INDIANA UNIVERSITY

TRANSPORTATION RESEARCH CENTER
School of Public and Environmental Affairs
501 S. Madison Street–Suite 105
Bloomington, Indiana 47403-2452
(812) 855-3908 Fax: (812) 855-3537

ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE INVESTIGATION

CASE NUMBER - IN08016
LOCATION - NEBRASKA
VEHICLE - 2004 MAZDA 6
CRASH DATE - February 2008

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February 5, 2009

Contract Number: DTNH22-07-C-00044

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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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On-site Certified Advanced 208 Compliant Vehicle investigation involving a 2004 Mazda 3 and a 1991 Dodge Daytona.

16. *Abstract*

This report covers an on-site investigation that involved a 2004 Mazda 3 and a 1991 Dodge Daytona, which were involved in an intersection collision. The focus of this on-site investigation was on the Mazda, which was certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The Mazda was traveling south and the Dodge was traveling north on city streets approaching a 4-leg intersection. As the vehicles entered the intersection, the Dodge's driver executed a left turn and the front of the Mazda impacted the front of the Dodge. The impact force was sufficient to deploy the Mazda's driver and front right passenger frontal air bags. The Mazda's driver was restrained by the lap-and-shoulder belt while the front right passenger was unrestrained, and both were uninjured. The second row left passenger was restrained in a booster seat and was also uninjured.

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This crash was brought to the National Highway Traffic Safety Administration's attention on April 4, 2008 by the sampling activities of the National Automotive Sampling System-General Estimates System. This on-site investigation was assigned on April 10, 2008. The crash involved a 2004 Mazda 3 (**Figure 1**) and a 1991 Dodge Daytona, and occurred in February, 2008 at 1249 hours in Nebraska and was investigated by the applicable city police department. The focus of this on-site investigation was on the Mazda, which was certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208. This contractor inspected the crash scene and the Mazda on April 15-16, 2008. No interview was conducted with the Mazda's driver because she could not be contacted. The Dodge was sold at auction and was not available for inspection. This report is based on the police crash report, crash scene and vehicle inspections, occupant kinematic principles, and this contractor's evaluation of the evidence.

Figure 1: The damaged 2004 Mazda 3

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which the Mazda was traveling was a 8-lane, divided, city street, traversing in a north-south direction, and the Mazda was traveling south approaching a 4-leg intersection. The Mazda's roadway had two through lanes and a left turn lane. The Dodge was traveling north on the same trafficway and its roadway had two through lanes, a left turn/through lane, a left turn lane and a right turn lane. The lane widths for both roadways were nominally 4 meters (13 feet). The roadway pavement markings consisted of solid white lines for the left turn lanes and dashed white lines for the through lanes. The Mazda's roadway had a positive 2% grade and the Dodge's roadway had a negative 2.5% grade. The trafficway was divided by a raised concrete median and the intersection was controlled by multiple 3-phase traffic signals. The speed limit for both trafficways was 64 km/h (40 mph). At the time of the crash, the light condition was daylight, the atmospheric condition was cloudy, and the roadway pavement was dry bituminous. The traffic density was unknown and the site of the crash was urban/commercial. See the Crash Diagram on page 8 of this report.

Pre-Crash: The Mazda was occupied by a restrained 28-year-old female driver, an unrestrained (unknown age and sex) front right passenger, and a restrained (unknown age and sex) second row left passenger. The driver was traveling south in the right through lane (**Figure 2**) approaching the intersection and intended to continue south. The Dodge was being driven by a restrained 20-year-old male driver. The driver was traveling north in the left turn/through lane and intended to turn left and proceed west. It is not known if the Mazda's driver made any avoidance maneuvers prior to the crash, which occurred within the intersection.

Crash: As the Dodge's driver was proceeding with the left turn (**Figure 3**), the front left of the Mazda (**Figure 4**) impacted the front of the Dodge. The Mazda's direction of principal force was within the 11 o'clock sector and the impact force was sufficient to trigger a deployment of the Mazda's driver and front right passenger air bags. The police crash report indicated that the Dodge's driver air bag also deployed. Both vehicles came to final rest within the intersection with the Mazda heading southwest and the Dodge heading northwest.

Post-Crash: The police and emergency medical service responded to the scene. The occupants of the Mazda were not injured. The Dodge's driver, front right passenger and unknown position second row passenger were transported by ambulance to a hospital. The Mazda and the Dodge were towed from the crash scene due to damage.

Figure 2: Approach of Mazda southbound to intersection in right through lane

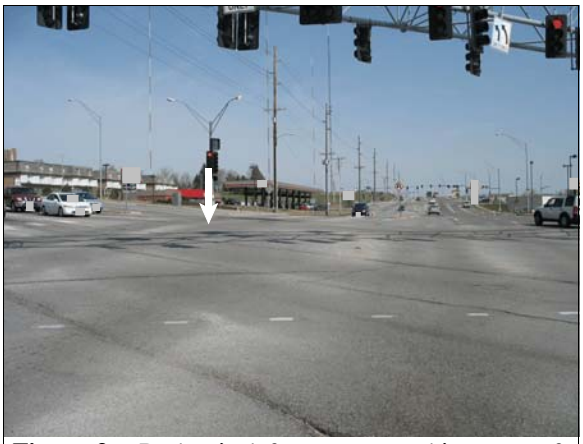


Figure 3: Dodge in left turn approaching area of impact (arrow)

Figure 4: Damage to front of Mazda from impact with the Dodge

CASE VEHICLE

The 2004 Mazda 3 was a front wheel drive, four-door sedan (VIN: JM1BK323141------) equipped with a 2.3L, 4-cylinder engine, 5-speed manual transmission and 4-wheel anti-lock brakes. The front row was equipped with bucket seats, adjustable head restraints, lap-and-shoulder belts, dual stage driver and front right passenger air bags, seat back-mounted side impact air bags, and side impact curtain air bags. The second row was equipped with a bench seat with folding backs, lap-and-shoulder belts, and adjustable head restraints and a Lower Anchor and Tethers for Children (LATCH) system in the outboard seating positions.

Exterior Damage: The Mazda's impact with the Dodge involved the front plane. The front bumper, bumper fascia, grille, hood, left headlamp/turn lamp assembly, and the left fender were directly damaged (**Figure 5**). The direct damage began at the front left bumper corner and extended 56 cm (22.0 in) across the front bumper. The maximum residual crush was 26 cm (10.2 in) and occurred at C_1. (**Figure 6**). The table below shows the vehicle's front crush profile.

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	56	26	113	26	23	23	18	11	0	-26	0
in		22.0	10.2	44.5	10.2	9.1	9.1	7.1	4.3	0.0	-10.2	0.0

The Mazda's left side wheelbase was reduced 9 cm (3.5 in) while the right side wheelbase was extended 1 cm (0.4 in). Induced damage involved the hood, both fenders, and the right headlamp/turn lamp assembly.

Figure 5: The damage to the front of the Mazda

Figure 6: Top view of crush to front of Mazda

Damage Classification The Mazda's Collision Deformation Classification was **11-FYEW-2** (**340** degrees). The Missing Vehicle algorithm of the WinSMASH program calculated the vehicle's total Delta V for the front impact as 41 km/h (25.5 mph). The longitudinal and lateral velocity changes were –38.5 km/h (-23.9 mph), and 14.0 km/h (8.7 mph). The results are considered borderline because they are based only on the Mazda's crush profile.

The manufacturer's recommended tire size was P205/55R16 or P205/55R17. The Mazda was equipped with tires size P205/50R17. The vehicle's tire data are shown in the table below.

Tire	*Measured Pressure*		*Vehicle Manufacturer's Recommended Cold Tire Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kPa	psi	kPa	psi	milli-meters	32nd of an inch			
LF	221	32	221	32	5	6	None	No	No
LR	207	30	221	32	7	9	None	No	No
RR	193	28	221	32	7	9	None	No	No
RF	207	30	221	32	5	6	None	No	No

Vehicle Interior: The inspection of the Mazda's interior revealed occupant contact evidence on the right side of the center console and adjacent glove box door (**Figure 7**) due to contact by the front right passengers left knee. A scuff mark was also located on the left roof side rail. There was no deformation of the steering wheel rim or compression of the energy absorbing steering column, and all the doors remained closed and operational. All the window glazing was either fixed or closed and there was no glazing damage due to impact forces or occupant contact. No passenger compartment intrusions were observed.

Figure 7: Front right passenger contact to center console and edge of glove box door (arrow)

Figure 8: Mazda's deployed driver air bag

AUTOMATIC RESTRAINT SYSTEM

The Mazda was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system that consisted of dual stage driver and front right passenger air bags, seat position sensors, seat belt usage sensors, seat belt buckle-mounted pretensioners, and a front right passenger weight sensor. The manufacturer has certified that the vehicle is compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208.

The driver's air bag was located within the steering wheel hub and the air bag module cover was a 2-flap configuration. The cover flaps were constructed of pliable vinyl and had a horizontal tear seam. The cover flaps opened at the designated tear points and there was no damage to the flaps or the air bag. The deployed driver's air bag (**Figure 8**) was round with a diameter of 59

cm (23 in) and had two vent ports located on the back on the air bag at the 11 and 1 clock positions. There was no discernable evidence of occupant contact on the air bag.

The front right passenger air bag was located within the top of the instrument panel. The air bag module cover consisted of a single cover flap that was 25 cm (9.8 in) in width and 13 cm (5.1 in) in height. The cover flap opened at the designated tear points and there was no damage to the cover flap or the air bag. The deployed front right passenger's air bag (**Figure 9**) was rectangular with a width of 33 cm (13 in) and a height of 48 cm (19 in). It had one vent port located on each side of the air bag. There was no discernable evidence of occupant contact on the air bag.

Figure 9: Mazda's deployed front right passenger air bag

Figure 10: Arrow shows load mark abrasion on the Mazda driver's seat belt

The Mazda was also equipped with front seat back-mounted side impact air bags and side impact curtain air bags. The seat back-mounted side impact air bags were located within the outboard side of the front seat backs, and the side curtain air bags were located within each roof side rail. The side impact sensor was located within each lower B-pillar. None of these air bags deployed because the vehicle did not sustain a side impact.

Figure 11 Mazda driver's buckle mounted pretensioner actuated in the crash

MANUAL RESTRAINT SYSTEM

The Mazda was equipped with lap-and-shoulder belts for all five seating positions. The driver's seat belt consisted of continuous loop belt webbing, sliding latch plate, buckle-mounted pretensioner, an Emergency Locking Retractor (ELR), and an adjustable upper anchor that was in the full-up position. The front right seat belt was similar but had a switchable ELR/Automatic Locking Retractor (ALR). The second row seat belts were equipped with continuous loop belt webbing, sliding latch plates, switchable ELR/ALR retractors, and fixed upper anchors.

The inspection of the driver's seat belt assembly revealed load abrasions on the belt webbing from the D-ring (**Figure 10**), and that the pretensioner actuated during the crash (**Figure 11**). The pretensioner distance had been reduced 7 cm as a result of the actuation. The evidence indicated that the driver was restrained in this crash.

Inspection of the front right seat belt assembly revealed no evidence of loading and the pretensioner did not actuate (**Figure 12**). The evidence indicated that the front right passenger was not restrained in this crash.

Figure 12: Mazda's front right passenger buckle-mounted pretensioner did not actuate in the crash

The inspection of the second row left seat belt assembly revealed no evidence of loading. The police crash report indicated that the second row left passenger was restrained in a child booster seat. The was no information regarding the type of booster seat. The remaining two seating positions were not occupied.

CASE VEHICLE DRIVER KINEMATICS

The Mazda's driver [28-year-old, female; unknown height and weight] was seated in an unknown posture. At the vehicle inspection, the seat track was adjusted to its rear-most position, the seat back was slightly reclined, and the tilt steering column was in its full up position. The distance from the top of the seat back to the top of the head restraint was 27 cm (10.6 in).

The Mazda's impact with the Dodge deployed the driver's air bag, actuated the driver's seat belt pretensioner, and displaced the driver forward and to the left opposite Mazda's 11 o'clock direction of principal force. The driver loaded the seat belt and while there was no discernable occupant contact evidence on the frontal air bag, her face and chest most likely contacted the air bag.

CASE VEHICLE DRIVER INJURIES

The police crash report did not list the driver as injured or transported to a hospital.

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

The Mazda's front right passenger (unknown age, sex, height and weight) was seated in an unknown posture. The passenger's seat track was adjusted to between the middle and rear-most positions, and the seat back was slightly reclined. The distance from the top of the seat back to the top of the head restraint was 27 cm (10.6 in).

The Mazda's impact with the Dodge deployed the front right air bag and displaced the front right passenger forward and to the left opposite the 11 o'clock direction of principal force. The passenger's left knee loaded the left edge of the glove box door and the center console. There was no discernable occupant contact on the front right passenger air bag, but the passenger's face and chest probably loaded the air bag.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The front right passenger was not injured or transported to a hospital.

CASE VEHICLE SECOND ROW LEFT PASSENGER KINEMATICS

The Mazda's second row left passenger (unknown age, sex, height, and weight) was seated in a child booster seat.

The Mazda's impact with the Dodge displaced the back left passenger forward and to the left opposite the 11 o'clock direction of principal force. There was no discernable evidence of occupant contact on the back of the left front seat.

CASE VEHICLE SECOND ROW LEFT PASSENGER INJURIES

The second row left passenger was not injured or transported to a hospital.

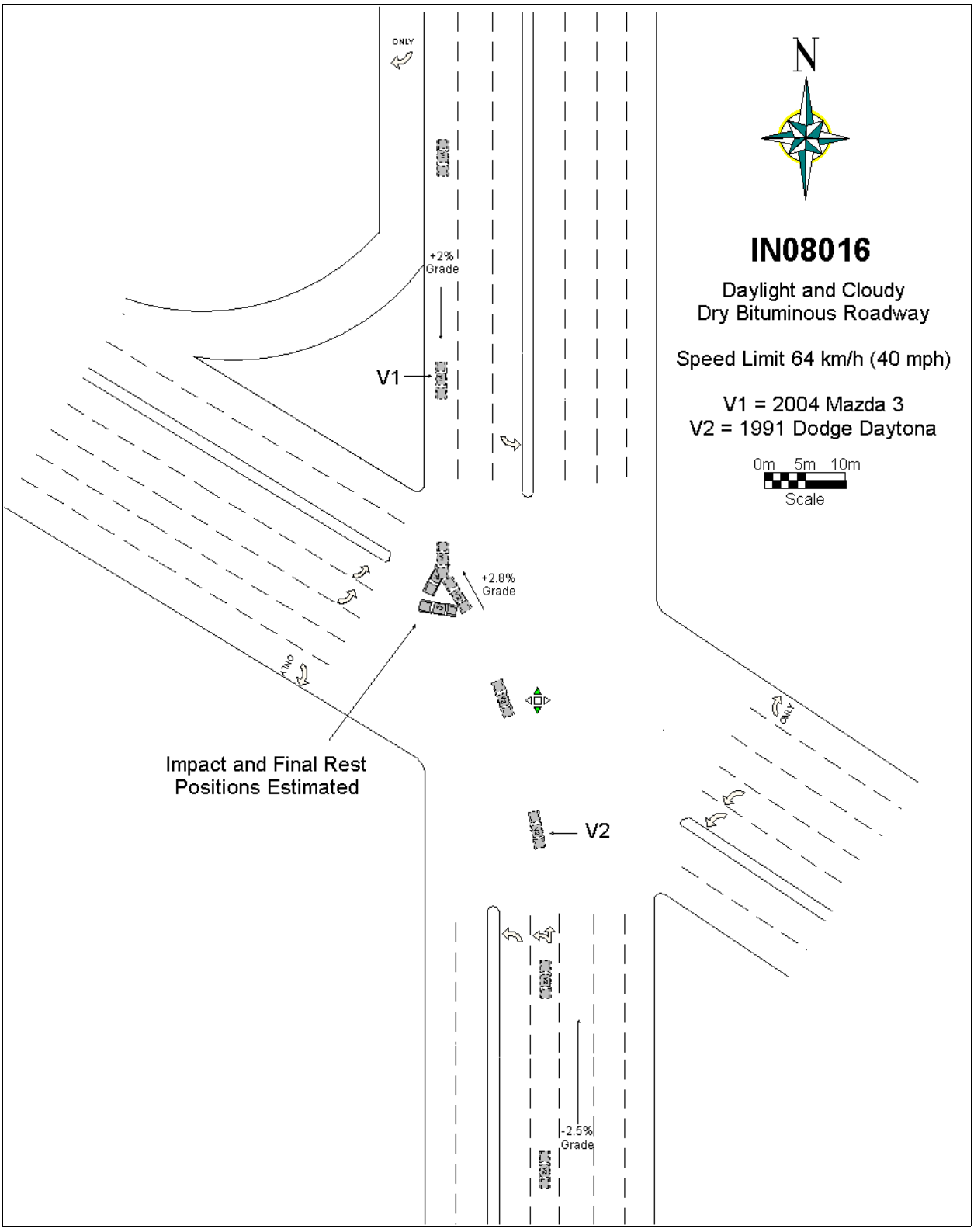
OTHER VEHICLE

The 1991 Dodge Daytona was a front wheel drive, two-door hatchback (VIN: 1B3XG24K3MG------), equipped with a 2.5L, 4-cylinder engine and a driver air bag.

Exterior Damage: The Dodge was not inspected. It had been sold at auction prior to this contractor's investigation.

Damage Classification: The Missing Vehicle algorithm of the WinSMASH program calculated the Dodge's total Delta V for the front impact as 36 km/h (22.4 mph). The longitudinal and lateral velocity changes were –35.5 km/h (-22.1 mph), and -6.3 km/h (3.9 mph). The results are considered borderline because they are based only on the Mazda's crush profile.

Dodge's Occupants: According to the police crash report, the driver of the Dodge (20-year-old male) was restrained by the lap-and-shoulder belt and sustained a B (non-incapacitating) injury. The front right passenger (39-year-old female) was restrained by the lap-and-shoulder belt and sustained a C (possible) injury. The back left passenger (15-year-old female) was not restrained and sustained a C (possible) injury. The back center and back right passengers (unknown age, sex) were not restrained and were not injured.


ONLY
+2% Grade
V1
+2.8% Grade
Impact and Final Rest Positions Estimated
V2
-2.5% Grade
N
IN08016
Daylight and Cloudy
Dry Bituminous Roadway
Speed Limit 64 km/h (40 mph)
V1 = 2004 Mazda 3
V2 = 1991 Dodge Daytona
0m 5m 10m
Scale