

CRASH DATA RESEARCH CENTER

Calspan Corporation
Buffalo, NY 14225

**CALSPAN ON-SITE CERTIFIED ADVANCED 208-COMPLIANT
VEHICLE CRASH INVESTIGATION**

CASE NO: CA05-016

VEHICLE: 2004 MAZDA 3

LOCATION: FLORIDA

CRASH DATE: DECEMBER 2004

Contract No. DTNH22-01-C-17002

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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 are 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.

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16. Abstract This investigation focused on the performance of the Certified Advanced 208-Compliant safety system in a 2004 Mazda 3. The manufacturer of this vehicle has certified that this 2004 Mazda 3 meets the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. An unknown age male driver and unknown age male front right passenger allegedly occupied the 2004 Mazda. Neither occupant was restrained. The insurance adjuster stated to the SCI investigator that the driver was the sole occupant of the Mazda, which was consistent with the police report. However, based on contact evidence in the vehicle, passenger air bag deployment, and statements from residents at the scene, a front right passenger was present in the vehicle at the time of the crash. The driver was operating the Mazda 3 on a local roadway during nighttime hours and lost control of the vehicle. The Mazda initiated a counterclockwise (CCW) yaw and the right front side of the Mazda impacted the front of a parked 2000 Ford Explorer. The impact was sufficient to deploy the frontal air bag system in the Mazda. The Mazda rotated rapidly in a CCW direction and the rear plane of the Mazda struck the left side plane of the Explorer in an end swipe configuration. During the crash, the right hinge of the Mazda's hood failed, resulting in partial hood separation. The Mazda came to rest facing its original travel direction, and the Explorer was displaced rearward onto the roadside. Reportedly, the driver was not injured. It was unknown if the front right passenger was injured. The vehicle was towed from the crash site and subsequently deemed a total loss by the insurance company.					
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TABLE OF CONTENTS

BACKGROUND	1
SUMMARY	2
Vehicle Data – 2004 Mazda 3.....	2
Vehicle Data – 2003 Ford Explorer	2
Crash Site	3
Crash Sequence	3
Pre-Crash.....	3
Crash	4
Post-Crash.....	4
Vehicle Damage.....	5
Exterior Damage – 2004 Mazda 3	5
Interior Damage – 2004 Mazda 3	6
Exterior Damage – 2000 Ford Explorer.....	7
Manual Safety Belts – 2004 Mazda 3	8
Certified Advanced 208-Compliant Safety System.....	8
Frontal Air Bag System – 2004 Mazda 3.....	8
Occupant Sensing System – 2004 Mazda 3.....	9
Occupant Demographics.....	9
Driver	9
Driver Kinematics	9
Front Right Passenger	10
Front Right Passenger Kinematics.....	10
Figure 13. Scene Schematic.....	11

**CALSPAN ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE CRASH
INVESTIGATION
CASE NO: CA05-016
LOCATION: STATE OF FLORIDA
VEHICLE: 2004 MAZDA 3
CRASH DATE: DECEMBER 2004**

BACKGROUND

This investigation focused on the performance of the Certified Advanced 208-Compliant safety system in a 2004 Mazda 3 (**Figure 1**). The manufacturer of this vehicle has certified that this 2004 Mazda 3 meets the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. An unknown age male driver and unknown age male front right passenger allegedly occupied the 2004 Mazda. Neither occupant was restrained. The insurance adjuster stated to the SCI investigator that the driver was the sole occupant of the Mazda, which was consistent with the police report. However, based on contact evidence in the vehicle, passenger air bag deployment, and statements from residents at the scene, a front right



Figure 1. Damaged 2004 Mazda 3

passenger was present in the vehicle at the time of the crash. The driver was operating the Mazda 3 on a local roadway during nighttime hours and lost control of the vehicle. The Mazda initiated a counterclockwise (CCW) yaw and the front right corner of the Mazda impacted the front of a parked 2000 Ford Explorer. The impact was sufficient to deploy the CAC frontal air bag system in the Mazda. The Mazda rotated rapidly in a CCW direction and the rear plane of the Mazda struck the left side plane of the Explorer in an endswipe configuration. During the crash, the right hinge of the Mazda's hood failed, resulting in partial hood separation. The Mazda came to rest facing its original travel direction, and the Explorer was displaced rearward onto the roadside. Reportedly, the driver was not injured. It was unknown if the front right passenger was injured. The vehicle was towed from the crash site and subsequently deemed a total loss by the insurance company.

This crash was identified from a list of claims provided by an insurance company to the National Highway Traffic Safety Administration (NHTSA) that identified Certified Advanced 208-Compliant vehicles that had been involved in crashes. The list was forwarded to the Calspan Special Crash Investigations (SCI) team for a follow-up investigation. The Mazda was located and cooperation was established with the salvage yard. An on-site investigation was assigned to the Calspan SCI team on February 17, 2005. The vehicle and crash site inspection was completed on February 21, 2005. Attempts to contact the police-reported driver of the Mazda were unsuccessful. An interview with the owner of the Ford Explorer was conducted during the scene inspection. It was reported by the Explorer's owner that the police-reported driver was not

operating the vehicle at the time of the crash, but that two non-police-reported males were the occupants of the vehicle.

SUMMARY

Vehicle Data – 2004 Mazda 3

The 2004 Mazda 3 was identified by the Vehicle Identification Number (VIN): JM1BK123541 (production sequence omitted). The Mazda 3 was equipped with a 2.4-liter, 4-cylinder engine, a four-speed automatic transmission, four-wheel power disc brakes, power steering, and a tilt and telescoping steering column. The Mazda 3 was equipped with 41 cm (16”) aluminum/alloy wheels and Toyo PROXES P205/55R16 tires. The manufacturer’s recommended tire pressure was 220 kPa (32 PSI). The specific tire information at the time of the vehicle inspection was as follows:

Position	Measured Pressure	Measured Tread	Damage
LF	152 kPa (22 PSI)	6 mm (8/32”)	None
LR	152 kPa (22 PSI)	7 mm (10/32”)	None
RF	145 kPa (21 PSI)	6 mm (8/32”)	None
RR	152 kPa (22 PSI)	8 mm (10/32”)	None

The Mazda 3 was configured with bucket seats and adjustable head restraints. Both head restraints were located in the full-down position. The driver’s seat was adjusted to a full-rear track position and the total track travel measured 25 cm (10”). The front right passenger’s seat was adjusted to 4 cm (1.5”) forward of the full-rear position and 17 cm (6.5”) rear of the full-forward position. The second row was configured with a bench seat with a 60/40 split folding back. The outboard rear seat positions were configured with adjustable head restraints that were in the full-down position.

Vehicle Data – 2000 Ford Explorer

The 2000 Ford Explorer was identified by the Vehicle Identification Number (VIN): 1FMZU73E9YU (production sequence omitted). At the time of the vehicle inspection, the Explorer’s odometer read 149,164 km (92,689 miles). The Explorer was a four-door 4 x 4 sport utility vehicle, and was equipped with a 4.0 liter, V6 engine, an automatic 5-speed transmission, anti-lock brakes, alloy wheels, power steering, and a tilt steering wheel. The Explorer was configured with 38 cm (15”) diameter wheels and Michelin XCX/APT P235/75R15 tires.

The specific tire information at the time of the vehicle inspection was as follows:

Position	Measured Pressure	Measured Tread	Damage
LF	0 kPa	6 mm (8/32")	None
LR	159 kPa (23 PSI)	9 mm (11/32")	None
RF	186 kPa (27 PSI)	6 mm (8/32")	None
RR	186 kPa (27 PSI)	6 mm (8/32")	None

Crash Site

This two-vehicle crash occurred during nighttime hours in the state of Florida in December 2004. The crash occurred on a two-lane, undivided, residential roadway in a private development. At the time of the crash, it was raining and the asphalt roadway surface was wet. The roadway was illuminated by roadside light poles. The east/west roadway consisted of one lane in each direction, bordered by concrete drainage channels. The roadway was straight and level at the crash site; however, an eastbound right curve exited west of the crash site, and a 90-degree left curve was present immediately east of the crash site. The roadside environment consisted of grassy yards, concrete sidewalks, concrete driveways, and private residences. The speed limit was not posted. The scene schematic is included as **Figure 13** at the end of this narrative report.

Crash Sequence

Pre-Crash

The male driver of the Mazda 3 was operating the vehicle in a westbound direction on the two-lane roadway. A 2000 Ford Explorer was legally parked on the north roadside, straddling the concrete drainage channel. As the Mazda 3 exited the right curve (**Figure 2**), the driver lost control of the vehicle. He steered left in an attempt to regain control, and the vehicle initiated a counterclockwise (CCW) yaw. The wet roadway surface and the low tire inflation in all four tires likely contributed to the vehicle's pre-crash yaw due to the reduced coefficient of friction. The Mazda crossed the center of the roadway and into the opposite travel lane in the CCW yaw. As it approached the parked Explorer, the Mazda was oriented approximately 45 degrees CCW from its original travel direction.

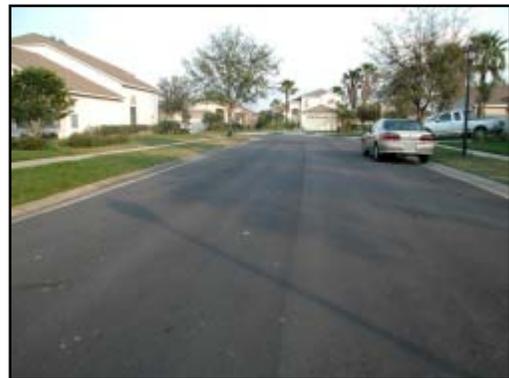


Figure 2. Westbound approach for the Mazda 3

Crash

The front right corner of the Mazda 3 impacted the front left corner of the Explorer. Initial contact on the Mazda began at the right front side area above the bumper, slightly rear of the bumper corner, with engagement of the right corner of the upper radiator support. The impact resulted in moderate damage to both vehicles. The Principal Direction of Force (PDOF) was 30 degrees for the Mazda and 350 degrees for the Explorer. The damage algorithm of the WinSMASH program computed a total delta-V of 21 km/h (13 mph) for the Mazda and 16 km/h (10 mph) for the Explorer based on their respective crush profiles. The Explorer was displaced approximately 5 m (16') rearward and approximately 30 degrees in a clockwise (CW) direction (**Figure 3**). The Mazda quickly rotated in a CCW direction around the front left corner of the Explorer. The rear plane of the Mazda struck the left side plane of the Explorer as the Mazda rotated around the Explorer as the Explorer was displaced rearward. The rear bumper fascia and trunk face of the Mazda 3 struck the left rear door panel of the Explorer in an end-swipe configuration as both vehicles traveled to final rest. There was no structural deformation to either vehicle aside from surface abrasions as a result of the secondary endswipe. The Mazda continued to rotate in a CCW direction and came to rest facing east in the eastbound lane, approximately 10 m (33') east of the initial impact. The Mazda's hood separated at the right hinge and rotated approximately 160 degrees in a CCW direction about the left hinge. At rest, the hood was suspended from the left side of the engine compartment, the right front corner of the hood on the roadway (**Figure 4**).



Figure 3. On-scene photograph showing final rest of the Explorer



Figure 4. On-scene photograph showing final rest of the Mazda 3

Post-Crash

Residents who lived in the residential neighborhood stated that immediately after the crash, they observed two young males running from the crash scene, believed to be the occupants of the Mazda 3. The owner of the Explorer contacted police to report the crash. An adult male resident of the household to which the Mazda was registered, subsequently responded to the crash scene. Neighbors reported that he was visibly upset about the condition of the Mazda, and talking on a cellular telephone with an unknown party. Police reported this individual as the driver of the Mazda, although neighbors stated that he was not one of the males seen running from the scene. The police report indicated that the male driver did not sustain injury and did not receive medical treatment. The Mazda was towed from the scene and the owner removed the Explorer.

Vehicle Damage

Exterior Damage – 2004 Mazda 3

The 2004 Mazda 3 sustained moderate frontal damage as a result of the initial impact with the Ford Explorer. Minor scuff marks were present on the right corner of the top aspect of the bumper fascia, although there was no structural deformation or crush of the front bumper beam. Minor direct contact deformation on the front aspect of the hood began 36 cm (14.0") right of center and extended to the front right corner. The composite upper radiator support was fractured 19 cm (7.3") right of center, and the fractured portion was separated from the vehicle (**Figure 5**). The entire upper radiator support was displaced rearward on the right side, pivoted around the left corner. The maximum crush was projected to the probable location of the right corner of the crushed upper radiator support, which measured 13 cm (5").

Six crush measurements were documented along the upper radiator support. The crush measurements were projected across the missing right section of the upper radiator support. The crush measurements were as follows: C1 = 0 cm, C2 = 0 cm, C3 = 6 cm (2.5"), C4 = 10 cm (4.0"), C5 = 11 cm (4.5"), C6 = 13 cm (5.0"). The Collision Deformation Classification for the impact with the Explorer was 01-FREN-1.



Figure 5. Frontal view of damaged Mazda 3

The direct contact damage began on the front corner of the right fender and extended 67 cm (26.3") rearward. The fender was crushed laterally and longitudinally from direct contact with the Explorer while rotating around the vehicle (**Figure 6**). The maximum lateral crush was located at the leading edge of the right fender and measured 36 cm (14.0"). The deformation involved the entire height of the right front fender and extended onto the right aspect of the hood. The combined direct and induced damage began at the leading edge of the right front fender, extended 88 cm (34.5") rearward, and terminated at the aft edge of the fender. The fender was buckled outward at the rear aspect due to the longitudinal crush. The aspect of the hood separated at the hinge during the crash, and the entire hood was displaced CCW about the left hinge. The right front window glazing disintegrated as a result of the impact. Six crush measurements were documented along the right front fender as follows: C1 = 0 cm, C2 = 0 cm, C3 = 13 cm (5.0"), C4 = 22 cm (8.5"), C5 = 36 cm (14.0"), C6 = 32 cm (12.5").

The crush measurements are for anecdotal purposes alone due to front end being the initial point of contact.



Figure 6. View of right front damage

The Mazda 3 sustained minor rear damage as a result of the secondary endswipe with the Explorer (**Figure 7**). The direct contact damage began 44 cm (17.5”) left of the centerline on the rear bumper fascia, and extended 119 cm (47.0”) to the right rear corner. Paint transfers and scuff marks from the Explorer were present on the rear bumper fascia. Additional paint transfers and scuff marks were present on the trunk face, from contact with the Explorer’s left rear mid-door area. The direct contact on the trunk face began 11 cm (4.5”) right of the centerline and extended 52 cm (20.5”) onto the right rear tail light. There was no residual crush or structural damage to the bumper fascia or trunk face. The CDC for the endswipe with the Explorer was 03-BDES-1.



Figure 7. Damaged rear trunk face and bumper fascia

Interior Damage – 2004 Mazda 3

The 2004 Mazda 3 sustained minor interior damage as a result of occupant contact (**Figure 8**). The center console was slightly displaced to the right, and sustained a fracture on the left side panel aft of the leading edge of the driver’s seat. Contact evidence supporting the presence of a front right passenger was present on the glove box door, the right front panel of the center console to the right of the HVAC controls, and on the interior right front door. Contacts to the right center console panel and the glove box door were consistent with a left knee strike by the front right passenger and the door. A faint transfer consistent with tissue was present on the upper aspect of the right panel, adjacent to the inboard aspect of the glove box. The transfer measured 6 cm (2.5”) in height and 4 cm (1.5”) in width. A curvilinear scuffmark was present below the probable tissue transfer and measured 10 cm (4.0”) in length. A second probable tissue transfer was present on the glove box door. The transfer was located 5 cm (2.0”) to the right of the inboard edge and 8 cm (3.0”) below the top edge. The transfer measured 5 cm (2.0”) in width and 4 cm (1.5”) in height. A linear scuff was present below the probable tissue transfer on the glove box door, began 4 cm (1.5”) to the right of the inboard edge, and 20 cm (8.0”) above the bottom edge. The transfer measured 13 cm (5.0”) in length. Pocketing on the right door interior began 18 cm (7.0”) rear of the leading edge of the door from the front right occupant’s right knee. The pocketing measured 11 cm (4.5”) in length and involved the entire height of the armrest. The top aspect of the armrest was displaced as a result of the contact.



Figure 8. View of front seat positions and occupant contact

Exterior Damage – 2000 Ford Explorer

The Explorer sustained moderate frontal damage as a result of the initial impact with the Mazda 3. The direct damage began 27 cm (10.5”) left of the centerline on the front bumper, and extended 53 cm (21.0”) to the left front bumper corner. The bumper was crushed rearward, and scuff marks were present on the left aspect of the bumper, and the reinforced plastic bumper was fractured inboard of the left corner. The left fog lamp was separated from the front bumper housing. The direct contact extended vertically to 14 cm (5.5”) below the leading edge of the hood. The grille was fractured on the left aspect, the left headlamp was displaced, and the trim surrounding the headlamp and grille was fractured. The combined direct and induced damage involved the entire frontal width of the Explorer and measured 151 cm (59.5”) across the front bumper. The entire bumper was displaced rearward and slightly to the right, as a result of the frontal impact. The forward aspect of the left fender was deflected inboard 6 cm (2.5”). The maximum crush to the front of the Explorer was located 45 cm (17.7”) left of the vehicle’s centerline and measured 11 cm (4.4”). The left front tire was debaded, but there was no wheelbase reduction as a result of the crash. The CDC for the impact with the Mazda was 11-FYEW-1. Six crush measurements were documented along the front bumper and were as follows: C1 = 10 cm (4.0”), C2 = 11 cm (4.4”), C3 = 8 cm (3.4”), C4 = 2 cm (1.0”), C5 = 0 cm, C6 = 0 cm.



Figure 9. View of damaged Ford Explorer

The Explorer sustained minor left side damage as a result of the Mazda 3’s endswipe (**Figure 10**). The direct contact began 12 cm (4.8”) aft of the leading edge of the left rear door. The direct contact abrasions were located below the side trim and extended 68 cm (26.7”) rearward. There was no lateral crush or deformation on the lower aspect of the door. Additional abrasions and paint transfers were located above the side trim on the rear door from contact with the Mazda’s trunk face. The direct contact damage began 20 cm (7.8”) aft of the leading edge of the left rear door and extended 43 cm (17.0”) rearward. The direct contact was vertically located 20 cm (8.0”) below the beltline and measured 15 cm (6.0”) in height. The maximum lateral deformation measured 1 cm (0.3”) on the aft aspect of the door above the trim. The combined direct and induced damage measured 97 cm (38.3”) along the entire length of the left rear door. The CDC for the endswipe was 12-LPES-1.



Figure 10. View of left side damage

Manual Safety Belts – 2004 Mazda 3

The 2004 Mazda 3 was configured with manual 3-point lap and shoulder belts for both front positions. Based on the vehicle inspection, it did not appear that the safety belts were utilized in this crash by either occupant. The driver's safety belt was configured with a sliding latch plate and an Emergency Locking Retractor (ELR). The front right passenger's safety belt was configured with a sliding latch plate and a switchable Automatic Locking Retractor (ALR)/ELR. Both front adjustable D-rings were positioned in the full-up position at the time of the vehicle inspection. There were no abrasions to either D-ring or latch plate, and there was no deformation to the safety belt webbing to indicate occupant loading. In addition, neither front buckle pretensioner fired, which supported the unrestrained status of both occupants. A faint plastic transfer was present on the driver's shoulder belt near the D-ring, but it was not related to this crash. The rear seat positions were configured with manual 3-point lap and shoulder belts with sliding latch plates and switchable ELR/ALR retractors.

Certified Advanced 208-Compliant Safety System Frontal Air Bag System – 2004 Mazda 3

The 2004 Mazda 3 was equipped with a Certified Advanced 208-Compliant safety system that included dual-stage frontal air bags, safety belt buckle pretensioners, and seat track position sensors. The driver's air bag deployed from the steering wheel hub through a tri-flap cover design. The top flap measured 11 cm (4.4") in width and 5 cm (2.0") in height, with a circular logo centered on the upper flap that extended an additional 4 cm (1.5") below the outboard aspects of the top flap. The bottom flaps were symmetrical, contoured around the circular logo cutout, and measured 6 cm (2.3") in height and 6 cm (2.3") in width. The driver's air bag (**Figure 11**) measured 61 cm (24.0") in diameter in its deflated state. There was no contact evidence present on the air bag fabric. The air bag was vented by two circular 3 cm (1.0") diameter ports that were located at the 11 and 1 o'clock sectors on the rear of the air bag, positioned 8 cm (3.0") from the circumferential seam. The driver's air bag was not tethered.



Figure 11. Deployed driver's air bag



Figure 12. Deployed front right passenger's air bag

The front right passenger air bag (**Figure 12**) deployed from a top-mount module configured with a rectangular cover flap hinged at the forward aspect. The cover flap measured 24 cm (9.5") in width and 14 cm (5.5"), in height. The front right passenger's air bag was slightly oblong in shape. The air bag measured 33 cm (13.0") in width (seam-to-seam) at the top and bottom aspects and measured 36 cm (14.0") in width at the

horizontal centerline. The air bag measured 60 cm (22.0”) in height. There was no contact evidence present on the air bag. A lateral external tether was present on the rear aspect of the air bag, 17 cm (6.5”) above the bottom seam. The tether measured 2 cm (1.8”) in height and 27 cm (10.5”) in width (seam-to-seam). A separate heavy fabric strap was attached to the outboard aspects of the air bag module housing. The strap was 2 cm (0.6”) in height and measured 48 cm (19.0”) in length.

The Mazda was equipped with safety belt buckle pretensioners for the driver and front right passenger positions. Neither pretensioner fired as a result of the crash. At the time of the vehicle inspection, the distance between the end of the piston and the end of the pretensioner barrels measured 7 cm (2.8”).

Occupant Sensing System – 2004 Mazda 3

The Certified Advanced 208-Compliant (CAC) safety system was configured with a weight sensor in the front right seat cushion. The system was designed to detect occupant presence and automatically suppress the front right passenger’s air bag if it detected a weight consistent with a child seat, a booster seat, or a child sitting in the front seat, or it if determined that the front seat was not occupied. A light on the lower left aspect of the center instrument panel below the HVAC controls confirmed the air bag on/off status. Based on occupant contact evidence at the time of the vehicle inspection, the front right seat appeared to have been occupied by an unrestrained occupant. Given the severity of the crash, since the front right seat was occupied and the safety belt buckle was not engaged, the CAC system deployed the front right passenger’s air bag and did not fire the front right safety belt buckle pretensioner. In addition, the system detected the unrestrained nature of the driver, and deployed the driver’s air bag without firing the driver’s safety belt buckle pretensioner.

The Mazda 3 was not equipped with an Event Data Recorder (EDR).

Occupant Demographics

Driver

Age/Sex:	Unknown age/Male
Height:	Unknown
Weight:	Unknown
Seat Track Position:	Full rear
Manual Restraint Use:	Unrestrained
Usage Source:	Vehicle inspection
Eyewear:	Unknown
Type of Medical Treatment:	Unknown

Driver Kinematics

The male driver of the Mazda was unrestrained. He was probably displaced to the right as the vehicle began to yaw prior to impact. At impact with the Explorer, the frontal air bag system deployed and the driver initiated a forward and lateral trajectory to the right. The driver loaded the deployed driver’s air bag, which mitigated contact with the steering wheel. His pelvic region

and right leg loaded the center console, evidenced by the fracture and displacement of the center console panel. He was redirected to the left as the Mazda rotated CCW and struck the Explorer in an endswipe configuration, and most likely came to rest upright in the driver's seat as the vehicle rotated to final rest. According to the owner of the Explorer, the driver of the Mazda was seen running from the crash site after the crash. The police reported driver of the Mazda could not be located during the SCI investigation.

Front Right Passenger

Age/Sex:	Unknown age/Male
Height:	Unknown
Weight:	Unknown
Seat Track Position:	3.8 cm (1.5") forward of full-rear and 16.5 cm (6.5") rear of full forward
Manual Restraint Use:	Unrestrained
Usage Source:	Vehicle inspection
Eyewear:	Unknown
Type of Medical Treatment:	Unknown

Front Right Passenger Kinematics

The male front right passenger of the Mazda was unrestrained. He was probably displaced to the right as the vehicle began to yaw prior to impact. At impact with the Explorer, the frontal air bag system deployed and the front right passenger initiated a forward and lateral trajectory to the right. He loaded the deployed front right passenger's air bag, which mitigated contact with the instrument panel. His right leg and knee struck the interior aspect of the right front door, evidenced by pocketing and displacement of the inboard aspect of the armrest. He was redirected to the left as the Mazda rotated CCW and struck the Explorer in an endswipe configuration. His left knee struck the glove box door and the side panel of the center instrument panel, evidenced by scuff marks and a faint tissue transfer. According to the owner of the Explorer, the alleged front right passenger of the Mazda was seen running from the crash site after the crash. It was not known if he sustained injury. The front right passenger of the Mazda could not be located during the SCI investigation.

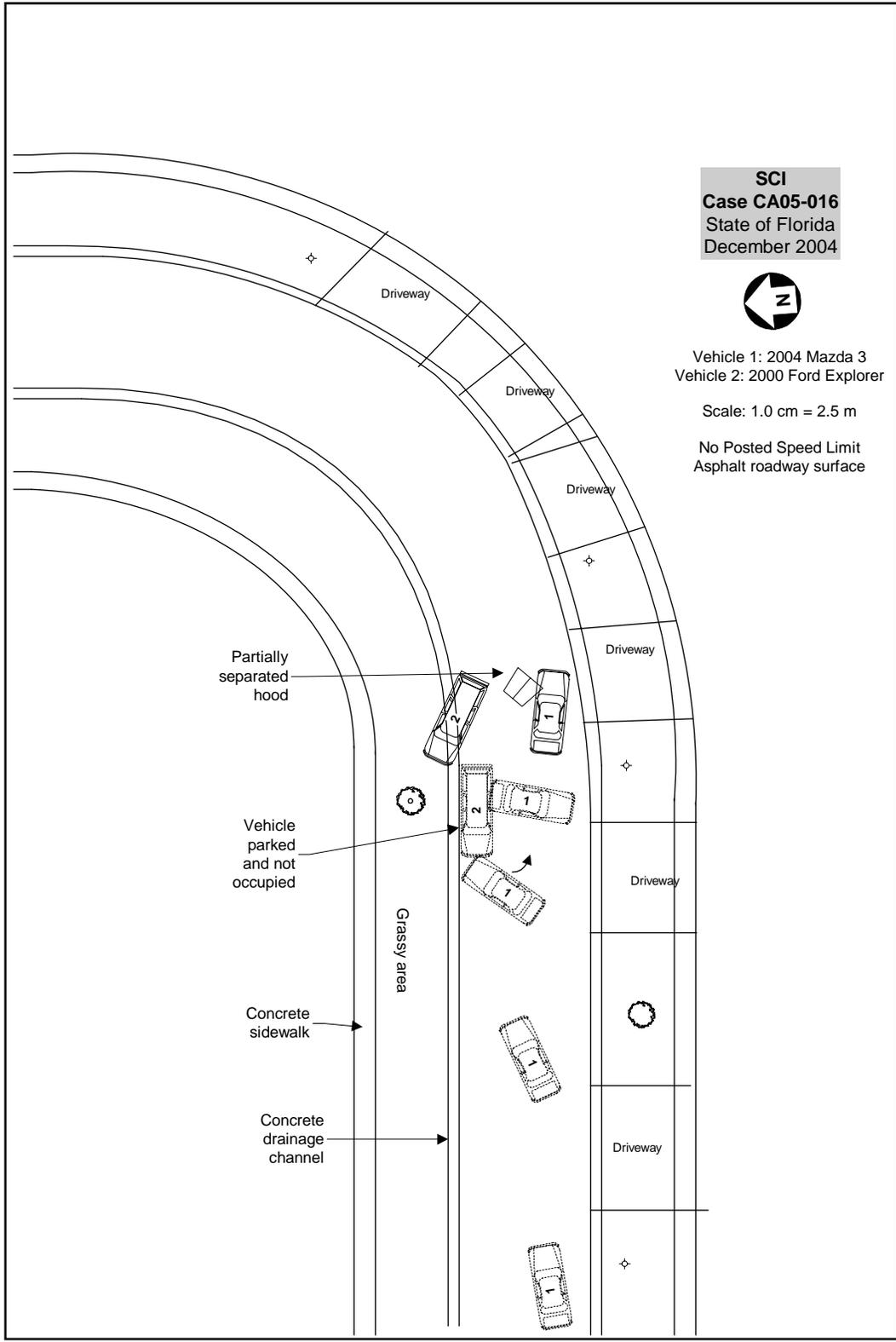


Figure 13. Scene schematic