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ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE INVESTIGATION

CASE NUMBER - IN07021
LOCATION TEXAS
VEHICLE - 2007 ISUZU I-290 EXTENDED CAB
CRASH DATE - June 2007

Submitted:

February 20, 2008
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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 a crash that involved a 2007 Isuzu I-290, which departed the roadway and impacted a concrete bridge rail. This crash is of special interest because the manufacturer of the Isuzu has certified that it meets the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208, and the Isuzu's driver (46-year-old, male) sustained fatal injuries as a result of the crash. The Isuzu was traveling in the left turn lane of a six-lane, one-way, undivided, urban roadway approaching a four-leg intersection. A non-contact vehicle was stopped in the left turn lane in front of the Isuzu for the traffic signal. The Isuzu's driver steered left around the non-contact vehicle and departed the roadside. The vehicle impacted three curbs and a sign pole as it crossed through the intersection prior to impacting a concrete bridge rail. The first curb impact caused the driver air bag to deploy. The bridge rail impact, therefore, caused the restrained driver, who was now unprotected by the driver air bag, to load his restraint system as well as the steering assembly. The driver was transported to a hospital and pronounced dead 35 minutes following the crash.			
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BACKGROUND IN07021

This crash was brought to the National Highway Traffic Safety Administration's attention on or before June 27, 2007 by sampling activities of the National Automotive Sampling System. This crash involved a 2007 Isuzu I-290 pickup truck that departed the roadway and impacted several fixed objects before impacting a concrete bridge rail. The crash occurred in June, 2007 at 6:02 a.m., in Texas and was investigated by the applicable city police department. This crash is of special interest because the manufacturer of the Isuzu has certified that it meets the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. This contractor inspected the Isuzu on July 16, 2006, inspected the crash scene on July 17, 2007 and interviewed the driver's wife on August 1,2007. This report is based on the police crash report, scene and vehicle inspections, an interview with the driver's wife, occupant kinematic principles, the driver's medical records and autopsy report, and this contractor's evaluation of the evidence.

SUMMARY

The Isuzu was traveling south in the left turn lane of a six-lane, one-way, undivided, urban roadway approaching a four-leg intersection. A non-contact vehicle was stopped for the traffic signal in the left turn lane. The Isuzu's driver steered left around the non-contact vehicle. The Isuzu impacted two curbs and a sign post as it traversed two traffic islands within the intersection before impacting a third curb and concrete bride rail on the south roadside. The first curb impact caused the driver air bag to deploy. The impact with the bridge rail involved the full width of the front of the Isuzu and resulted in 102 centimeters (40.2 inches) of maximum residual crush to the front end. This impact caused the restrained driver, who was now unprotected by the driver air bag, to load his restraint system as well as the steering assembly. The loading of the steering assembly severely deformed the steering wheel, compressed the energy absorbing steering column and displaced the steering column upward. As a result, the driver sustained a skull fracture, an atlanto-occipital dislocation, brain injuries, chest fractures and internal injuries. The driver was transported to a hospital and pronounced dead 35 minutes following the crash. At the time of the crash the light condition was dawn, the atmospheric condition was cloudy, and the roadway pavement was dry concrete.

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which the Isuzu was traveling was a six-lane, one-way, undivided, service road to a U.S. highway. The Isuzu was traveling in a southerly direction approaching a four-leg intersection (**Figure 1**). On the northern leg of the intersection, the roadway had a right turn/southbound through lane, two southbound through lanes, a left turn/southbound through lane, a left turn lane, and a U-turn lane that was separated from the through lanes by a traffic island. Each lane was nominally 3.4 meters (11.2 feet) in width. On the southern

Figure 1: Case Vehicle approach to first traffic island in crash sequence.

leg of the intersection, the roadway had three southbound through lanes. A U-turn lane, which was separated from the eastbound through lanes by a traffic island, was also present within the southeast quadrant of the intersection. At the time of the crash the light condition was dawn, the atmospheric condition was cloudy, and the roadway pavement was dry, level concrete. The traffic density at the time of the crash was light, and the site of the crash was commercial. See Crash Diagram at the end of this report.

Pre-Crash: The Isuzu was traveling south in the left turn lane approaching a non-contact vehicle that was stopped in the left turn lane waiting for the light to turn green. The driver of the non-contact vehicle stated to police that she saw the Isuzu approach her from behind at a high rate of speed. The Isuzu suddenly steered left around her toward the raised traffic island. The crash sequence began on the raised traffic island on the northeast quadrant of the four-leg intersection.

Crash: The left front wheel of the Isuzu impacted the curb at the north end of the north U-turn traffic island (**Figure 2**) followed by the left rear wheel impact to the same curb (events 1 and 2). The front left of the Isuzu then impacted a street sign (event 3) on the same island (**Figure 2**). The Isuzu continued southeast across the intersection, and both front wheels impacted the curb at the second U-turn traffic island (**Figure 3**, events 4 and 5). The Isuzu traveled across the traffic island and the U-turn lane and both front wheels impacted the south curb of the U-turn lane (**Figure 4**, events 6 and 7). Finally, the Isuzu's front end (**Figure 5**) impacted a concrete bridge rail (**Figure 4**, event 8). The damage to the left front wheel indicated that the driver's air bag deployed as a result of one of the curb impacts. It is probable that it deployed during the first curb impact.

Figure 2: Isuzu's left front and rear wheels impact curb of first traffic island followed by front left impact with sign, arrow shows base of impacted sign.

Figure 3: Both of Isuzu's front wheels impacted curb on second U-turn traffic island

Figure 4: Both of Isuzu's front wheels impacted curb and front end impacts concrete bridge rail

Post-Crash: The Isuzu rebounded slightly off the concrete bridge rail and came to final rest facing south.

The 2007 Isuzu I-290 was a rear wheel drive, four-door pickup truck (VIN: 1GGCS199578------). The manufacturer of the Isuzu has certified that it meets the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The Isuzu was equipped with four wheel, anti-lock brakes with electronic brake force distribution and dual stage driver and right front passenger air bag inflators. Furthermore, there was an occupant weight sensor for the front right passenger seating position. The front seating row was also equipped with lap-and-shoulder safety belts with adjustable upper anchors and pretensioners. Seat back-mounted side impact air bags and side curtain air bags were not available for this model. The Isuzu was also equipped with tire pressure monitoring and LATCH system features for securing child safety seats in the back seat.

Figure 5: Front left view of damage to front of Isuzu due to impact with the concrete bridge rail; each stripe on the rods is 5cm (2in)

CASE VEHICLE DAMAGE

Exterior Damage: The Isuzu I-290's curb impacts involved the front wheels (**Figures 6** and **7**). The Isuzu's impact with the sign post involved the left portion of the front plane, but the specific location of the impact is unknown due to overlapping damage from the concrete bridge rail impact. The Isuzu's impact with the concrete bridge rail involved the entire front plane (**Figure 5** and **Figure 8**). The front bumper, hood, grille, headlamp/turn signal assemblies and front of the fenders were directly damaged and crushed extensively rearward.

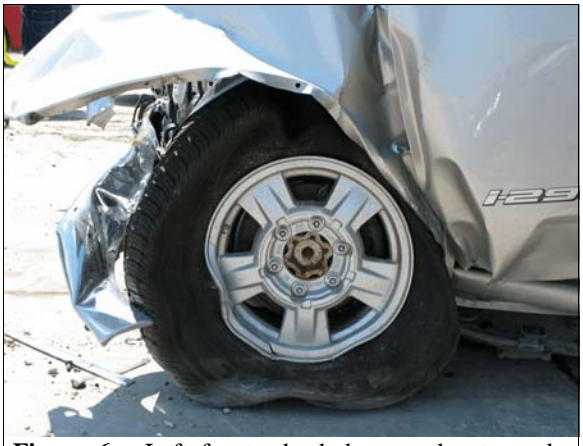


Figure 6: Left front wheel damage due to curb impacts

Figure 7: Right front wheel damage from curb impacts.

The front crush measurements were taken along the front bumper. The direct damage length was measured as 152 centimeters (59.8 inches). The residual maximum crush was measured as 102 centimeters (40.2 inches) occurring at C_3 (**Figure 9**). The table below shows the Isuzu's front crush profile.

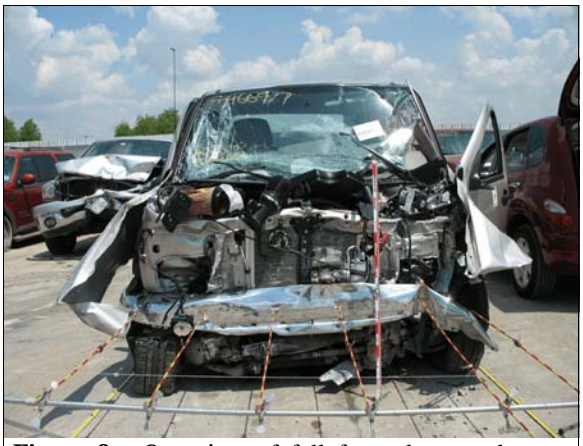


Figure 8: Overview of full front damage due to impact with the concrete bridge rail

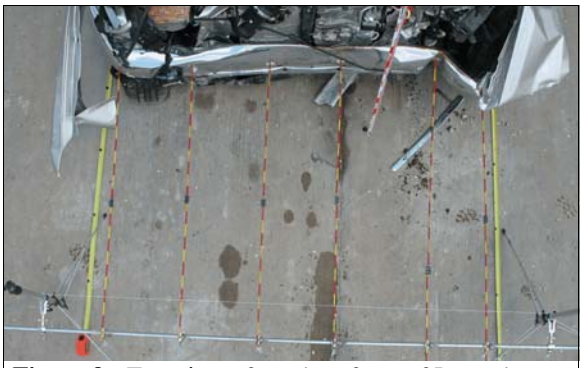


Figure 9: Top view of crush to front of Isuzu due to impact with the concrete bridge rail

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	8	152	102	154	79	99	102	99	92	78	0	0
in		59.8	40.2	60.6	31.1	39.0	40.2	39.0	36.2	30.7	0.0	0.0

Induced damage included both fenders, the windshield, both A-pillars, the roof, all doors, the truck bed, and rear axle. The Isuzu's left side wheelbase was shortened 62 centimeters (24.4 inches) while the right side was shortened 77 centimeters (30.3 inches).

The manufacturer's recommended tire size was P225/75R15. The Isuzu was equipped with tires of this size. The Isuzu's tire data are shown in the table below.

Tire	*Measured Pressure*		*Recommended Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kPa	psi	kPa	psi	milli-meters	32nd of an inch			
LF	Flat	Flat	303	44	9	11	Rim dented in three places	Yes	Yes
RF	Flat	Flat	303	44	9	11	Tire cut, rim dented in two places	Yes	Yes
LR	55	8	303	44	9	11	Small rim dent	No	No
RR	172	25	303	44	9	11	None	No	No

Vehicle Interior: Inspection of the Isuzu's interior revealed occupant contact to the driver's air bag, steering wheel (**Figure 10**), safety belt, seat back, and knee bolster. Significant intrusions were noted at the left and right toe pans, which were intruded longitudinally 34 and 26 centimeters (13.4 and 10.2 inches) respectively. The left instrument panel (**Figure 10**) was displaced 30 centimeters (11.8 inches) vertically and 17 centimeters (6.7 inches) longitudinally.

Figure 10: Intrusion of Isuzu's left toe pan and instrument panel and deformation of steering assembly

Damage Classification: Based on the vehicle inspection, the CDCs for the Isuzu I-290 were assigned as follows: event 1, left front wheel curb impact: **12-FLWN-3** (**0** degrees); event 2, left rear wheel curb impact: **12 FLWN-9** (**0** degrees); event 3, sign pole impact: **12-FL9N-9** (**0** degrees); events 4 and 5, front wheel curb impacts: **12-FLWN-3** (**0** degrees) and **12-FRWN-3** (**0** degrees); events 6 and 7, front wheel curb impacts: **12-FLWN-3** and **12-FRWN-3** (both **0** degrees); and event 8, front impact to concrete bridge rail: **12-FDEW-4** (**0** degrees). The WinSMASH reconstruction program, damage only algorithm, was used to reconstruct the Isuzu's highest severity impact (i.e., impact with the concrete bridge rail). The Total, Longitudinal, and Lateral Delta Vs are, respectively: 94 km.p.h. (58.4 m.p.h.), -94 km.p.h. (-58.4 m.p.h.), and 0 km.p.h. The crash fit the reconstruction model and the results appeared high. The Isuzu was towed due to damage.

AUTOMATIC RESTRAINT SYSTEM

The Isuzu I-290's driver air bag was located within the steering wheel hub. An inspection of the air bag module cover flaps and the air bag's fabric revealed that the cover flaps opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flaps. The driver's air bag was designed with two tethers, each approximately 7 centimeters (~3 inches) in width. The driver's air bag had two vent ports, each approximately 2.5 centimeters (~1 inch) in diameter, located at the 1 and 11 o'clock positions. The deployed driver's air bag was round with a diameter of 62

Figure 11: Driver air bag

centimeters (24.4 inches). An inspection of the driver's air bag fabric revealed a copious amount of blood on the front of the air bag (**Figure 11**). There were also some small blood spots on the back of the air bag near the bottom. The driver air bag was otherwise unremarkable. The front right passenger's air bag was located in the middle of the instrument panel. This air bag did not deploy in this crash because there was no front right passenger seated in the Isuzu.

CASE VEHICLE DRIVER KINEMATICS

Prior to the crash, the Isuzu I-290's driver [46-year-old, male; 175 centimeters and 86 kilograms (69 inches, 190 pounds)] was seated in an unknown posture. The position of the driver's feet and the position of his hands on the steering wheel are also unknown. However, based on the occupant contact evidence observed during the vehicle inspection, the driver was seated in a nominal upright position at the time of the impact with the concrete bridge rail. The Isuzu driver's seat track was located in the approximate center position. The tilt position of the driver's seat back could not be determined because it had been deformed forward and to the left as a result of the crash.

Based on the vehicle inspection, the Isuzu's driver was restrained by the lap-and-shoulder, safety belt system. There were loading abrasions on the driver's sliding latch plate and D-Ring (**Figures 11** and **12**). Furthermore, the driver's safety belt was cut by rescue personnel as part of the extrication of the driver from the Isuzu.

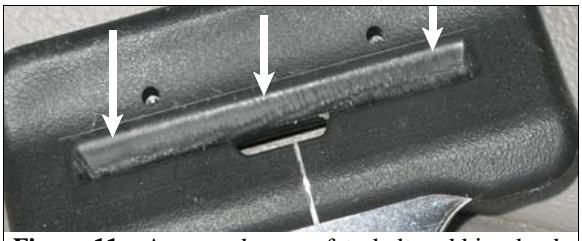


Figure 11: Arrows shows safety belt webbing load abrasions on Isuzu driver's latch plate

Figure 12: Arrows show safety belt webbing abrasions on Isuzu driver's "D"-ring

Just prior to the crash, the Isuzu's driver steered to the left to avoid the non-contact vehicle that was stopped at the traffic signal on the north leg of the intersection. The Isuzu impacted and ran over the first of three curbs prior to the impact with the concrete bridge rail. The first curb impact was severe enough to deploy the driver's air bag, which left the driver with no air bag protection at the time of the concrete bridge rail impact. The Isuzu's front impact with the concrete bridge rail caused the driver to continue forward opposite the Isuzu's 0 degree direction of principal force as the vehicle decelerated. The driver loaded the safety belt and his chest contacted the deflated air bag and steering wheel. As the impact progressed, the driver continued to load the steering wheel and his throat and head contacted the steering wheel. The driver's interaction with the steering assembly heavily deformed the steering wheel and compressed the energy absorbing steering column (**Figure 13**) fracturing his ribs and sternum, lacerating his aorta, lacerating his thyroid, and causing a severe atlanto-occipital dislocation. In addition, the driver sustained a ring fracture at the base of his skull as well as numerous brain injuries including

brainstem compression and transection of the medulla oblongata. The driver rebounded back into his seat and remained there as the Isuzu came to final rest. The driver was extricated from the Isuzu by emergency medical personnel.

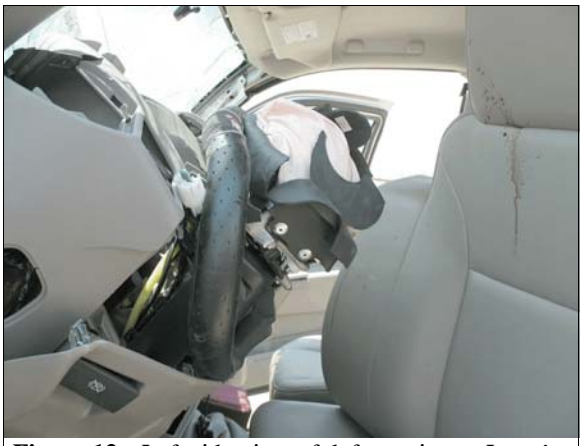


Figure 13: Left side view of deformation to Isuzu's steering assembly due to driver contact

CASE VEHICLE DRIVER INJURIES

The driver was transported by ambulance to the hospital. He was pronounced dead 35 minutes post-crash. The table below shows the driver'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 unconsciousness, unresponsive to stimuli, pupils dilated, non-reactive, asystole, PEA[1], GCS = 3	Not coded	Steering wheel rim	Certain	Emergency room records
1	Compression brainstem–tonsillar herniation present	critical 140202.5,8	Steering wheel rim	Certain	Autopsy
2 3	Transection medulla oblongata and laceration pontomedullary region	maximum 140218.6,8 140212.6,8	Steering wheel rim	Certain	Autopsy
4	Contusion pontomedullary region, not further specified	critical 140204.5,8	Steering wheel rim	Certain	Autopsy
5	Contusion cerebellum, not further specified	serious 140402.3,6	Head restraint, driver's seat	Possible	Autopsy
6	Contusion overlies left posterior parietal cortex, not further specified	serious 140604.3,2	Head restraint, driver's seat	Possible	Autopsy
7	Edema, brain, markedly, not further specified	serious 140660.3,9	Steering wheel rim	Certain	Autopsy

[1] The following terms are defined in DORLAND'S ILLUSTRATED MEDICAL DICTIONARY as follows:
asystole (a-sis′to-le): cardiac standstill or arrest; absence of a heartbeat.
asystolic (a"sis-tol′ik): asystole.
PEA: pulseless electrical activity
pulseless electrical activity: continued electrical rhythmicity of the heart in the absence of effective mechanical function; it may be due to uncoupling of ventricular muscle contraction from electrical activity or may be secondary to cardiac damage with respiratory failure and cessation of cardiac venous return. Called also *electromechanical dissociation*.

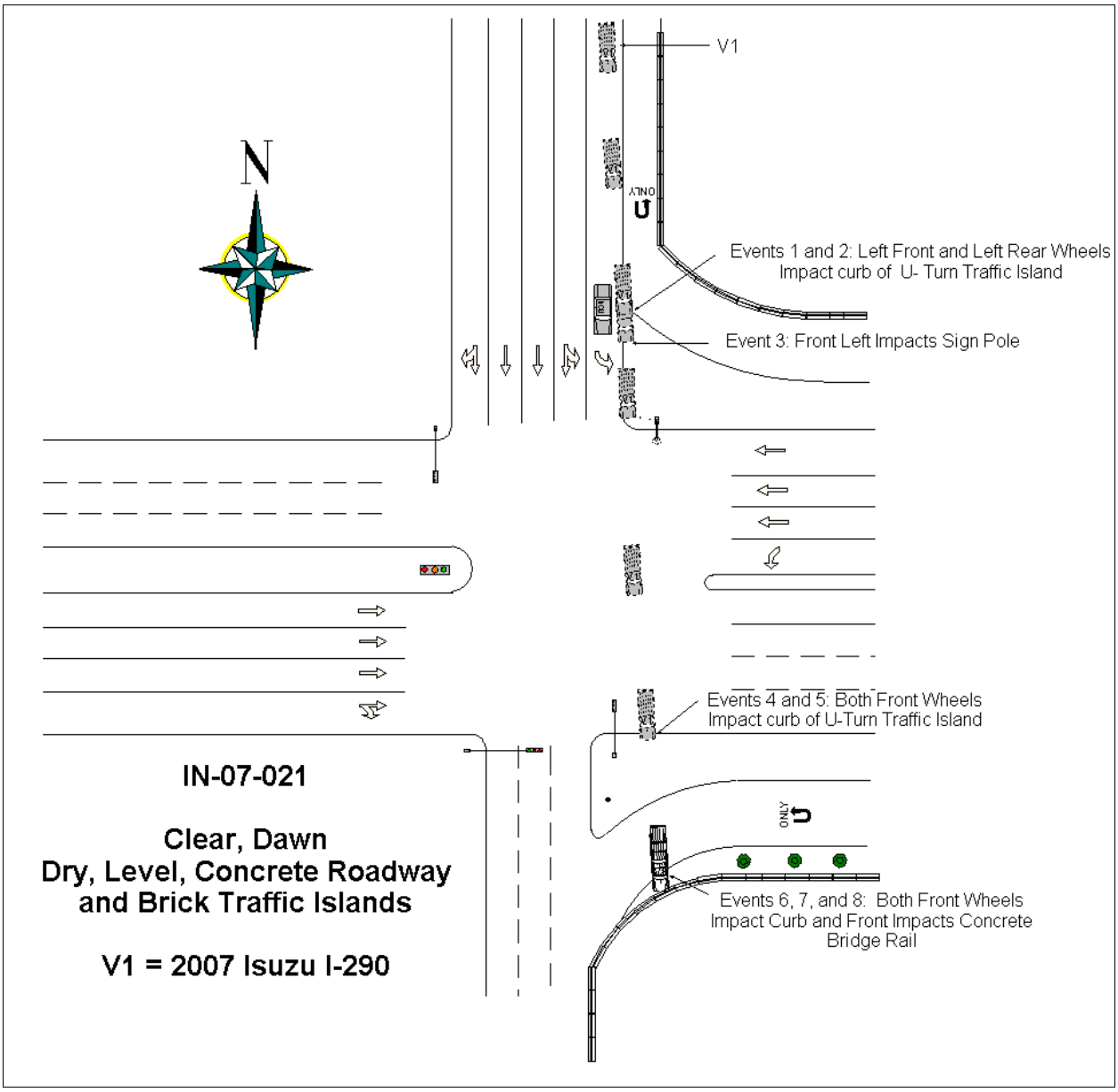
Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
8	Hemorrhage, subarachnoid, overlying base of brain, not further specified	serious 140684.3,9	Steering wheel rim	Certain	Autopsy
9	Fracture, ring, completely symmetrical, extending through petrous ridges at base of skull and through entire posterior cranial fossa	severe 150206.4,8	Steering wheel rim	Certain	Autopsy
10	Dislocation, atlanto-occipital, severe, not further specified	moderate 650208.2,6	Steering wheel rim	Certain	Autopsy
11	Laceration {fracture} left superior cornu of thyroid cartilage	moderate 340204.2,5	Steering wheel rim	Certain	Autopsy
12	Contusion thyroid gland, not further specified	minor 341402.1,5	Steering wheel rim	Certain	Autopsy
13	Laceration aorta at root just above aortic valve and at ligamentum arteriosum[2] with over one liter of bilateral hemothoraces {primarily in left pleural cavity	maximum 420218.6,4	Steering wheel hub and/or spokes	Certain	Autopsy
14	Laceration pericardial sac, not further specified	moderate 441602.2,4	Steering wheel hub and/or spokes	Certain	Autopsy
15	Contusion heart, not further specified	minor 441002.1,4	Steering wheel hub and/or spokes	Certain	Autopsy
16	Fracture, with flail[3], almost all ribs anterior–many displaced, not further specified with right lung contusion	critical 450266.5,3	Steering wheel hub and/or spokes	Certain	Autopsy
17	Fracture sternum, not further specified	moderate 450804.2,4	Steering wheel hub and/or spokes	Certain	Autopsy
18	Laceration liver, not further specified with 500 ml hemoperitoneum	moderate 541820.2,1	Steering wheel hub and/or spokes and rim	Certain	Autopsy
19	Fracture thoracic with displacement vertebral column at T_5 with spinal cord easily visualized through fracture defect	moderate 650416.2,7	Steering wheel hub and/or spokes	Probable	Autopsy

[2] The following term is defined in DORLAND'S ILLUSTRATED MEDICAL DICTIONARY as follows:
ligamenta arterio/sum: a short, thick, strong fibromuscular cord extending from the pulmonary artery to the arch of the aorta; it is the remains of the ductus arteriosus. Called also *ligament of Botallo*.

[3] Flail was documented in the emergency room records.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
20	Fracture right fibula, mid-portion, not further specified	moderate 851606.2,1	Left lower instrument panel and/or knee bolster, right of steering column	Probable	Autopsy
21	Fracture right tibia, mid-portion, not further specified	moderate 853420.2,1	Left lower instrument panel and/or knee bolster, right of steering column	Probable	Autopsy
22	Contusion {hemorrhages}, subscalpular overlying left temporal bone	minor l90402.1,2	Steering wheel rim	Probable	Autopsy
23	Contusion {hemorrhages} subscalpular overlying posterior right parietal bone	minor 190402.1,1	Head restraint, driver's seat	Probable	Autopsy
24	Contusions anterior strap muscles {neck}, not further specified	minor 390402.1,5	Steering wheel rim	Certain	Autopsy
25	Contusion, faint, band-like, from right hip to center chest	minor 590402.1,1	Torso portion of safety belt system	Certain	Autopsy
26	Abrasion, horizontally oriented, in mid-lower abdomen	minor 590202.1,8	Lap portion of safety belt system	Certain	Autopsy
27	Contusion overlies right hip, not further specified	590402.1,1	Lap portion of safety belt system	Probable	Autopsy
28	Abrasions, few, on both upper extremities, not further specified	minor 790202.1,3	Air bag, driver's	Possible	Autopsy
29	Contusions, few, on both upper extremities, not further specified	minor 790402.1,3	Air bag, driver's	Possible	Autopsy
30	Abrasions overlying prevertebral aspect of both legs, not further specified	minor 890202.1,3	Seat cushion, driver's	Probable	Autopsy
31	Contusions overlying prevertebral aspect of both legs, not further specified	890402.1,3	Seat cushion, driver's	Probable	Autopsy
32	Abrasion lateral right knee	minor 890202.1,1	Center instrument panel	Probable	Autopsy
33	Laceration lateral right knee	minor 890402.1,1	Center instrument panel	Probable	Autopsy
34	Fracture right foot where great toe intersects metatarsals	minor 853602.1,1	Floor, foot controls	Certain	Autopsy

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
35	Contusion bottom (i.e., ball) right foot	minor 890402.1,1	Floor, foot controls	Certain	Autopsy


V1
N
Events 1 and 2: Left Front and Left Rear Wheels
Impact curb of U- Turn Traffic Island
Event 3: Front Left Impacts Sign Pole
Events 4 and 5: Both Front Wheels
Impact curb of U-Turn Traffic Island
Events 6, 7, and 8: Both Front Wheels
Impact Curb and Front Impacts Concrete
Bridge Rail
IN-07-021
Clear, Dawn
Dry, Level, Concrete Roadway
and Brick Traffic Islands
V1 = 2007 Isuzu I-290