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ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE INVESTIGATION

CASE NUMBER - IN-04-010
LOCATION - Texas
VEHICLE - 2004 TOYOTA CAMRY
CRASH DATE - March 2004

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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 an on-site investigation of an air bag deployment crash that involved a 2004 Toyota Camry (case vehicle) and a 2000 Ford Explorer XLS (other vehicle), which collided in an offset front impact on an Interstate highway. This crash is of special interest because the case vehicle was equipped with multiple Advanced Occupant Protection System (AOPS) features, including certified advanced 208-compliant air bags, as well as an Event Data Recorder (EDR), and neither the case vehicle's driver (48 year-old, female) nor the front right passenger (19-year-old male) sustained any police reported injuries as a result of the crash. The case vehicle was traveling east in the inside lane of a multi-lane Interstate highway on a rainy afternoon. The Ford was in the process of entering the highway from an on ramp and began to rotate counterclockwise on the rain slick roadway. The Ford rotated across all four travel lanes, and the front left of the case vehicle impacted the front left of the Ford causing a stage one deployment of the case vehicle's driver air bag and a stage two deployment of the case vehicles front right passenger air bag. The case vehicle's EDR recorded a maximum longitudinal Delta V of -42.5 km.p.h. (-26.4 m.p.h.). The Ford continued to rotate counterclockwise, entered the median and rolled over driver side leading one-and-one half times (i.e. six quarter rolls) and came to rest on its roof facing southeast. The case vehicle rotated counterclockwise and came to rest partially in the median facing northwest. The impact caused the restrained driver to move forward, load her safety belt and her face and chest impacted her air bag and her knees impacted the knee bolster. She sustained multiple minor injuries and went to the hospital the day following the crash and was treated and released. The impact caused the restrained front right passenger to move forward, load his safety belt, and his face and chest impacted his deployed air bag, and his knee impacted the knee bolster. He also sustained multiple minor injuries and went to the hospital the day following the crash and was treated and released.			
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This on-site investigation was brought to NHTSA's attention on or before April 23, 2004 by NASS GES sampling activities. This crash involved a 2004 Toyota Camry LE (case vehicle) and a 2000 Ford Explorer XLS (other vehicle). The crash occurred in March 2004, at 2:26 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 Advanced Occupant Protection System (AOPS) features, including certified advanced 208-compliant air bags, as well as an Event Data Recorder (EDR), and neither the case vehicle's driver (48 year-old, Asian female) nor the front right passenger (19-year-old male) sustained any police reported injuries as a result of the crash. This contractor inspected both vehicles and harvested the Restraint Control Module (RCM) on May 10, 2004. The RCM was subsequently sent to NHTSA headquarters for transfer to the manufacturer and downloading of the EDR data. This contractor completed the scene inspection on May 11, 2004 and interviewed the husband of the driver on May 17, 2004 (the case vehicle's driver was did not speak English well). This report is based on the police crash report, interviews with the investigating police officer and the husband of the driver, scene and vehicle inspections, occupant kinematic principles, medical records of the driver and passenger and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling east in the inside lane of a multi-lane Interstate highway on a rainy afternoon. The Ford was in the process of entering the highway from an on ramp and began to rotate counterclockwise on the rain slick roadway. The Ford rotated across all four travel lanes, and the front left of the case vehicle impacted the front left of the Ford causing a stage one deployment of the case vehicle's driver air bag and a stage two deployment of the case vehicles front right passenger air bag. The Ford continued to rotate counterclockwise, entered the median and rolled over driver side leading one-and-one half times (i.e. six quarter rolls) and came to rest on its roof facing southeast. The case vehicle rotated counterclockwise and came to rest partially in the median facing northwest.

The CDC for the case vehicle was determined to be **12-FDEW-2** (**0** degrees). The CDCs for the Ford were determined to be **12-FLEW-1** (**0** degrees) for the front impact with the case vehicle and **00-TDDO-3** for the rollover. The WinSMASH reconstruction program, damage only algorithm, calculated the case vehicle's Total, Longitudinal and Lateral Delta Vs respectively as: 25.5 km.p.h. (15.8 m.p.h.), -25.5 km.p.h. (–15.8 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). The case vehicle's EDR recorded a maximum longitudinal Delta V of -42.5 km.p.h. (-26.4 m.p.h.). WinSMASH calculated the Total, Longitudinal and Lateral Delta Vs for the Ford respectively as: 19.0 km.p.h. (11.8 m.p.h.), -19.0 km.p.h. (–11.8 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). The results of the WinSMASH reconstruction appeared low based on the damage to both vehicles and the fact that both vehicle's left front wheels snagged during the impact.

Just prior to the crash, the case vehicle's driver was seated in an upright position with her back against the seat back, both hands on the steering wheel, her left foot on the floor and her right foot most likely on the brake. Her seat was adjusted to between its middle and forward-most track position, the seat back was slightly reclined, and the driver was restrained by her manual,

three-point, lap-and-shoulder safety belt system. The tilt position of her steering column is not known. The impact with the Ford caused the driver's safety belt pretensioner to activate, and she continued forward opposite the case vehicle's 0 degree direction of principal force and loaded her safety belt system. The driver's face and chest impacted her deployed air bag causing a nonanatomic brain injury with dizziness and headache, a cervical and lumbar strain, and contusions to her chest and arms. In addition, her knees impacted the knee bolster causing contusions to both knees. She went to the hospital the day following the crash and was treated and released. The driver's use of her safety belt and the deployment of the air bag prevented the driver from impacting the steering wheel and mitigated her injuries.

Just prior to the crash, the case vehicle's front right passenger was seated in an upright position with his back against the seat back, his feet on the floor and his hands in an unknown position. His seat track was located between its middle and rearmost positions, and the seat back was slightly reclined. The impact with the Ford caused the front right passenger's safety belt pretensioner to activate, and he continued forward opposite the case vehicle's 0 degree direction of principal force and loaded his safety belt system. The passenger's face and chest impacted his deployed air bag causing a cervical strain and chest contusion. In addition, both knees impacted the knee bolster causing contusions to both knees. He went to the hospital the day following the crash and was treated and released. The front right passenger's use of his safety belt and the deployment of the air bag prevented his interaction with the instrument panel and windshield and mitigated his injuries.

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which both vehicles were traveling was a eight-lane, divided, Interstate highway, traversing in an east-west direction and curving gently to the left for eastbound traffic (**Figure 1**). Both the eastbound and westbound roadways had four through lanes and paved shoulders. In addition, the eastbound roadway had an entrance ramp while the westbound roadway had an exit ramp. The trafficway was divided by a grass median, and there was a concrete median barrier along the inside shoulder of the westbound traffic way. Each travel lane was approximately 3.7 meters (12 feet) wide and the speed limit was 105 km.p.h. (65 m.p.h.). Roadway marking consisted of broken white lane lines, solid white edge lines and solid yellow median edge lines. At the time of the crash the light condition was daylight, the atmospheric condition was raining, and the roadway pavement was wet bituminous with a slight negative grade for eastbound traffic. Traffic density was moderate and the site of the crash was primarily urban commercial. See the Crash Diagram at the end of this report.

Figure 1: Easterly view from gore of entrance ramp and through lanes showing overview of crash scene, exact location of impact was not determined

Pre-Crash: The case vehicle was traveling east in the inside through lane (**Figure 2**) at a driver estimated speed of 97 km.p.h. to 105 km.p.h. (60 to 65 m.p.h.), and the driver was intending to continue straight ahead. The Ford was traveling east in the eastbound entrance ramp (**Figure 3** below), and the driver was intending to merge into the outside through lane. The Ford began to rotate counterclockwise on the rain slick roadway just prior to entering the highway. It continued to rotate and traveled diagonally across all four eastbound lanes of traffic. It is unknown if the case vehicle's driver made any avoidance maneuvers prior to the crash, however it is likely that she applied the brakes. The crash occurred within the interchange area, in the inside through lane of the eastbound roadway.

Figure 2: Case vehicle's eastbound travel path in inside through lane approaching crash area

Figure 3: Overview of Ford's travel path from on ramp to crash area

Figure 4: Case vehicle's front left damage and damage to left fender and wheel assembly from the impact with the Ford

Figure 5: Ford's front left and left fender damage from impact with the case vehicle, and top damage due to the subsequent rollover.

Crash: The front left of the case vehicle (**Figure 4**) impacted the front left of the Ford (**Figure 5**) causing a stage one deployment of the case vehicle driver's air bag and a stage two deployment of the front right passenger air bag. As a result of the impact with the case vehicle, the Ford's counterclockwise rotation was accelerated, and the Ford entered the median and rolled over, driver side leading, one-and-one half times (six quarter turns).

Post-Crash: The Ford came to final rest on its roof facing southeast near the median barrier. After the impact with the Ford, the case vehicle rotated counterclockwise. The extent of rotation is not known. According to the interviewee, the driver attempted to regain control of the vehicle after the impact. The case vehicle came to final rest partially in the median facing northwest.

CASE VEHICLE

The 2004 Toyota Camry LE was a front wheel drive, four-door sedan (VIN: 4T1BF32K14U------) equipped with a V6 engine, four speed automatic transmission and four wheel anti-lock brakes. The front seating row was equipped with dual stage driver and front right passenger air bags, manual three-point, lap-and-shoulder safety belt systems with retractor-mounted pretensioners, force limiters and belt usage sensors. In addition, the driver and front right passenger seats were equipped with seat position sensors, and the front right passenger seat was equipped with a weight sensor. Lastly, front seat-back mounted side impact air bags and side curtain air bags were optional for this vehicle, but it was not so equipped. The case vehicle's mileage a the time of inspection could not be determined because the vehicle was equipped with an electronic odometer. The interviewee estimated that the case vehicle had 906 kilometers (563 miles) on it at the time of the crash. The case vehicle's wheelbase was 272 centimeters (107.1 inches).

The various sensors in the case vehicle's advanced occupant restraint system analyze a combination of factors including the predicted crash severity, driver and front right seat position and safety belt usage to determine the front air bag inflation level appropriate for the severity of the crash. For the front right seat, an occupant weight sensor in the seat cushion determines if an occupant is on the seat and enables or suppresses deployment of the air bag based on the amount of weight on the seat.

CASE VEHICLE DAMAGE

Exterior Damage: The case vehicle's contact with the Ford involved the front bumper, hood, grille, left fender (**Figure 4** above), and the left front wheel (**Figure 6**). Direct damage began at the left front bumper corner and extended 121 centimeters (47.6 inches) along the bumper. Direct damage also extended 118 centimeters (46.5 inches) along the left fender, which was torn off. Residual maximum crush was measured as 37 centimeters (14.6 inches) occurring at C_2 (**Figure 7** below). The case vehicle's front bumper, bumper fascia, grille, radiator, left fender, left turn lamp/headlamp assemblies, left front wheel, and hood were directly damaged and crushed rearward. The table below shows the case vehicle's crush profile.

Figure 6: Close-up of case vehicle's damaged left front wheel

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	121	37	141	32	37	27	18	9	0	-8	0
in		47.6	14.6	55.5	12.6	14.6	10.6	7.1	3.5	0.0	-3.2	0.0

The wheelbase on the case vehicle's left side was shortened 19 centimeters (7.5 inches) while the right side wheelbase was unaltered from the crash. There was induced damage to the hood, front bumper, and left front door. No other obvious induced damage or remote buckling was observed on the case vehicle.

The case vehicle's recommended tire size was: P205/65R15, and the vehicle was equipped with tires of this size.. The case vehicle's left front tire was deflated and rotated outward as a result of the crash. The case vehicle's tire data are shown in the table below.

Figure 7: Overhead view of case vehicle's front crush profile, each increment on rods is 5 cm (2 in)

Tire	*Measured Pressure*		*Recommend Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kpa	psi	kpa	psi	milli-meters	32nd of an inch			
LF	0	0	200	29	7	9	Cut in sidewall and tread	Yes	Yes
RF	255	37	200	29	7	9	None	No	No
LR	248	36	200	29	7	9	None	No	No
RR	255	37	200	29	7	9	None	No	No

Vehicle Interior: Inspection of the case vehicle's interior revealed occupant contact marks on the driver's air bag. The right portion of the windshield was cracked due to contact by the deploying front right air bag. The case vehicle did not sustain any intrusion, and there was no evidence of compression of the energy absorbing steering column or deformation of the steering wheel.

Damage Classification: Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **12-FDEW-2** (**0** degrees). The WinSMASH reconstruction program, damage only algorithm, was used to calculate the case vehicle's Delta Vs. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 25.5 km.p.h. (15.8 m.p.h.), -25.5 km.p.h. (–15.8 m.p.h.),

and 0.0 km.p.h. (0.0 m.p.h.). The results appeared low based on the damage to the case vehicle and the fact that both vehicle's left front wheels snagged during the impact. The case vehicle's EDR recorded a maximum longitudinal Delta V of -42.5 km.p.h. (-26.4 m.p.h.). The case vehicle was towed due to damage.

Figure 8: Overview of driver's air bag module cover flaps

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with certified advanced 208-compliant air bags in the driver and front right passenger position. Both of these air bags deployed as a result of the front impact with the Ford.

The case vehicle's driver air bag was located in the steering wheel hub. An inspection of the air bag module cover flaps (**Figure 8**) and the air bag fabric revealed that the cover flaps opened at the designated tear points There was no evidence of damage during the deployment to the air bag or the cover flaps. The top cover flap was triangular in shape and was 16.5 centimeters (6.5 inches) in width at it widest point near the tear seam and 7 centimeters (2.8 inches) in height. The bottom cover flap was also triangular in shape and was 14 centimeters (5.5 inches) in width at its widest point near the tear seam and 8 centimeters (3.1) in height. The driver's air bag was designed with two tethers, each approximately 11 centimeters (4.3 inches) in width and had two vent ports, each approximately 3 centimeters (1.2 inches) in diameter, located at the 11 and 1 o'clock positions. The deployed driver's air bag (**Figure 9**) was round with a diameter of 65 centimeters (25.6 inches). An inspection of the driver's air bag fabric revealed eye and lip makeup near the center of the air bag (**Figure 10**). The distance between the mid-center of the driver's seat back as positioned at the time of the inspection (i.e., between forward-most and middle track position) and the front surface of the air bag's fabric at full excursion was 24 centimeters (9.4 inches).

Figure 9: Case vehicle's deployed driver air bag, occupant contact evidence highlighted with yellow tape

Figure 10: Close view of occupant contact evidence within center stitching of case vehicle's deployed driver air bag

The front right passenger's air bag was located in the top of the instrument panel (**Figure 11**). 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 air bag module cover flap was rectangular in shape and was 21 centimeters (8.3 inches) in width and 10 centimeters (3.9 inches) in height. The front right passenger's air bag was designed without any tethers. The front right air bag had two vent ports, each approximately 5.5 centimeters (2.2 inches) in diameter, located at the 9:30 and 2:30 clock positions. The deployed front right air bag (**Figure 12**) was rectangular with a height of approximately 60 centimeters (23.6 inches) and a width of approximately 44 centimeters (17.3 inches). Although some occupant contact with this air bag was likely, an inspection of the front right passenger air bag revealed no evidence of occupant contact. The distance between the mid-center of the passenger's seat back as positioned at the time of the inspection (i.e., between rear-most and middle track position) and the front surface of the air bag's fabric at full excursion was 24 centimeters (9.4 inches). The deployment of the front right passenger's air bag fractured the windshield (**Figure 11**).

Figure 11: Overview of location of front right air bag, air bag module flap and cracked windshield from deployment

Figure 12: Front surface of case vehicle's deployed front right passenger air bag showing no obvious evidence of occupant contact

CRASH DATA RECORDING

The case vehicle's EDR indicated that the time from algorithm enable (AE) to deployment command was 16 milliseconds, and the air bag warning lamp was not illuminated. The crash sensing algorithm commanded a stage one deployment of the driver's air bag and a stage two deployment of the front right passenger's air bag. The EDR recorded a maximum longitudinal Delta V of 42.5 km.p.h. (26.4 m.p.h.) occurring at 150 milliseconds after AE. The data also indicated that the driver and front right passenger were restrained, the driver's seat was located in the "mid-forward" position and the front right

passenger weight sensor evaluated the front right passenger as a "fifth percentile female". The EDR had no pre-crash data recording capability.

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash the case vehicle's driver [47 year-old, Asian female, 160 centimeters and 57 kilograms (63 inches, 125 pounds)] was seated in an upright position with her back against the seat back. It is likely that her left foot was on the floor, her right foot on the brake, and both hands were on the steering wheel. Her seat track was located between its middle and forward-most positions, the seat back was slightly reclined, and the tilt steering wheel was is in an unknown positon. The interviewee was unsure how it was adjusted, and the column adjuster lever was found unlatched during the vehicle inspection. The driver was not wearing glasses at the time of the crash.

Based on this contractor's vehicle inspection, the case vehicle's driver was restrained by her manual, three-point, lap-and-shoulder safety belt system. The belt system was equipped with a retractor-mounted pretensioner with force limiter housed within the "B"-pillar. Inspection of the driver's seat belt webbing, "D"-ring, and latch plate revealed no load markings. However, it appeared that the pretensioner had actuated because the belt was partially unspooled and jammed in that position. Upon manipulation of the belt, it retracted, and the retractor locked and the belt could not be drawn back out. These factors indicate a strong probability of usage. In addition, the interviewee reported that the driver was restrained by her lap-and-shoulder belt.

The interviewee indicated that the driver thought the case vehicle was stopped at the time of the crash. This is not possible given the pre-crash movement of the Ford and impact configuration of the vehicles. It is likely that the driver of the case vehicle braked in an effort to avoid the crash. As a result of the probable braking, the case vehicle driver's safety belt retractor most likely locked and she moved forward into her safety belt just prior to impact. The case vehicle's impact with the Ford caused the case vehicle's driver to continue forward along a path opposite the case vehicle's 0 degree direction of principal force as the case vehicle decelerated. The driver impacted her deployed air bag leaving a transfer of lipstick and eye makeup on the air bag (**Figure 10** above). The driver's impact with her deployed air bag caused a nonanatomic brain injury with dizziness and headache, a cervical and lumbar strain, and contusions to her chest and arms. In addition, her knees impacted the knee bolster causing contusions to both knees. The driver rebounded off the air bag and moved to the right as the case vehicle rotated counterclockwise to final rest. The driver remained restrained in her seat as the case vehicle came to final rest, and she exited the vehicle with the assistance of the front right occupant.

CASE VEHICLE DRIVER INJURIES

The case vehicle driver was not transported from the crash scene to a medical facility. She sought treatment the day after the crash at a hospital emergency room and was treated and released. The case vehicle's driver sought follow-up treatment with a chiropractor and lost a total

of eight work days due to her injuries. The table below shows the case vehicle driver's injuries and injury contact mechanisms.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Nonanatomic brain injury with dizziness and headache but without evidence of loss of consciousness following crash	minor 160402.1.0	Air bag, driver's	Possible	Emergency room records
2	Strain, acute, cervical with residual pain on left lateral and posterior neck	minor 640278.1,6	Air bag, driver's {indirect injury}	Probable	Emergency room records
3	Strain, acute, lumbar with residual pain on left flank and lower back	minor 640678.1,8	Air bag, driver's {indirect injury}	Probable	Emergency room records
4	Contusion chest, not further specified	minor 490402.1,4	Air bag, driver's	Certain	Emergency room records
5	Contusions arms, not further specified with pain	minor 790402.1,3	Air bag, driver's	Possible	Emergency room records
6	Contusions left knee, not further specified with pain	minor 890402.1,2	Knee bolster, driver's, left of steering column	Probable	Emergency room records
7	Contusions right knee, not further specified with pain	minor 890402.1,1	Knee bolster, driver's, right of steering column	Probable	Emergency room records

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

The case vehicle's front right passenger [(i.e., nephew of driver); 19-year-old, Asian male; 165 centimeters and 50 kilograms (65 inches, 110 pounds)] was seated in an upright position with his back against the seat back, his feet on the floor and his hands in an unknown position. His seat track was located between its middle and rearmost positions, and the seat back was slightly reclined. The front right passenger was not wearing glasses at the time of the crash.

The case vehicle's front right passenger was restrained by his manual, three-point, lap-and-shoulder safety belt system. The safety belt system was equipped with a retractor-mounted pretensioner with force limiter housed within the B-pillar. Inspection of the front right passenger's seat belt webbing, "D"-ring, and latch plate revealed that the pretensioner had actuated. A length of belt webbing consistent with a restrained occupant was found withdrawn from the retractor. The webbing would not retract and was locked in this position. Furthermore, there were friction burns on the belt webbing (**Figure 13**) and "D"-ring indicating the front right passenger was restrained during the crash. In addition, the interviewee indicated that the front right passenger was wearing his safety belt.

As a result of the probable braking, the case vehicle's front right safety belt retractor most likely locked, and the front right passenger moved forward into his safety belt just prior to impact. The case vehicle's impact with the Ford caused the front right passenger to continue forward along a path opposite the case vehicle's 0 degree direction of principal force as the case vehicle decelerated. The passenger's face and chest impacted his deployed air bag causing a cervical strain and chest contusion. In addition, both knees impacted the knee bolster causing contusions to both knees. The passenger rebounded off his air bag moved to the right as the case vehicle rotated counterclockwise to final rest. The passenger remained restrained in his seat as the case vehicle came to final rest and exited the vehicle under his own power.

Figure 13: Case vehicle's front right safety belt showing friction burns (indicated by yellow tape) on webbing

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The right front passenger was not transported from the crash scene to a medical facility. He sought treatment the day after the crash at a hospital emergency room. However, according to the interviewee, the case vehicle's front right passenger did not sustain any injuries as a result of this crash. The front right passenger was not working at the time of the crash.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Strain, acute, cervical, with reversal of normal curvature	minor 640278.1,6	Air bag, front right passenger's {indirect injury}	Probable	Emergency room records
2	Contusion chest, not further specified	minor 490402.1,4	Air bag, front right passenger's	Certain	Emergency room records

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
3	Contusion knees bilaterally, not further specified	minor 890402.1,3	Knee bolster, front right passenger's	Probable	Emergency room records

OTHER VEHICLE

The 2000 Ford Explorer was a four wheel drive, four-door sport utility vehicle (VIN: 1FMZU72X4YU------). The Ford was equipped with redesigned driver and front right passenger air bags which deployed as a result of this vehicle's front impact with the front of the case vehicle.

Exterior Damage: The Ford's impact with the front of the case vehicle involved the front left of the Ford. The bumper, left headlamp/turn lamp assembly, grille and the left fender were directly contacted and crushed rearward. The direct damage began at the left corner of the front bumper and extended 49 centimeters across the bumper. The maximum residual crush was measured as 26 centimeters (10.2 inches) occurring at C_1. The Ford's crush profile is shown 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	49	26	138	26	1	1	0	0	0	-54	0
in		19.3	10.2	54.3	10.2	0.4	0.4	0.0	0.0	0.0	-21.3	0.0

The Fords left side wheelbase was reduced 5 centimeters (2 inches) while the right side wheelbase was extended 1 centimeter (0.4 inch). Induced damage involved the front bumper, grille, hood, left fender and left front door.

The rollover involved both sides and the top of the Ford (**Figures 14** and **15**). Direct damage involved the roof, the right side and the top of the left quarter panel and left front door. The area of maximum crush occurred to the roof, inboard of the right roof side rail. The maximum roof crush was approximately 23 centimeters (9.1 inches). Induced damage also involved the roof, and both sides of the Ford.

Figure 14: Front right view of rollover damage to case vehicle

Figure 15: Back left view of damage to Ford

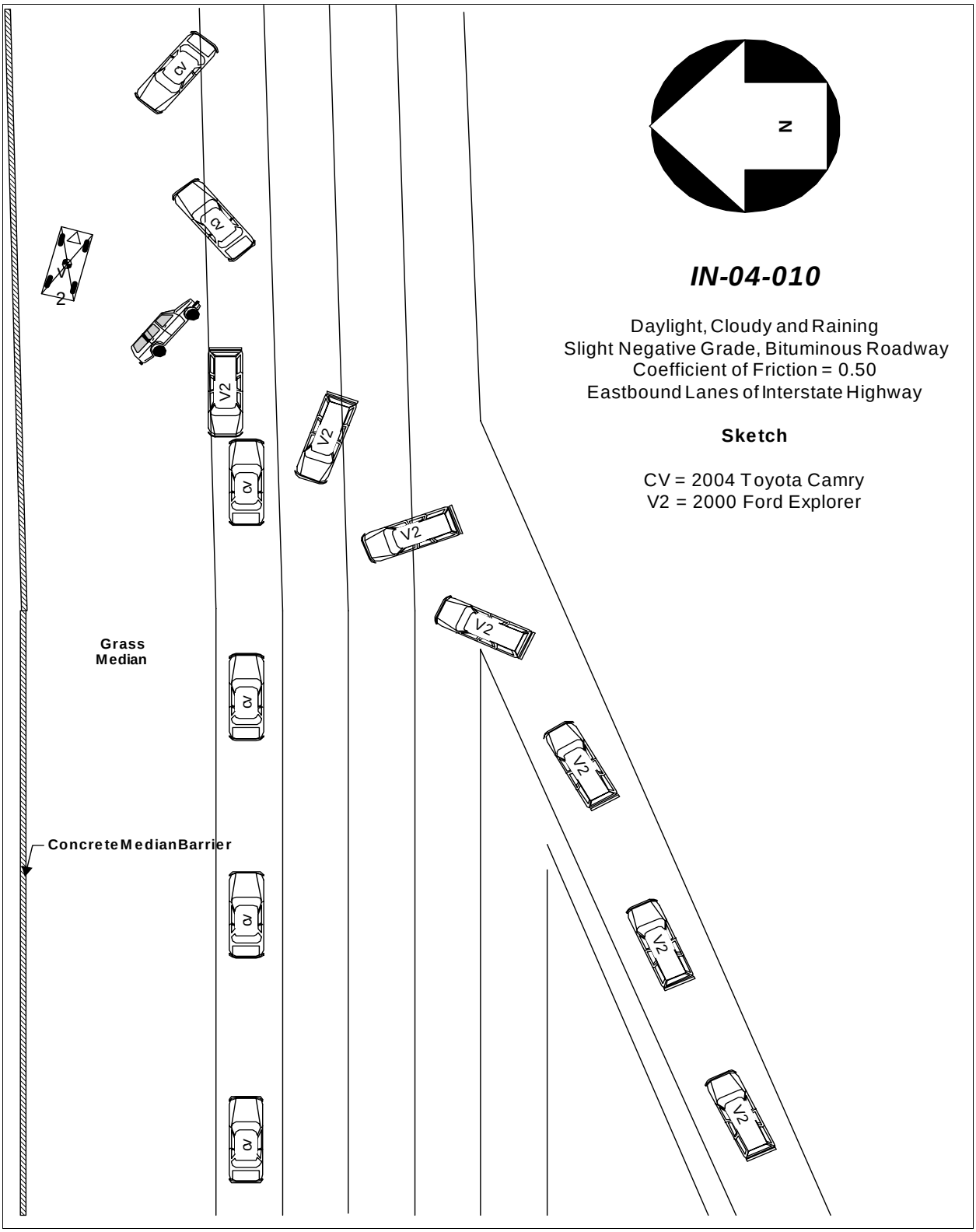
The Ford's recommended tire size was: P235/75R15, and the vehicle was equipped with tires of this size.. The Ford's tire data are shown in the table below.

Tire	*Measured Pressure*		*Recommend Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kpa	psi	kpa	psi	milli-meters	32nd of an inch			
LF	Unk	Unk	179	26	Unk	Unk	Unknown, tire missing	Unknown	Most likely
RF	255	37	179	26	5	6	None	No	No
LR	0	0	179	26	5	6	Bead separated	No	Yes
RR	221	32	179	26	6	7	None, but grass in bead	No	No

Damage Classification: Based on the vehicle inspection, the CDCs for the Ford were determined to be: **12-FLEW-1** (**0** degrees) for the front impact with the case vehicle and **00-TDDO-3** for the rollover. The WinSMASH reconstruction program, damage only algorithm, was used to calculate the Fords Delta Vs for the front impact with the case vehicle. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 19.0 km.p.h. (11.8 m.p.h.), -19.0 km.p.h. (–11.8 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). The results of the WinSMASH reconstruction appeared low based on the damage to both vehicles and the fact that both vehicle's left front wheels snagged during the impact.

Ford's Occupants: According to the police crash report, the Ford's driver [56-year-old, Black (unknown if Hispanic) female] was restrained by her manual, three-point, lap-and-shoulder, safety belt system. The driver was transported by ambulance to the hospital and sustained police-reported "C" (possible) injuries as a result of the crash.

The Ford's back right passenger [4-year-old, (unknown race and ethnic origin) male] was restrained in a child safety seat. While on site, this contractor made an in-person attempt to locate the child seat for a possible child safety seat investigation, but the seat had been discarded by the mother of the child. The back right passenger was also transported by ambulance to the hospital and sustained police-reported "C" (possible) injuries as a result of the crash.


N
IN-04-010
Daylight, Cloudy and Raining
Slight Negative Grade, Bituminous Roadway
Coefficient of Friction = 0.50
Eastbound Lanes of Interstate Highway
Sketch
CV = 2004 Toyota Camry
V2 = 2000 Ford Explorer
Grass Median
Concrete Median Barrier
CV
V2