthened by 9 centimeters (3.5 inches) on the right. The crush profile was measured along the sill (**Figure 4**), with maximum crush identified as 49 centimeters (19.3 inches) at C3, near the junction of the B-pillar and the door sill.

The Ford also sustained minor side slap damage on the left fender (**Figure 4**). This consisted of denting and scraping on the fender, with maximum crush measured as 6 centimeters (2.4 inches) at C3, directly above the front left axle.

Figure 5: Overhead view of Ford's damage

Figure 6: Ford's damage, angle view from rear

The following table details the crush profile measurements for the Ford's two impacts.

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	202	49	291	0	20	49	43	27	7	-13	-10
in		79.5	19.3	114.6	0.0	7.9	19.3	16.9	10.6	2.8	-5.1	-3.9
cm	2	120	6	120	5	3	6	3	5	4	138	138
in		47.2	2.4	47.2	2.0	1.2	2.4	1.2	2.0	1.6	54.3	54.3

The Ford's recommended tire size was P215/60R15 and the it was equipped with four tires of this size. The Ford's tire data are detailed in the table below.

Tire	*Measured Pressure*		*Manufacturer's Recommended Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kPa	psi	kPa	psi	milli-meters	32nd of an inch			
LF	179	26	207	30	4	5	None	No	No
RF	179	26	207	30	5	6	None	No	No
LR	214	31	207	30	4	5	None	No	No
RR	214	31	207	30	5	6	None	No	No

Damage Classification: Based on the vehicle inspection, the Collision Deformation Classification (CDC) for the Ford's first left side impact (event #1) was determined to be: **10-LPEW-03 (290 degrees)**. The WinSMASH reconstruction program, damage only algorithm based on the measured crush profile of both vehicles, was used on the first impact, which was the Ford's most severe impact. The total, longitudinal and lateral delta-Vs were, respectively: 35 km/h (21.7 mph), -12 km/h (-7.5 mph) and 33 km/h (20.5 mph).

The CDC for the Ford's second left side impact (event #2, side slap) was determined to be: **10-LFEW-01 (310 degrees)**. The WinSMASH reconstruction program, damage only algorithm based on the measured crush profile of both vehicles, was used on the second impact. The total, longitudinal and lateral delta-Vs were, respectively: 8 km/h (5.0 mph), -5 km/h (-3.1 mph) and 6 km/h (3.7 mph).

Vehicle Interior: The Ford sustained numerous lateral intrusions by left side components. The largest intrusions were: the second row left door: 47 centimeters (18.5 inches); the left B-pillar: 35 cms. (13.8 ins.); the front left door: 32 cms. (12.6 ins.); the door sill below the second row left door: 26 cms. (10.2 ins.); the left roof side rail in the front row: 18 cms. (7.1 ins.). There were many lesser intrusions, including: the door sill below the driver's door: 11 cms. (4.3 ins.); driver's seat back crushed inward with the deformed seat back intruding 9 cms. (3.5 ins.) into the driver's seating space; and the center console intruding 5 cms. (2.0 ins.) into the front right passenger's seating space. There was no evidence of damage to the instrument panel and the steering wheel was not deformed. The center console was cracked on the left side due to contact by the driver and also cracked on the right side due to contact by the front right passenger. No other evidence of occupant contact was noted during the interior inspection.

AUTOMATIC RESTRAINT SYSTEM

The Ford was equipped with dual stage frontal air bags, seat back-mounted side impact air bags and buckle stalk pretensioners for the driver and the front right passenger. The vehicle sustained severe damage from the left side impact. The direction of force emanated from the 10 o'clock direction and resulted in a maximum left door intrusion of 47 cm (19"). The left B-pillar also intruded laterally 35 cm (14"), displacing the seat back to the right. Due to it being a side impact, the frontal air bags did not deploy and the buckle pretensioners did not actuate. The left seat back-mounted side air bag also did not deploy. There was no evidence that any of the intruded components impeded the deployment of the side air bag. Moreover, an analysis of the NASS images did not yield any evidence as to why the system did not deploy. The driver stated that he did not know if the vehicle has been in any previous crashes or if the air bag system had prior maintenance. Based on the severity of the impact the side air bag should have deployed. The reason it did not deploy could not be determined.

CASE VEHICLE DRIVER'S KINEMATICS

The Ford's driver [49-year-old male, 178 centimeters, 95 kilograms (70 inches, 210 pounds)] was restrained by the manual lap-and-shoulder safety belt system and was seated in a normal driving posture.

The driver was beginning to execute a left turn and was probably leaning slightly to the right when the Ford's left side was impacted by the Dodge's front. He probably moved left and slightly forward in response to the 290 degree principal direction of force. The impact caused the left B-pillar and the driver's door to intrude inward. The intruding B-pillar contacted the driver's seat back, causing the seat back to be crushed and displaced laterally, and the left side of the driver's head contacted the B-pillar, causing a contusion on the left temporal-parietal-occipital region of the his scalp and a cerebral concussion. The left-posterior region of his thorax and abdomen also contacted the B-pillar, resulting in abrasions on the upper-left region of his back and the left side of his abdomen, posterior fractures of left ribs 6-12, lacerations of his spleen, and lacerations on the left side of his diaphragm. His left hand contacted the intruding door surface, resulting in minor lacerations on his left hand and a fracture of the left 5th metacarpal. The driver was displaced to the right by the intruding left side components and his left knee probably contacted

the instrument panel, resulting in an abrasion on his left knee. The right side of his abdomen and his right hip impacted the center console, resulting an a contusion of his right adrenal gland. The second (side-slap) impact was very minor and probably did not affect the driver's posture. His position at final rest is not known.

DRIVER'S INJURIES

The driver was transported via ground ambulance to a trauma center, where he was admitted for ten days.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1.	Cerebral concussion, loss of consciousness less than one hour	moderate 160202.2,0	Left B-pillar	Probable	Hospital Records
2.	Fracture, left ribs 6-12, posterior, with small left hemothorax	severe 450232.4,2	Left B-pillar	Probable	Hospital Records
3.	Lacerations of spleen, superior and inferior aspects, ~ 4 cm (1.6 inches) deep	serious 544224.3,2	Left B-pillar	Probable	Hospital Records
4.	Superficial contusion, right adrenal gland	minor 540212.1,1	Center Console, first row	Probable	Hospital Records
5.	Superficial abrasion, left abdomen	minor 590202.1,2	Left B-pillar	Probable	Emergency Room
6.	Superficial abrasion, left knee	minor 890202.1,2	Instrument panel[1]	Probable	Emergency Room
7.	Minor laceration, left hand	minor 790602.1,2	Left side interior surface	Probable	Emergency Room
8.	Superficial abrasion, left upper back	minor 690202.1,2	Left B-pillar	Probable	Emergency Room
9.	Superficial abrasion, left hand	minor 790202.1,2	Left side interior surface	Probable	Emergency Room
10.	Lacerations, left diaphragm; three tears, one 5 cm (2 inches), two smaller	serious 440604.3,8	Left B-pillar	Probable	Hospital Records
11.	Contusion, left parietotemporal occipital scalp	minor 190402.1,2	Left B-pillar	Probable	Hospital Records
12.	Comminuted fracture, left fifth metacarpal	moderate 752002.2,2	Left side interior surface	Probable	Hospital Records

[1]The NASS injury coding shows this injury as resulting from the driver's knees hitting together, but SCI has determined that this is not correct.

The Ford's front right passenger [47-year-old female, 170 centimeters, 73 kilograms (67 inches, 160 pounds)] was restrained by the manual lap-and-shoulder safety belt system and was seated in a normal forward-facing posture.

The front right passenger was probably leaning slightly to the right as the Ford began the left turn. When the Ford's left side was impacted by the Dodge's front, she probably moved to the left and slightly forward in response to the 290 degree direction of principal force. Her left hip and thigh impacted the right side of the center console. Her contact with the center console resulted in a contusion on her left thigh, a fracture of the left wing of her sacral ala (pelvic region), and fractures of her left superior and inferior pubic rami. Her left arm probably contacted the driver and she sustained a contusion on the lateral aspect of her left upper arm. The second (side-slap) impact was very minor and probably did not affect the front right passenger's posture. Her position at final rest is not known.

FRONT RIGHT PASSENGER'S INJURIES

The front right passenger was transported via ground ambulance to a trauma center, where she was admitted for two days.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Fracture, left sacral ala, closed, non-displaced	moderate 852602.2,6	Center console, first row	Certain	Hospital Records
2	Fracture, left superior and inferior pubic rami, comminuted	serious 852604.3,5	Center console, first row	Certain	Hospital Records
3	Contusion, left lateral upper arm	minor 790402.1,2	Other occupant (driver)	Probable	Other Researcher
4	Contusion, left lateral thigh	minor 890402.1,2	Center console, first row	Certain	Emergency Room

OTHER VEHICLE: 2004 DODGE STRATUS

The other vehicle was a 2004 Dodge Stratus SXT front wheel drive, 4-door, 5-passenger sedan (VIN: 1B3EL46R74N------), equipped with a 2.7 liter, V6 gasoline engine and an automatic transmission with a console-mounted selector lever. Four-wheel anti-lock brakes and traction control were options for this model, but it is not known if this vehicle was so equipped. It was equipped with dual-stage frontal air bags for the driver and front right passenger seat positions, and manual lap-and-shoulder safety belt systems at all 5 seat locations. Its specification wheelbase was 274 centimeters (108.0 inches). The Dodge was towed due to disabling damage.

Exterior Damage: The Dodge was under repair at the time of the inspection and both fenders, the front bumper cover and the grille with both headlamp/turn signal assemblies had been removed (**Figures 7** and **8**). The right front tire had been removed and a compact temporary spare tire and rim were mounted on the right front wheel.

Figure 7: Dodge's front and right side

Figure 8: Dodge's front and left side

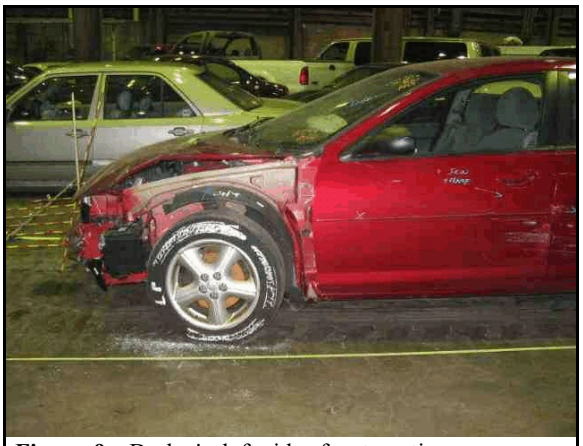


Figure 9: Dodge's left side, front portion

Figure 10: Dodge's left side, rear portion

The Dodge sustained direct contact across its entire front from event #1 (**Figures 7** and **8**). The steel bumper was crushed rearward against the radiator, with both bumper support brackets slightly deformed. The engine hood was crushed downward and rearward at its front and buckled upward across its center. The front bumper was removed thereby inhibiting a more thorough inspection. The crush profile for the first event was measured along the steel bumper.

The Dodge also sustained direct contact on its left side, extending from approximately the rearward portion of the driver's door to the left tail light area, from the event #2 side slap impact (**Figures 9** and **10**). This was a minor event that caused surface abrading and minor denting, with maximum crush measured as 3 centimeters (1.2 inches) at C5, approximately the middle of the left back door. The crush profile for the second event was measured at the mid-door level.

The crush measurements for both impacts are detailed in the table below:

Units	Event	Direct Damage		Field L	C_1	C_2	C_3	C_4	C_5	C_6	Direct	Field L
		Width CDC	Max Crush								± D	± D
cm	1	110	24	110	16	20	24	24	21	16	0	0
in		43.3	9.4	43.3	6.3	7.9	9.4	9.4	8.3	6.3	0.0	0.0
cm	2	255	3	255	1	1	1	2	3	1	-107	-107
in		100.4	1.2	100.4	0.4	0.4	0.4	0.8	1.2	0.4	-42.1	-42.1

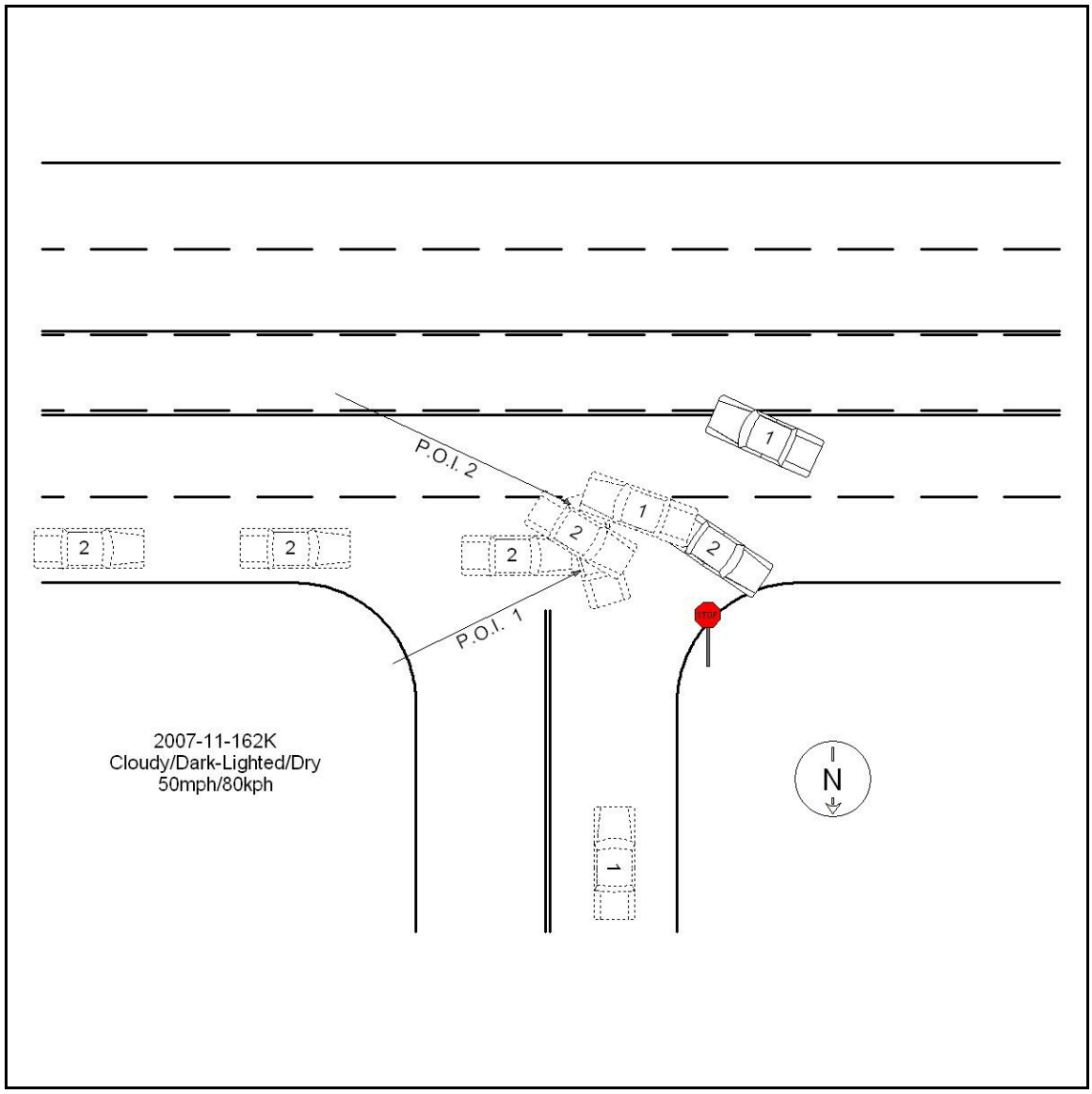
The Dodge's recommended tire size was P205/65R15 and the Dodge was equipped with four tires of this size. The Dodge's tire data are shown in the table below.

Tire	*Measured Pressure*		*Manufacturer's Recommended Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kPa	psi	kPa	psi	milli-meters	32nd of an inch			
LF	179	26	207	30	7	9	None	No	No
RF	unk	unk	207	30	3	4	unknown	unk	unk
LR	193	28	207	30	6	8	None	No	No
RR	179	26	207	30	6	8	None	No	No

Damage Classification: Based on the vehicle inspection, the CDC for the Dodge's first impact (event #1) was determined to be: **12-FDEW-02 (10 degrees)**. The WinSMASH reconstruction program, damage only algorithm based on the measured crush profile of both vehicles, was used on the first impact, which was the Dodge's most severe impact. The total, longitudinal and lateral delta-Vs were, respectively: 38 km/h (23.6 mph), -37 km/h (-23.0 mph) and -7 km/h (4.3 m.p.h.).

The CDC for the Dodge's second impact (event #2, side slap) was determined to be: **10-LZEW-01 (310 degrees)**. The WinSMASH reconstruction program, damage only algorithm based on the measured crush profile of both vehicles, was used on the second impact. The total, longitudinal and lateral delta-Vs were, respectively: 9 km/h (5.6 mph), -5 km/h (-3.1 mph) and 8 km/h (5.0 mph).

The Dodge's driver [81-year-old male, 178 centimeters, 86 kilograms (70 inches, 190 pounds)] was restrained by the available manual, lap-and-shoulder safety belt system and was seated in a normal driving posture. The driver's steering wheel air bag deployed. According to his statement during the NASS interview, he sustained minor contusions below his chin and on his left forearm, both attributed to his contact with the driver's air bag. He was not transported to a hospital and did not seek medical treatment. There were no other occupants in the Dodge.


P.O.I. 2
P.O.I. 1
1
2
2
2
1
2
2
1
STOP
2007-11-162K
Cloudy/Dark-Lighted/Dry
50mph/80kph
N