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ON-SITE CHILD AIR BAG-RELATED FATALITY INVESTIGATION

CASE NUMBER - IN-07-001
LOCATION - LOUISIANA
VEHICLE - 1995 FORD MUSTANG
CRASH DATE - April 2006

Submitted:

July 9, 2007
Revised: June 12, 2008

Contract Number: DTNH22-07-C-00044

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
National Center for Statistics and Analysis
Washington, D.C. 20590-0003

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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

1. *Report No.* IN-07-001	2. *Government Accession No.*	3. *Recipient's Catalog No.*	
4. *Title and Subtitle* On-Site Child Air Bag-Related Fatality Investigation Vehicle - 1995 Ford Mustang Location - Louisiana		5. *Report Date:* July 9, 2007 6. *Performing Organization Code*	
7. *Author(s)* Special Crash Investigations Team #2		8. *Performing Organization Report No.*	
9. *Performing Organization Name and Address* Transportation Research Center Indiana University 222 West Second Street Bloomington, Indiana 47403-1501		10. *Work Unit No. (TRAIS)* 11. *Contract or Grant No.* DTNH22-07-C-00044	
12. *Sponsoring Agency Name and Address* U.S. Department of Transportation (NPO-122) National Highway Traffic Safety Administration National Center for Statistics and Analysis Washington, D.C. 20590-0003		13. *Type of Report and Period Covered* Technical Report Crash Date: April 2006 14. *Sponsoring Agency Code*	
15. *Supplementary Notes* On-site child air bag-related fatality investigation involving a 1995 Ford Mustang with manual safety belts and driver and front right passenger air bag system.			
16. *Abstract* This report covers an on-site child air bag-related fatality investigation that involved a 1995 Ford Mustang (case vehicle) and a 2006 Ford Five Hundred (other vehicle), which were involved in an intersection crash. This crash is of special interest because the case vehicle's front right passenger [6-year-old, White (non-Hispanic) female] sustained fatal injury due to contact with her deploying air bag. The case vehicle was traveling northbound (i.e., the wrong way) in the right lane of a one-way southbound city street approaching a four leg intersection. The Five Hundred was traveling eastbound, also approaching the intersection. The front of the case vehicle impacted the right side of the Five Hundred causing the case vehicle's driver and front right passenger air bags to deploy. The case vehicle rotated clockwise and came to rest heading northeast. The Five Hundred rotated clockwise and came to rest heading southwest. The case vehicle's front right passenger was not restrained by her manual, three-point, lap-and-shoulder safety belt system. The case vehicle driver's pre-crash braking caused the front right passenger to continue forward as the case vehicle decelerated, and the passenger was near or over the air bag module when the air bag deployed. Her face and chest were directly impacted by the deploying air bag and she sustained fatal injuries.			
17. *Key Words* Child Air Bag-Related Fatality Air Bag Deployment Motor Vehicle Traffic Crash Injury Severity		18. *Distribution Statement* General Public	
19 *Security Classif. (of this report)* Unclassified	20. *Security Classif. (of this page)* Unclassified	21. *No. of Pages* 12	22. *Price*

Form DOT 1700.7 (8-72) Reproduction of completed page authorized

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This crash was brought to NHTSA's attention on or before January 4, 2007 by an attorney in Louisiana. This crash involved a 1995 Ford Mustang 2-door coupe (case vehicle) and a 2006 Ford Five Hundred SE (other vehicle). The crash occurred in April 2006, at 4:06 p.m., in Louisiana and was investigated by the applicable city police department. This crash is of special interest because the case vehicle's front right passenger [6-year-old, White (non-Hispanic) female] sustained fatal injury due to contact with her deploying air bag. This on-site investigation was assigned on March 16, 2007 and this contractor inspected the scene and case vehicle on March 22, 2007. The case vehicle's driver was interviewed on April 5, 2007. This report is based on the police crash report, scene and case vehicle inspections, an interview with the case vehicle's driver, police photographs of the scene and vehicles, medical records and autopsy, occupant kinematic principles, and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling northbound (i.e., the wrong way) in the right lane of a one-way southbound city street approaching a four leg intersection. The Five Hundred was traveling eastbound, also approaching the intersection. The case vehicle's driver applied hard braking in an attempt to avoid the crash with the approaching Five Hundred. The front of the case vehicle impacted the right side of the Five Hundred causing the case vehicle's driver and front right passenger air bags to deploy. The case vehicle rotated clockwise and came to rest in the mouth of the east leg of the intersection heading northeast. The Five Hundred rotated clockwise into the east leg of the intersection and came to rest heading southwest. At the time of the crash the light condition was daylight, the atmospheric condition was clear, and the roadway pavement was dry.

The case vehicle's CDC was determined to be **71-FDEW-2** (**320** degrees, force direction incremented for right shift of end structure). The case vehicle sustained 26 centimeters (10.2 inches) of residual maximum crush occurring at C_1. The WinSMASH reconstruction program, missing vehicle algorithm, calculated the case vehicle's Total, Longitudinal, and Lateral Delta Vs respectively as: 26.0 km.p.h. (16.2 m.p.h.), -19.9 km.p.h. (-12.4 m.p.h.), and 16.7 km.p.h. (10.4 m.p.h.). The case vehicle was towed due to damage.

The Five Hundred's CDC was estimated based on photographs and was determined to be **02-RZEW-1** (**50** degrees). The WinSMASH reconstruction program, missing vehicle algorithm, calculated the Five Hundred's Total, Longitudinal, and Lateral Delta Vs respectively as: 22.0 km.p.h. (13.7 m.p.h.), -14.1 km.p.h. (-8.8 m.p.h.), and -16.9 km.p.h. (-10.5 m.p.h.). The Five Hundred was towed due to damage.

The case vehicle's front right passenger was not restrained by her manual, three-point, lap-and-shoulder, safety belt system. Her seat track was adjusted to the middle position and the seat back was slightly reclined. The case vehicle driver's pre-crash braking caused the front right passenger to continue forward as the case vehicle decelerated and the passenger was near or over the air bag module when the impact occurred and the air bag deployed. Her face and chest was directly impacted by her deploying air bag and she sustained brain injuries and a dislocated atlanto-occipital.

The case vehicle's driver was not restrained. Her face and chest impacted her deployed air bag and she traveled over the air bag and her head impacted and fractured the windshield. She also sustained an abrasion on her right wrist due to contact with her deploying air bag.

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which the case vehicle was traveling was a two-lane, undivided, city street, which was one-way southbound. However, the case vehicle was traveling the wrong way (i.e., northbound) approaching a four leg intersection. The intersection was controlled by three-phase traffic signals. However, since the case vehicle was traveling the wrong way, there was no traffic signal pointing at the case vehicle. The case vehicle's travel lane was 3.9 meters (12.8 feet) in width while the other travel lane was 3.5 meters (11.5 feet) in width. The roadway was bordered by mountable curbs. Roadway pavement markings consisted of a yellow edge line to the right of the case vehicle, broken white center line and a white left edge line. The trafficway on which the Five Hundred was traveling was a two-lane, state highway business route, traversing in a nominal east-west direction approaching the four leg intersection. The eastbound travel lane was 4.1 meters (13.4 feet) in width. The westbound travel lane was 6.1 meters (20 feet) in width. The roadway was divided near the intersection by a pair of solid, double yellow lines. The division was 2.3 meters (7.5 feet) in width. The speed limit for both trafficways was 56 km.p.h. (35 m.p.h.). At the time of the crash the light condition was daylight, the atmospheric condition was clear, and the roadway pavement was dry, level bituminous. Traffic density was light, and the site of the crash was urban residential. See the Crash Diagram at the end of this report.

Pre-Crash: The case vehicle was traveling northbound in the right lane of the one-way southbound street (**Figure 1**) approaching the intersection. The case vehicle's driver had just turned left (i.e., the wrong way) onto the one-way street from an intersecting city street (**Figure 2** below). The case vehicle's driver stated she was a little "bewildered" and wondering where she was, but was intending to continue northbound through the approaching intersection. The Five Hundred was traveling eastbound in the eastbound lane, also approaching the intersection (**Figure 3** below). The police crash report indicated that the case vehicle's driver applied the brakes in an attempt to avoid the crash. The driver also stated that she applied hard braking in an attempt to avoid the crash with the approaching Five Hundred. The crash occurred in the intersection of the two trafficways (**Figures 3** and **6** below).

Figure 1: Approach of case vehicle to intersection, northbound on southbound one-way street, number on pavement shows meters to intersection

Figure 2: Intersection where case vehicle driver turned left onto one-way city street

Figure 3: Approach of Five Hundred eastbound to intersection, arrow shows area of impact

Figure 4: Damage to front of case vehicle from impact with the Five Hundred, vertical scale in tenths of meter

Figure 5: Police photo showing damage to right side of Five Hundred from impact with case vehicle

Crash: The front of the case vehicle (**Figure 4**) impacted the right rear door, quarter panel and right rear wheel of the Five Hundred (**Figure 5**) causing the case vehicle's driver and front right passenger air bags to deploy.

Post-Crash: As a result of the impact, the case vehicle rotated clockwise and came to rest in the mouth of the east leg of the intersection heading northeast (**Figure 6** below). The Five Hundred rotated clockwise approximately 145 degrees, traveled into the east leg of the intersection and came to rest heading southwest (**Figure 6** below).

CASE VEHICLE

The 1995 Ford Mustang was a rear wheel drive, two-door coupe (VIN: 1FALP4045SF------) equipped with a 3.8L, V6 engine and four-speed automatic transmission. The front seating row was equipped with bucket seats with folding backs and adjustable head restraints, driver and front right passenger air bags and manual, three-point, lap-and-shoulder, safety belts. Four wheel, anti-lock brakes were an option on the case vehicle, but it is unknown if it was so equipped.

Exterior Damage: The case vehicle's impact with the Five Hundred involved the totality of the front plane. The front bumper, grille, hood, both headlamp/turn lamp assemblies and the front of both fenders were directly damaged and crushed rearward and to the right. The direct damage began at the front left bumper corner and extended approximately 148 centimeters (58.3 inches) across the front end. The front bumper and front bumper fascia were not present on the vehicle, so the crush measurements were taken to the front unibody structure as well as the end of the bumper bracket on each unibody frame end. Comparison values were subsequently obtained from an exemplar vehicle. Since the primary engagement occurred to the bumper, it was decided that two crush measurements, one taken at each bumper bracket, yielded the most reasonable representation of the frontal crush. As a result, the residual maximum crush was determined to be approximately 26 centimeters (10.2 inches) occurring at C_1. The table below shows the case vehicle's front crush profile.

Figure 6: View eastbound to area of impact (right arrow) and final rest of case vehicle (left arrow) and Five Hundred (middle arrow)

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	148	26	94	26	20	N/A	N/A	N/A	N/A	0	0
in		58.3	10.2	37.0	10.2	7.9	N/A	N/A	N/A	N/A	0.0	0.0

The case vehicle's wheelbase was unaltered by the crash. Induced damage involved the hood and both fenders.

The manufacturer's recommended tire size was P205/65R15. The case vehicle was equipped with tires of this size. The manufacturer's recommended tire pressure was 207 kPa (30 psi). The case vehicle's tire data are shown in the table below.

Tire	*Measured Pressure*		*Vehicle Manufacturer's Recommended Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kPa	psi	kPa	psi	milli-meters	32nd of an inch			
LF	152	22	207	30	6	7	None	No	No
LR	207	30	207	30	6	7	None	No	No
RR	152	22	207	30	5	6	None	No	No
RF	186	27	207	30	3	4	None	No	No

Vehicle Interior: Inspection of the case vehicle's interior revealed a "star burst" type fracture to the windshield left of the centerline of the steering wheel due to driver head contact (**Figure 7**). A few possible fluid spots were observed on the front right passenger's air bag. No other evidence of possible occupant contact was noted in the case vehicle's interior. Finally, there was no passenger compartment intrusion, and no evidence of compression of the energy absorbing steering column or deformation of the steering wheel.

Figure 7: Overview of case vehicle's front seat area, arrow shows "star burst" type fracture to windshield from driver's head contact

Damage Classification: Based on the case vehicle inspection, the CDC was determined to be **71-FDEW-2** (**320** degrees, force direction incremented for right shift of end structure). The WinSMASH reconstruction program, missing vehicle algorithm, was used to reconstruct the case vehicle's Delta Vs. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 26.0 km.p.h. (16.2 m.p.h.), -19.9 km.p.h. (-12.4 m.p.h.), and 16.7 km.p.h. (10.4 m.p.h.). Due to the missing vehicle algorithm and the usage of two crush measurements for the case vehicle, the reconstruction was considered borderline, but the results appeared reasonable. The case vehicle was towed due to damage.

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with driver and front right passenger air bags. Both air bags deployed as a result of the impact with the Five Hundred.

The case vehicle's front right passenger air bag was located in the middle of the right instrument panel (**Figure 8** below). The air bag module cover consisted of two cover flaps made of thick, pliable, vinyl. The upper cover flap was semi-circular in shape while the lower cover

flap was trapezoidal-shaped. The upper cover flap was approximately 41 centimeters (16.1 inches) in length and 7 centimeters (2.8 inches) in height at the center. The lower cover flap was approximately 46 centimeters (18.1 inches) in length and 7.5 centimeters (3 inches) in height. The distance between the leading edge of the instrument panel and the leading edge of the module cover flaps was approximately 5.5 centimeters (2.2 inches). The distance between the mid-center of the front right passenger's seat back, as positioned at the time of the vehicle inspection, (i.e., seat at full forward position, seat back slightly reclined) and the front surface of the air bag's fabric at approximate full excursion was approximately 9 centimeters (3.5 inches). An inspection of the air bag module cover flaps and the air bag fabric revealed that the cover flaps opened at the designated tear points. There was no evidence of damage or occupant contact to the cover flaps (**Figures 8** and **9**). The deployed front right passenger air bag (**Figure 10)** was square with a height and width of approximately 60 centimeters (23.4 inches). The air bag was designed without tethers and had one vent port located on the left side of the air bag at the approximate 10:30 o'clock position. The vent port was 6 centimeters (2.4 inches) in diameter. Inspection of the air bag revealed no evidence of skin or cloth transfer. However, a reddish-brown spot was observed on the lower front right quadrant of the air bag (**Figure 10**) and a few yellows spots were noted on top of the air bag (**Figure 11**). It is possible these spots were fluid stains related to contact with the front right passenger.

Figure 8: Case vehicle's front right passenger air bag module, lower cover flap

Figure 9: Case vehicle's front right passenger air bag module, upper cover flap

Figure 10: Case vehicle's front right passenger air bag, arrow shows location of small reddish/brown spot

Figure 11: Top of case vehicle's front right passenger air bag, yellow tape shows location of small yellow spots

Figure 12: Case vehicle driver's air bag

The case vehicle's driver air bag was located in the steering wheel hub. An inspection of the air bag module cover flaps 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 module cover flaps or the air bag. The deployed driver's air bag (**Figure 12**) was round with a diameter of approximately 62 centimeters (24.4 inches). The air bag was designed with three tethers, each 7.5 centimeters (3 inches) in width and had two vent ports, each 2.5 centimeters (1 inch) in diameter, located at the 11 and 1 o'clock positions. Inspection of the air bag was unremarkable. There was no evidence of occupant contact to the air bag.

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

Immediately prior to the crash the case vehicle's front right passenger [6-year-old, White (non-Hispanic) female; 114 centimeters and 20 kilograms (45 inches, 45 pounds)] was seated in an upright position with both feet dangling over the edge of the seat. The case vehicle's driver indicated that the front right passenger's seat track was adjusted to the middle position. The front right passenger was not wearing glasses.

The case vehicle's front right passenger was not restrained by her lap-and-shoulder safety belt. The driver stated during her interview as well as to police that the front right passenger was not restrained. The examination of the passenger's safety belt assembly also revealed no evidence of loading.

The case vehicle's driver applied hard braking just prior to the impact. As a result of the braking, the unrestrained front right passenger continued forward as the case vehicle decelerated. The front right passenger was near or over the air bag module when the impact occurred and the air bag deployed. As a result, the deploying air bag directly contacted the front right passenger's face, neck, chest and shoulders. The front right passenger's contact with the air bag resulted in a cerebral edema, intracranial hemorrhage, subarachnoid hemorrhage and complete dislocation of the atlanto-occipital. In addition, the front right passenger sustained a large abrasion underneath her chin and across her neck as well as contusions to her chest and shoulders. The deploying air bag projected the front right passenger back into her seat. She impacted her seat back and remained in her seat as the case vehicle came to final rest. The front right passenger was removed from the case vehicle by emergency medical personnel.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The police crash report indicated the front right passenger was transported by ground ambulance to a hospital. The front right passenger died as a result of her injuries during her

second day in the hospital. The table below shows the front right passenger's injuries and injury mechanisms.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
	Nonanatomic brain injury with loss of consciousness; unresponsive to painful stimuli; pupils fixed, dilated, and nonreactive; GCS=3;	Not coded	Air bag, front right passenger's	Certain	Emergency room records
	loss of consciousness greater than 24 hours; no response to cold calorics, no corneal or gag reflexes[1]				Hospitalization records
1	Edema, cerebral, diffuse, massive, with effacement of cortical sulci, basal cisterns, and slit like ventricles	critical 140666.5,9	Air bag, front right passenger's	Certain	Autopsy
2	Hemorrhage {bleed}, small, intracranial, not further specified	severe 140640.4,9	Air bag, front right passenger's	Probable	Hospitalization records
3	Hemorrhage, subarachnoid, at base of brain associated with cervical injury	serious 140684.3,9	Air bag, front right passenger's	Certain	Autopsy
4	Dislocation {separation}, complete, atlanto-occipital without mention of cervical cord injury[2]	moderate 650208.2,6	Air bag, front right passenger's	Certain	Autopsy
5	Contusion {hemorrhage}, mediastinum, not further specified	moderate 441804.2,4	Air bag, front right passenger's	Probable	Autopsy
6 7	Contusions {bruises} on face, right more than left, with swelling to right jaw	minor 290402.1,1 290402.1,2	Air bag, front right passenger's	Certain	Hospitalization records
8	Abrasion underneath chin from side-to-side	minor 290202.1,8	Air bag, front right passenger's	Certain	Graphic photographs
9	Abrasion, large, with oozing, across anterior neck, from ear-to-ear	minor 390202.1,5	Air bag, front right passenger's	Certain	Autopsy
10	Contusion chest, not further specified	minor 490402.1,4	Air bag, front right passenger's	Probable	Autopsy

[1] Occupant was pronounced dead after brain flow study showed no blood flow to brain and all examinations and tests were consistent with no brain function.

[2] This contractor was only provided with a summary of the autopsy. No spinal cord lesion was cited. It is unclear whether there was no lesion to the spinal cord or the spinal cord was not examined.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
11	Contusions {bruises} on shoulders, not further specified	minor 790402.1,3	Air bag, front right passenger's	Probable	Hospitalization records

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash the case vehicle's driver [30-year-old, White (non- Hispanic) female; 170 centimeters and 73 kilograms (67 inches, 160 pounds)] was seated leaning forward and to the right. She had both hands on the steering wheel, her left foot on the floor and her right foot on the brake. The driver's seat track was adjusted to between the middle and rear-most position and her seat back was slightly reclined. The tilt steering column was adjusted to its full down position. The driver was wearing glasses at the time of the crash.

Although the driver stated she was restrained by the lap-and-shoulder safety belt, the evidence indicated she was not restrained. Inspection of the safety belt assembly showed no evidence of loading, and the driver's head contacted and fractured the windshield during the crash.

The case vehicle's driver applied the brakes just prior to the impact and was most likely bracing her hands against the steering wheel at the time of the impact. The impact caused the driver to continue forward and to the left opposite the case vehicle's 320 degree direction of principal force as the case vehicle decelerated longitudinally and accelerated laterally to the right. The driver's face and chest impacted her deployed air bag, and she was deflected up and over the air bag and impacted her head on the windshield fracturing the windshield (**Figure 13**). The driver rebounded back into her seat and remained in her seat as the case vehicle came to final rest. The driver exited the case vehicle under her own power.

Figure 13: "Starburst" type fracture to the windshield due to contact by unrestrained driver's head

CASE VEHICLE DRIVER INJURIES

The police crash report indicated the driver was not injured. The driver rode in the ambulance with the front right passenger to the hospital. The table below shows the case vehicle driver's self reported injuries.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
	Pain, soreness central forehead at hairline above nose	not coded	Front left windshield's glazing	Certain	Interviewee (same person)
1	Abrasion, 5.1 cm (2 in) right dorsal wrist	minor 790202.1.1	Air bag, driver's	Certain	Interviewee (same person)

CASE VEHICLE BACK LEFT PASSENGER KINEMATICS

Immediately prior to the crash the case vehicle's back left passenger [8-year-old, White (non- Hispanic) female; 127 centimeters and 25 kilograms (50 inches, 55 pounds)] was seated in an unknown posture. Her feet were on the floor, but the position of her hands is not known. The back left passenger's seat track and seat back were not adjustable.

Based on the driver's interview, the back left passenger was restrained by her lap-and-shoulder safety belt.

The case vehicle's driver applied the brakes just prior to the impact. As a result, the passenger's safety belt retractor most likely locked and she moved forward and loaded the safety belt. The impact caused the passenger to continue forward and to the left opposite the case vehicle's 320 degree direction of principal force as the case vehicle decelerated longitudinally and accelerated laterally to the right. She loaded her safety belt and her lower legs most likely contacted the back of the driver's seat. The passenger rebounded back into her seat and remained in her seat as the case vehicle came to final rest. The passenger exited the case vehicle under her own power.

CASE VEHICLE BACK LEFT PASSENGER INJURIES

Based on the driver's interview and the police crash report, the back left passenger was not injured and was not transported to a medical facility.

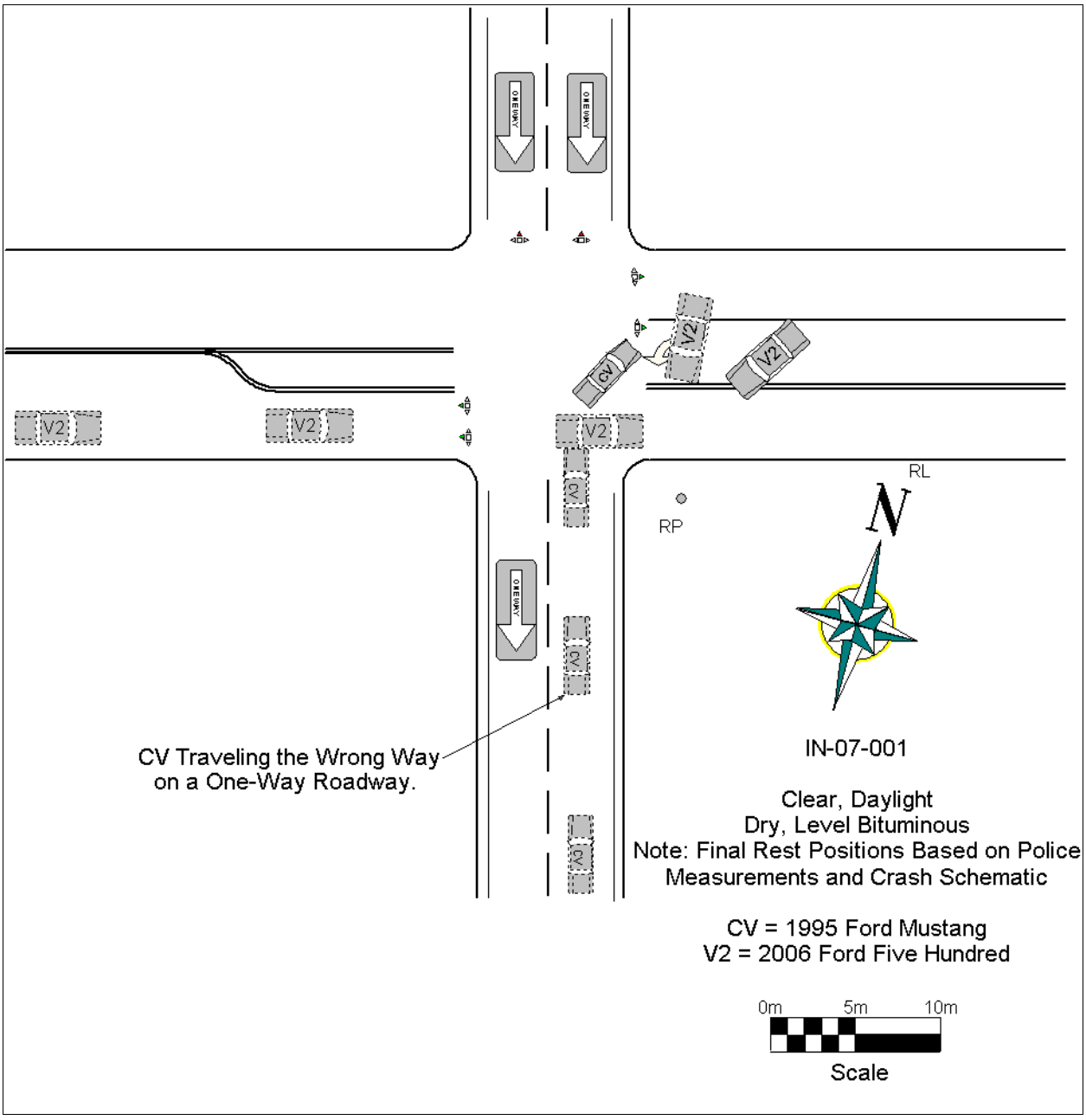
OTHER VEHICLE

The 2006 Ford Five Hundred was a front wheel drive, four-door sedan (VIN: 1FAFP23126G------) equipped with a 3.9L, V6 engine and four-wheel, anti-lock brakes. The Five Hundred was also equipped with dual stage driver and front right passenger air bags, which did not deploy as a result of the impact with the case vehicle.

Exterior Damage: The Five Hundred's impact with the case vehicle involved the right side of the vehicle. The police photographs of the Five Hundred showed that direct damage involved a small portion of the back edge of the right front door, the right rear door, front portion of the right quarter panel, and the right rear wheel.

Damage Classification: Based on the police photographs of the Five Hundred, the CDC was determined to be **02-RZEW-1** (**50** degrees). The WinSMASH reconstruction program, missing vehicle algorithm, was used to reconstruct the Five Hundred's Delta Vs. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 22.0 km.p.h. (13.7 m.p.h.), -14.1 km.p.h. (-8.8 m.p.h.), and -16.9 km.p.h. (-10.5 m.p.h.). The crash fit the reconstruction model and the results were borderline but appeared reasonable. The Five Hundred was driven from the scene by the driver.

Five Hundred's Occupants: According to the police crash report, the driver of the Five Hundred [80-year-old, White (unknown if Hispanic) male] was restrained by his manual, three-point, lap-and-shoulder, safety belt system. The police crash report indicated the driver was not injured and was not transported to a medical facility.


ONE WAY
ONE WAY
ONE WAY
V2
V2
V2
V2
V2
V2
CV
CV
CV
RP
RL
N
CV Traveling the Wrong Way
on a One-Way Roadway.
IN-07-001
Clear, Daylight
Dry, Level Bituminous
Note: Final Rest Positions Based on Police
Measurements and Crash Schematic
CV = 1995 Ford Mustang
V2 = 2006 Ford Five Hundred
0m
5m
10m
Scale