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Special Crash Investigations On-Site ET-Plus Guardrail End Terminal Investigation Vehicle: 1997 Chevrolet Blazer Location: Missouri Crash Date: February 2016

DISCLAIMER

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15. Supplementary Notes

Each crash is a unique sequence of events, and generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems. This report and associated case data are based on information available to the Special Crash Investigation team on the date the report was published.

16. Abstract

This report covers an on-site investigation of a sport utility vehicle (SUV) crash into an ET-Plus guardrail end terminal that is of interest to the Federal Highway Administration (FHWA). This crash occurred on a six-lane, divided, interstate highway. The 1997 Chevrolet Blazer was a 4-door SUV equipped with a driver's frontal air bag. An unbelted 22-year-old male driver occupied the vehicle. The Chevrolet departed the roadway and its right plane sideswiped the left leg of a speed limit sign and the front left corner of the vehicle then immediately struck the end terminal. The vehicle remained engaged with the guardrail and traveled down its back side. The vehicle then rolled over, right side leading, six quarter turns across a distance of approximately 24 m (79 ft), coming to final rest on its top plane on the field side of the guardrail. The crash damaged 43.3 m (142.0 ft) of guardrail and 23 posts. The left front door came open during the rollover and the driver was ejected from the vehicle. He sustained fatal injuries and was pronounced deceased at the crash scene. The Chevrolet was towed from the crash scene due to damage.

17. Key Words	18. Distribution Statement
ET-Plus guardrail end terminal, motor vehicle traffic crash, fatal injury, rollover	Document is available to the public from the National Technical Information Service, www.ntis.gov.

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Table of Contents

Special Crash Investigations
On-Site ET-Plus Guardrail End Terminal Investigation
Case Number: IN16005
Vehicle: 1997 Chevrolet Blazer
Location: Missouri
Crash Date: February 2016

BACKGROUND

This report covers an onsite investigation of a sport utility vehicle (SUV) impact to an ET-Plus (10.2 cm [4 in] model]) guardrail end terminal (**Figure 1**) of interest to the Federal Highway Administration (FHWA). This crash was identified by an engineer with the Missouri Department of Transportation, who submitted photographs of the damaged guardrail end terminal to the FHWA. The FHWA determined that the guardrail end terminal and crash type were of interest. This crash investigation was then initiated by the National Highway Traffic Safety Administration in February 2016 and assigned to the Special Crash Investigation (SCI) team at the Indiana University Transportation Research Center. This single-vehicle crash involved a 1997 Chevrolet Blazer (**Figure 2**), which was not supported by the Bosch Crash Data Retrieval tool. The crash occurred in Missouri in February 2016 during early morning and was investigated by a local police agency. The vehicle, guardrail, and crash scene were inspected in February 2016. An SCI interview with the tow truck driver was conducted in April 2016.

Figure 1. View east to the damaged guardrail.

Figure 2. The damaged 1997 Chevrolet Blazer.

This crash occurred on the south roadside of a six-lane, divided, interstate highway. The Chevrolet Blazer was a 4-door SUV equipped with a driver's frontal air bag. An unbelted 22-year-old male driver occupied the vehicle. The Chevrolet was traveling east in the right lane when it departed the right (south) edge of the roadway. The right plane of the vehicle sideswiped the left leg of a speed limit sign (event 1) and the front left corner of the vehicle then immediately struck the end terminal (event 2). The

vehicle remained engaged with the guardrail and traveled down its back side. The vehicle then rolled over (event 3), right side leading, six quarter turns across a distance of approximately 24 m (79 ft) coming to final rest on its top plane on the field side of the guardrail heading northwest. The crash damaged 43.3 m (142.0 ft) of guardrail and 23 posts. The left front door came open during the rollover and the driver was ejected from the vehicle. He sustained fatal injuries and was pronounced deceased at the crash scene. The Chevrolet was towed from the crash scene due to damage.

Figure 3. Approach to impact, view east.

SUMMARY

Crash Site

This crash occurred during a dark early morning on the south roadside of a six-lane, divided, interstate highway. The weather conditions were clear with 16.1 kilometers (10 miles) visibility, south-southwest winds at 9.7 km/h (6 mph), a temperature of 9.4 °C (49 °F), and a dew point of -5.5 °C (22 °F), according to local weather reports. The interstate had three bituminous eastbound through lanes separated from the three westbound through lanes by a concrete median barrier. The eastbound travel lanes were each 3.7 m (12.1 ft) wide and were bordered by a 3.4 m (11.2 ft) wide concrete median shoulder and a 3.6 m (11.8 ft) wide concrete outside shoulder. A blocked-out W-beam guardrail equipped with an ET-Plus end treatment was located on the south side of the eastbound lanes. A speed limit sign supported by two break-away posts was located adjacent to the end terminal. The speed limit was 105 km/h (65 mph). The crash diagrams are included at the end of this report.

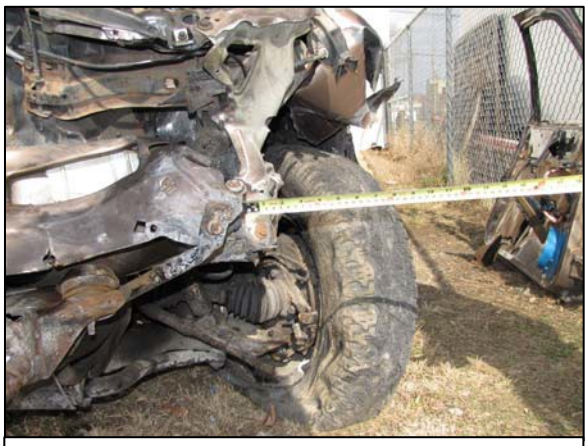


Figure 4. Area of end terminal impact.

Figure 5. The damaged end terminal.

Pre-Crash

The Chevrolet was traveling east in the right lane according to the police crash report when, for an unknown reason, the vehicle departed the right road edge and entered the grass 75.0 m (246.0 ft) prior to the end terminal (**Figure 3**). The right-side tires created a rolling tire mark in the grass as the vehicle traveled toward the end terminal. The tire mark curved back toward the roadway as the vehicle approached the end terminal and a speed limit sign suggesting that the driver

probably steered left in an attempt to reenter the roadway and avoid the crash. The vehicle's travel speed is not known.

Crash

The Chevrolet's right plane sideswiped the left post of the speed limit sign (Event 1), displacing the post from the sign. The front left corner (**Figure 4**) of the vehicle then immediately struck the end terminal (**Figure 5**, Event 2). The contact occurred to the right face of the end terminal and was 18 cm (7.1 in) wide. The impact with the end terminal was minor as indicated by the extrusion of only 28 cm (11.0 in) of guardrail from the end terminal. Rubber transfer on the face and right edge of the end terminal indicated that the left front wheel of the vehicle also made contact as the vehicle traveled past the end terminal and into the back side of the guardrail. The vehicle remained in contact with the back side of the guardrail as it traveled approximately 38 m (125 ft) while rotating counterclockwise an estimated 70 degrees and damaging 20 guardrail posts. The vehicle then rolled over, right side leading, damaging three additional guardrail posts. The vehicle rolled over a total of six quarter turns across a distance of approximately 24 m (79 ft), coming to final rest on its top plane on the field side of the guardrail heading northwest (**Figure 6**). The left front door came open due to driver contact during the rollover (See Exterior Damage, Event 3 on page 6) and the unbelted driver was ejected. He came to final rest on the right eastbound through lane located 20.3 m (66.5 ft) east of the vehicle's final rest position according to the police measurements. The left front door separated from the vehicle during the rollover and was located on the field side of the guardrail 3.0 to 6.0 m (10.0 to 20.0 ft) east of the final rest position of the vehicle, according to the SCI interview with the tow truck driver. The rollover initiation type was classified as "Trip Over," since there was a divot in the ground that corresponded to the approximate location of the right front wheel at the beginning of the path of several other ground divots and the debris field from the rollover.

Figure 6. View northwest through area of final rest (arrow) and back along path of rollover.

Figure 7. The field side of the end terminal.

Post-Crash

The police were notified of the crash at 0441 hours and arrived on scene at 0452. The county medical examiner also responded to the crash scene and pronounced the driver deceased. The driver was removed from the crash scene by ambulance and taken to the medical examiner's facility where a non-invasive examination was conducted. The medical examiner's report stated that the driver's blood alcohol concentration (BAC) was .195 grams per deciliter (g/dL). The driver also tested positive for cannabinoids (569 nanograms/milliliter). The vehicle was towed from the crash scene due to damage.

Figure 8. Extruded guardrail on field side of end terminal.

END TERMINAL AND GUARDRAIL DAMAGE

The Chevrolet's front plane impact to the ET-Plus was minor (**Figures 5** and **7**), engaging only an 18 cm (7.1 in) wide area of the face of the ET-Plus that extruded 28 cm (11.0 in) of guardrail (**Figures 7** and **8**) toward the field side. Rubber transfer was present on the ET-Plus, indicating that the left front tire also contacted the ET-Plus. Post 1 to 23 were directly struck by the vehicle as it traveled down the back side of the guardrail and rolled over. Posts 1 to 7 were constructed of wood and all were fractured and separated from the guardrail and ground (**Figure 9**). Post 8 and 9 were constructed of steel and were bent downstream nearly to the ground and separated from the guardrail (**Figure 10**). The wooden block-outs for posts 2 to 9 were fractured into numerous pieces and scattered around the crash scene. The bolts for posts 2 to 12, 14 to 20, 22 and 23 had pulled through the bolt holes. The plastic block-outs for steel posts 10 to 20, 22, and 23 were damaged but still attached to the post. Each post was also bent downstream. The block-out for post 21 was separated from the post, but was still attached to the guardrail. The anchor cable was separated from the guardrail and was found at post 11. The width of the ET-Plus feeder channel was 10 cm (4.0 in). The guide chute height was 38 cm (15.0 in). The connection of the feeder channel to the head was not damaged and there were no kinks in the damaged guardrail.

Figure 9. Fractured posts 1 - 7, view west.

Figure 10. Bent posts 8 and 9, view west.

The height of the guardrail was 67 cm (26.5 in) and the total length of the damaged guardrail was 43.3 m (142.0 ft). The FHWA Guardrail Form is attached to the end of this report as **Appendix A**.

1997 CHEVROLET BLAZER DESCRIPTION

Description

The Chevrolet was a 4-wheel drive, 5- occupant, 4-door SUV with the Vehicle Identification Number 1GNDT13W2V2xxxxxx, manufactured in September 1997. The vehicle was equipped with a 4.3-liter, V-6 engine, 4-speed automatic transmission, 4-wheel anti-lock brakes, driver's frontal air bag, and a tilt steering column adjusted between the full-up and middle positions. The vehicle was not supported by the Bosch CDR tool. The windshield glazing was AS1 laminated. The left front and right front glazing were AS2 tempered. The remaining glazing was AS3 tempered and had original tinting. The odometer reading at the SCI vehicle inspection was 325,664 kilometers (202,358 miles). The specified wheelbase was 272 cm (107.1 in). The vehicle manufacturer's recommended tire size was P235/70R15. The vehicle was equipped with Goodyear Wrangler Radial tires size P235/75R15 on the left front, right front and left rear wheels. The right rear wheel was displaced off the vehicle during the rollover and was not at the vehicle inspection. The vehicle manufacturer's recommended cold tire pressure for the front and rear tires was 221 kPa (32 psi). The tire data for the Chevrolet is presented in the table below.

Position	*Measured Pressure*	*Measured Tread Depth*	*Restricted*	*Damage*
LF	Flat	4 mm (5/32 in)	Yes	Sidewall cut, cut in tread, bead separated
LR	Flat	4 mm (5/32 in)	No	None
RR	Unknown	Unknown	Unknown	Unknown
RF	Flat	3 mm (4/32 in)	No	Sidewall cut, bead separated

The front row was equipped with driver and front right occupant, leather-covered bucket seats with adjustable head restraints. The second row was equipped with a leather-covered split bench seat with folding backs and no head restraints. The driver's seat track was adjusted to the rear-most position and the seat back was slightly reclined. The remaining seats were unoccupied at the time of the crash.

Exterior Damage

Exterior Damage Event 1. The right plane of the Chevrolet was damaged from the impact with the left leg of the speed limit sign. The direct damage involved the right fender, A-pillar, right front door, and upper B-pillar. The direct damage began 14 cm (5.5 in) rear of the right front door and extended 164 cm (64.6 in) forward. The Field L was also 164 cm (64.6 in) beginning at the same location. Crush measurements were taken at the upper door level and the maximum

residual crush was 11 cm (4.3 in) occurring 150 cm (59.1 in) rear of the right front axle. The crush values were: C_1 = 0 cm, C_2 = 11 cm (4.3 in), C_3 = 11 cm (4.3 in), C_4 = 8 cm (3.1 in), C_5 = 4 cm (1.6 in), C_6 = 0 cm.

Damage Classification Event 1. The Collision Deformation Classification (CDC) was 12RYAS2. The severity of the damage was minor.

Exterior Damage Events 2. The Chevrolet sustained overlapping direct damage to the front plane from the impact with the end terminal and the guardrail posts. The direct damage from the end terminal began at the front left bumper corner and the total width of the front plane, 160 cm (63.0 in), was directly damaged from the contact with both the end terminal and the guardrail posts. The width of the direct damage from only the end terminal could not be discerned, but would have been narrow occurring at the front left corner of the vehicle based on the contact damage to the face of the end terminal. The Field L for the front plane damage was also 160 cm (63.0 in) beginning at the front left bumper corner. Crush measurements were taken on the front bumper bar and the maximum residual crush was 20 cm (7.9 in) occurring 50 cm (19.7 in) left of the vehicle centerline. The crush values were: C_1 = 14 cm (5.5 in), C_2 = 20 cm (7.9 in), C_3 = 17 cm (6.6 in), C_4 = 8 cm (3.1 in), C_5 = 4 cm (1.6 in), C_6 = 5 cm (2.0 in).

Figure 11. Chevrolet's torn door frame sheet metal where left front door striker was mounted.

Damage Classification Event 2. The CDC was 12FDEW1 (0 degrees). The severity of the damage was moderate.

Exterior Damage Event 3. The left, right, and top planes sustained direct damage during the rollover. The direct damage on the left plane consisted of scratches on the left fender, left front door, top of the B-pillar, top of the left rear door, and quarter panel. Dirt was entrapped in the bead of the left rear wheel. The left front door also came open during the rollover and separated from the vehicle. Examination of the door, door frame, and components revealed that the striker was pulled out of the door frame sheet metal and the striker remained in the latch (**Figures 11** and **12**). The door was deformed outward (**Figure 13)** from contact by the driver indicating that during the rollover the unbelted driver contacted the door with sufficient force to deform the door and separate the latch from its mounting surface on the door frame. The door opened and

Figure 12. Striker remained in left front door latch.

the driver was ejected from the vehicle. The door then separated from the vehicle as it continued to rollover. The door's upper hinge was fractured and the pin separated from the hinge. The lower hinge and hinge pin were deformed and the hinge separated. There was insufficient damage to the door and window frame to indicate that the door came open as a result of ground or guardrail contact during the rollover.

Direct damage from the rollover to the right plane consisted of scratches and deformation to the quarter panel and cuts in the fender from contact with steel guardrail posts. The right front wheel was flat and debeaded and the right rear wheel was displaced off the vehicle.

The damage from the rollover was most severe to the top plane. The front portion of the roof especially over the driver's seat was crushed. There were also cuts in the hood from contact with the steel guardrail posts. The maximum vertical and lateral crush was 18 cm (7.1 in) and 7 cm (2.8 in), respectively, occurring on the left roof side rail and located 15 cm (5.9 in) rear of the left A-pillar.

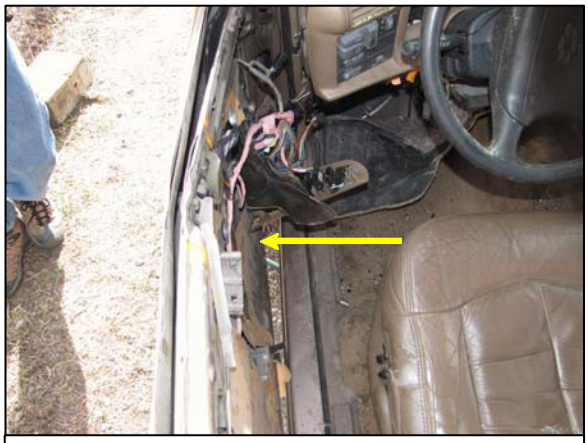


Figure 13. Chevrolet's deformed left front door from occupant contact.

Damage Classification Event 3. The CDC was 00TYDO3. The severity of the damage was moderate based on the extent of the crush.

Interior Damage

The interior of the Chevrolet sustained moderate severity intrusion from the rollover. The most severe intrusions into the driver's seating position involved 18 cm (7.1 in) of lateral displacement of the left roof side rail, and 18 cm (7.1 in) and 10 cm (3.9 in) of vertical displacement of the roof and windshield header, respectively. There was no penetration of the guardrail or guardrail posts into the vehicle's interior.

Evidence of occupant contact consisted of a cracked lower left instrument panel, probably from contact by the driver's left knee, and the left front door was deformed from contact by the driver's left flank. While the steering wheel was not deformed, the steering column was displaced slightly upward suggesting contact by the driver's chest and possibly abdomen and thighs during the frontal impact. The right front door was jammed shut. The left front door separated from the vehicle during the crash as discussed in the Exterior Damage section of this report on page 6. The left rear and right rear doors and the rear hatch remained closed and operational. All of the non-fixed glazing was closed at the time of the crash. The windshield was cracked and holed from impact forces. The left front, left rear, third left rear, backlight, third right rear, right rear, and right front glazing was disintegrated from impact forces. The second left and right rear glazing was undamaged.

Manual Restraint Systems

The front row seating positions were equipped with three-point lap and shoulder seat belts with sliding latch plates and fixed upper anchors. The second-row outboard seating positions were

equipped with 3-point lap and shoulder seat belts with sliding latch plates and fixed upper anchors. The second-row middle seating position was equipped with a lap belt.

The driver was not restrained by the lap and shoulder seat belt. Inspection of the seat belt assembly revealed no evidence of loading. There was also a large dust deposit on the belt webbing immediately within the B-pillar suggesting the belt had been in the retracted position an extended period of time. Ejection of the driver also indicated no belt usage.

Supplemental Restraint Systems

The Chevrolet was equipped with a driver's frontal air bag only. The frontal air bag did not deploy during the crash.

1997 CHEVROLET BLAZER OCCUPANT

Driver Demographics

Age/Sex:	22 years/male
Height:	178 cm (70 in)
Weight:	71 kg (157 lbs)
Eyewear:	Unknown
Seat type:	Bucket
Seat track position:	Rear-most
Manual restraint usage:	None
Usage source:	Vehicle inspection
Air bags:	Frontal, not deployed
Alcohol/drug involvement:	BAC = .195 g/dL; cannabinoids = 569 nanograms/milliliter
Egress from vehicle:	Ejected during crash
Transport from scene:	Transported by ambulance to medical examiner's facility
Medical treatment:	None, pronounced deceased at crash scene

Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
1 2	Fracture, indented/depressed, left frontal skull with anterior and inferior pneumocephalus, not further specified	150404.3 140682.3	Critical IPC configuration Roof, left front side rail Ground	Probable Possible
3	Fracture, basilar, with hemotympanum in right ear canal, not further specified	150200.3	Critical IPC configuration Roof, left front side rail Ground	Probable Possible

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
4	Dislocation (distraction) wide spacing between the base of skull and C_1 and between C_1 and C_2, not further specified	650206.3	Critical IPC configuration Roof Ground	 Possible Probable
5	Fracture, palpable, upper thoracic spine with abnormal contour, not further specified	650416.2	Critical IPC configuration Roof Ground	 Possible Probable
6	Fracture, palpable, mental area of mandible, not further specified	250607.1	A-pillar, left	Probable
7	Fracture, maxillary, palpable, below the nose, not further specified	250800.2	A-pillar, left	Probable
8	Fractured left ribs: 1st and 2nd posteriorly, 2nd anteriorly, and 6th through 8th posteriorly, not further specified	450203.3	Left front door panel, rear upper quadrant	Probable
9 10	Fracture (deformity), open[1], left humerus x 2, proximal and distal diaphysis, not further specified	751221.2 751222.3	Left front door panel, rear upper quadrant	Probable
11	Fractured pelvis, including wide pubic symphysis, not further specified	856100.2	Ground	Probable
12	Contusion (hematoma), palpable, left posterior scalp, not further specified	110402.1	Roof	Probable
13	Lacerations, multiple, superficial left scalp area, not further specified	110602.1	Noncontact injury: flying glass, left front glazing	Probable
14	Abrasions, multiple, overlying in- dented fracture, left forehead	210202.1	Ground	Probable
15 16 17	Multiple abrasions about face, including cheeks and nasal area, not further specified	210202.1 210202.1 210202.1	Noncontact injury: flying glass, left front glazing	Probable
18 19	Contusions periorbital left and right eyes, not further specified	210402.1 210402.1	A-pillar, left	Probable

[1] There was a laceration, 9.5 by 4.4 cm (3.5 x 1.75 in) on the distal left upper arm with exposure of fat and muscle that was not further specified.

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
20 21	Contusions and lacerations to lower lip mucosa, adjacent to fracture, not further specified	210402.1 210602.1	A-pillar, left	Probable
22 23	Lacerations, multiple, superficial overlying right forehead and ex- tending down to right cheek	210602.1 210602.1	Ground	Probable
24 25	Abrasion right neck below right ear and abrasion on left neck, 5.1 by 0.6 cm (2 x 0.25 in), not further specified	310202.1 310202.1	Noncontact injury: flying glass, left front glazing	Probable
26	Abrasion, vertically oriented, 3.8 cm (1.5 in) right mid-back, not further specified	410202.1	Ground	Probable
27	Abrasion, small, left mid-back near axillary line, not further specified	410202.1	Ground	Probable
28	Abrasion, 12.1 by 3.8 cm (4.75 x 1.5 in), on left chest near axillary line, not further specified	410202.1	Ground	Probable
29 30	Abrasions, multiple, 27.9 by 19.1 cm (11 x 7.5 in) in area with largest 7.0 cm (2.75 in) covering right chest, abdomen, and flank areas, not further specified	410202.1 510202.1	Ground	Probable
31	Abrasion, 7.6 by 1.9 cm (3 x 0.75 in) left lower abdomen near umbilicus, not further specified	510202.1	Ground	Probable
32	Abrasion (scrape), up to 3.2 cm (1.25 in), on left flank, not further specified	510202.1	Ground	Probable
33	Abrasions, multiple, over right shoulder, not further specified	710202.1	Ground	Probable
34	Abrasion, 12.7 by 1.9 cm (5 x 0.75 in) over left posterior shoulder, not further specified	710202.1	Ground	Probable
35	Abrasions, multiple, right arm including medially near axillary area and upper forearm–3.8 by 11.4 cm (1.5 x 4.5 in), posterolaterally near elbow, mid- and distal forearm, and dorsum wrist, not further specified	710202.1	Ground	Probable

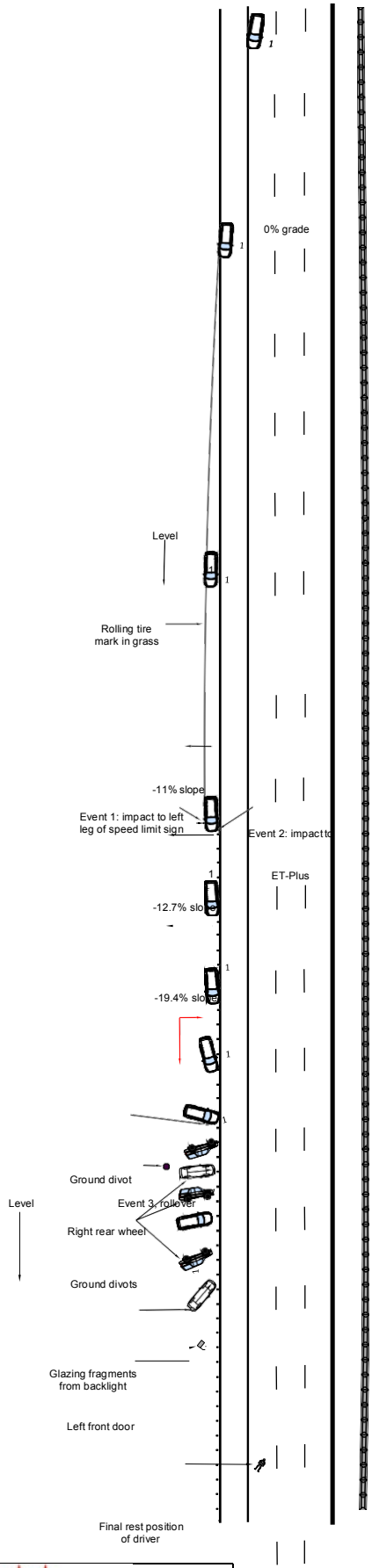
Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
36	Abrasions, multiple, left arm up to 7.0 cm (2.75 in) over left anteriomedial proximal forearm–just below ante- cubital fossa, and over left elbow and left posterior lower forearm, not further specified	710202.1	Ground	Probable
37 38 39 40	Abrasions and contusion, up to 3.2 cm (1.25 in) dorsum left hand and fingers, and up to 2.5 cm (1 in) dorsum right hand and fingers, not further specified	710202.1 710202.1 710402.1 710402.1	Ground	Probable
41	Laceration, small, dorsum right hand, not further specified	710602.1	Ground	Probable
42	Abrasions (6) right leg involving anterior upper thigh–2.5 by 1.3 cm (1 x 0.5 in) and 1.9 by 0.6 cm (0.75 x 0.25 in), lateral proximal thigh–3.8 by 1.9 cm (1.5 x 0.75 in) and 3.8 by 3.2 cm (1.5 x 1.25 in), mid thigh–17.8 by 8.9 cm (7 x 3.5 in), and posterior thigh–14.0 by 5.1 cm (5.5 x 2 in), just below right buttock	810202.1	Ground	Probable
43	Abrasions (2) anterior right knee area–3.8 by 3.8 cm (1.5 x 1.5 in) and 1.9 by 1.3 cm (0.75 x 0.5 in)	810202.1	Ground	Probable
44	Abrasions (3) lateral right mid lower leg–6.4 by 3.2 cm (2.5 x 1.25 in), 3.2 by 1.9 cm (1.25 x 0.75 in), and 10.2 by 5.7 cm (4 x 2.25 in)	810202.1	Ground	Probable
45	Abrasions anterior left knee area (4), including distal thigh and proximal lower leg; largest 7.6 by 1.3 cm (3 x 0.5 in) upper knee, not further specified	810202.1	Ground	Probable
46 47	Abrasions feet including: right great toe, right lateral ankle, right dor- sum foot, and left ankle, 2.5 cm (1 in), not further specified	810202.1 810202.1	Ground	Probable
48	Contusions right dorsum (top) foot, 1.3 by 2.5 cm (0.5 x 1 in), and over right great toe, 1.9 cm (0.75 in), not further specified	810402.1	Ground	Probable

Source: Medical examiner records–noninvasive exam.

Driver Kinematics

The driver was unbelted and his seat track was adjusted to the rear-most position. The driver was displaced forward during the impact with the guardrail. He was probably redirected to the right as the vehicle continued in contact with the back side of the guardrail and rotated counterclockwise. Slight vertical displacement of the steering assembly suggests his chest and possibly abdomen contacted the steering wheel during the initial phase of this impact and his thighs possibly contacted it during the ejection. He was subsequently redirected to the left during the rollover and the left side of his body contacted and deformed the left front door and his face and head probably contacted the left A-pillar, roof, and roof side rail, respectively. Contact with the door caused left rib fractures and an open fracture of the left humerus. Contact with the left A-pillar caused fractures of the right mandible and left maxillary. Contact with the roof caused a hematoma to the left posterior scalp. Contact with a combination of the roof, left roof side rail, and ground caused fractures of the left frontal skull, basilar fracture, dislocation of the base of the skull at C_1 and between C_1 and C_2 and a fracture of the upper thoracic spine. The ground contact occurred when the left front door came open as a result of driver contact and the driver was ejected from the vehicle. He also sustained a fractured pelvis from contact with the ground as well as multiple abrasions and lacerations over his body. The driver came to final rest on the right eastbound through lane located 20.3 m (66.5 ft) east of the vehicle's final rest position according to the police measurements. The driver was pronounced deceased at the crash scene by the medical examiner (time of death was listed as 0438 hours on the medical examiner's report). The driver was transported from the crash scene by ambulance to the medical examiner's facility where a non-invasive examination was conducted. An autopsy was not performed.

Crash Diagram



Clear and Dry

Eastbound Lanes of Divided Interstate Highway

Speed Limit 105 km/h (65 mph)

1 = 1997 Chevrolet Blazer

0 10 20

Meters

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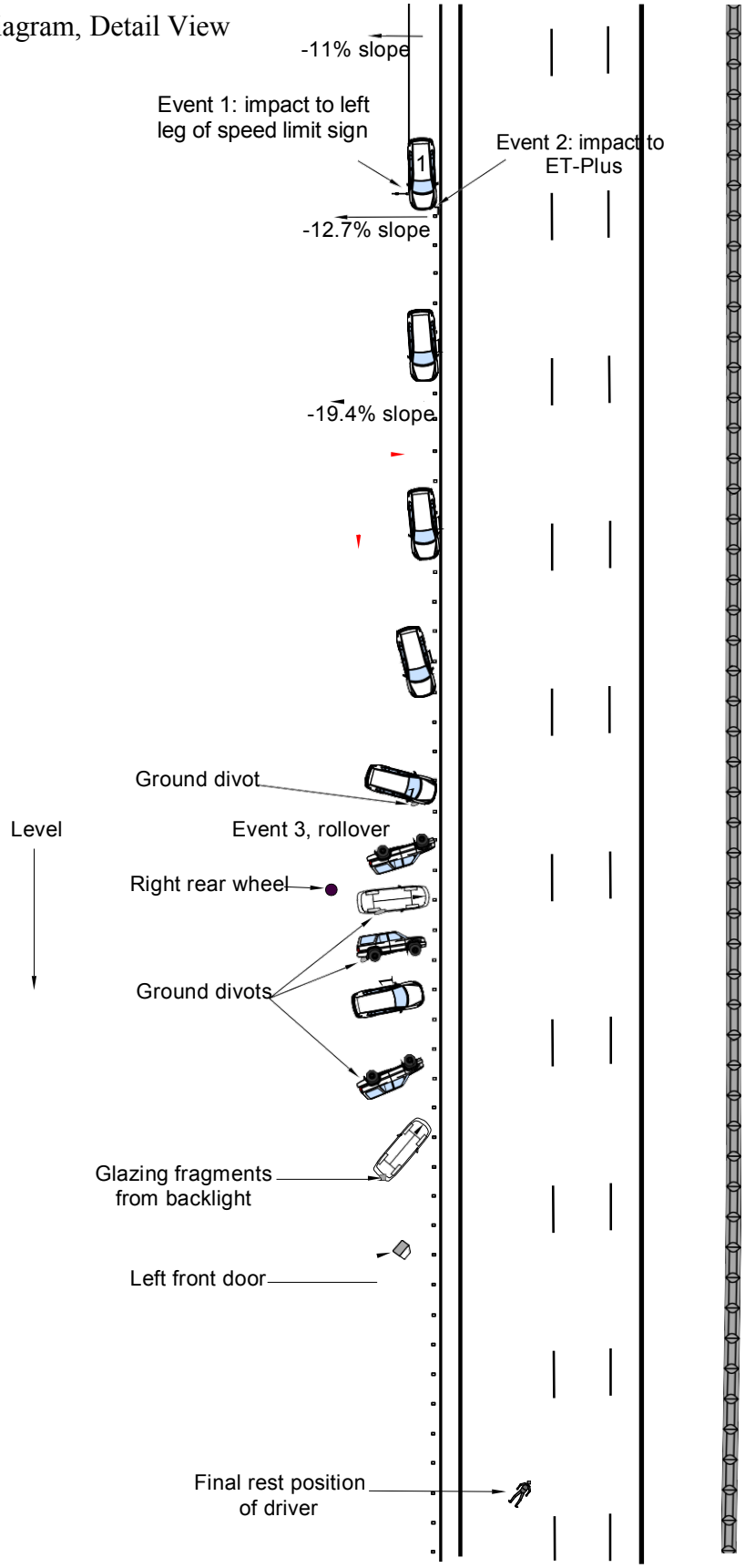
Case Number:	IN16005

Crash Diagram, Detail View



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IN16005

Clear and Dry

Eastbound Lanes of Divided Interstate Highway

Speed Limit 105 km/h (65 mph)

1 = 1997 Chevrolet Blazer

0 10 20

Meters

NHTSA www.nhtsa.gov

Case Number: IN16005

APPENDIX A:
FHWA Guardrail Form

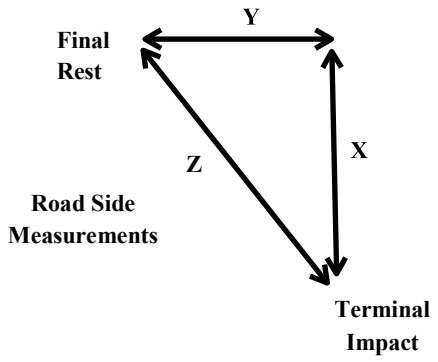
Case No.: IN6005

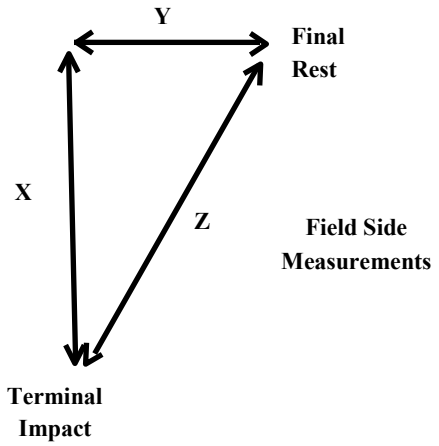
PREPOPULATED DATA (BY OTHERS)			
Date of Crash	February 2016	**Time of Crash (Military)**	Early Morning
Case Number	IN16005	**State**	Missouri
Traffic Route	Interstate	**Direction (Southbound = SB)**	EB
Ambient Conditions (at time of crash)			
Temperature (°F)	49	**Lighting**	Dark
Atmospheric	Clear & dry		

SCENE INFORMATION	
Type of area where crash occurred	❒Urban ❒Rural ☒Suburban
Terminal on a horizontal curve?	☒No ❒Curve/LT ❒Curve/RT
Estimated or Reconstructed Speed at Impact (MPH)	Unknown
Est. distance (straight line) from terminal impact to COM final rest position (ft.)	Z = 206 ft
Est. distance (longitudinal) along guardrail from terminal impact to COM final resting location (ft.)	X = 206 ft
Est. distance (normal) from either 1. the white paint line; or 2. roadway/shoulder/pavement edge to COM rest position (ft.)	Y = 19 ft
Super elevation	❒+2% ❒-2% ☒ NONE or FLAT (Flat)
Curve Radius (ft.)	N/A

KEY:

- COM - Center of Mass of Vehicle.
- Distance Measurements.





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ON-SCENE INFORMATION		
End Treatment Type	☒Extruder	❒ET2000 ☒ET-PLUS 4in ❒ET-PLUS 5in ❒SKT ❒FLEAT ❒SOFT STOP
	❒Telescope	❒X-LITE ❒X-TENSION
Curb?	☒No ❒Yes	❒AASHTO Type A ❒AASHTO Type B ❒AASHTO Type C ❒AASHTO Type D ❒AASHTO Type E ❒AASHTO Type F ❒AASHTO Type G ❒AASHTO Type H
Curb Height:		

GUARDRAIL INSTALLATION

Post No.	Post		Offset Block		PRE-Existing Damage		Offset to post or post hole (ft.)		Spacing to next post (ft. -in.)
	Type	Dim.	Type	Dim.	Yes No Unknown	Describe	Travel Way	Curb	
	Steel Wood Other	D x W (in.) or Dia. (in.)	Steel Wood Composite	D x W (in.)					
0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1	Wood	7.5 x 5.3	None	N/A	Unk		12.8		6’2”
2	Wood	7.5 x 5.4	None	N/A	Unk		12.2		6’4”
3	Wood	8 x 6	Wood	Unk	Unk		12.8		6’4”
4	Wood	7.7 x 5.9	Wood	Unk	Unk		12.5		6’2”
5	Wood	8 x 6	Wood	Unk	Unk		12.5		6’2”
6	Wood	8 x 6	Wood	Unk	Unk		12.6		6’2”
7	Wood	8 x 6	Wood	Unk	Unk		12.6		6’5”
8	Steel	5.8 x 4.0	Wood	Unk	Unk		12.3		6’6”

Case No.: IN16005

Post No.	Post		Offset Block		PRE-Existing Damage		Offset to post or post hole (ft.)		Spacing to next post (ft. -in.)
	Type	Dim.	Type	Dim.	Yes No Unknown	Describe	Travel Way	Curb	
	Steel Wood Other	D x W (in.) or Dia. (in.)	Steel Wood Composite	D x W (in.)					
9	Steel	5.8 x 4.0	Wood	Unk	Unk		12.0		6’6”
10									
11									
12									

Additional Comments: Posts 10–12 were not assessed since the investigation was completed using an earlier version of this from that only assessed posts 1–9.

Case No.: IN16005

EXTRUDER			
Feeder Channel Width at impact head	☒4inches ☐5 inches ☐Other _____		
Guide Chute Exit Height (in.)	15.0 in		
Connection of feeder channels to head damaged?	☒No ☐Yes	Are Welds Broken?	☒No ☐Yes
Anchor Cable Present?	☐No ☒Yes	Connected?	☒No ☐Yes
Rail Extrusion?	☐No ☒Yes	Length (ft. in.)	0’ 11”
Rail Extrusion Direction	☐Traffic Side ☒Field Side		
Total Length of Rail Damaged (ft.) [total length would include extruded rail plus damaged rail downstream from head.]	142 ft		

TELESCOPE				
Rail Displacement	☐No	☐Yes; Length:	No of Panels Displaced	☐1 ☐2 ☐3 ☐4 ☐5 ☐6

ALL-SYSTEM PERFORMANCE			
Railkinks Downstream of Head?	☒No	☐Yes; No. of Kinks in Rail:	
Was there intrusion into the Occupant Compartment by foreign object (guardrail)?	☒No ☐Yes		
Did vehicle impact other objects after impact with terminal?	☐No ☒Yes		
Object Contacted	Ground (rollover)		

ALL-SYSTEM PERFORMANCE ENVIRONMENT			
SIDESLOPE	**50 ft in advance of Post 1**	**At Post 1**	**50 ft Past Post 1**
Percent - %	-11%	-13%	-19%
Adjacent Lane Width (ft)	12.1 ft		

Lane Type (NAS EDS Variable: Sur. Type)	Concrete
Shoulder Type	Concrete
Shoulder Width (ft)	11.8 ft
Guardrail Height (in)	26.5 in

VEHICLE INFORMATION		
Vehicle Type (NHTSA Input)	Sport Utility Vehicle	
Vehicle Identification Number (VIN)	1GNDT13W2V2XXXXXX	
Vehicle Mass (NASS var.: veh.wgt)	4043 lbs	
Vehicle orientation upon impact	☒Case Type 1 ❒ Case Type 2 ❒ Case Type 3 ❒ Case Type 4 ❒ Case Type 5 ❒ Case Type 6 ❒ Case Type 7 ❒ Case Type 8 ❒ Other	
If 'Other', describe		
Collision Deformation Classification	12FDEW1	
Delta-V	Moderate	
Occupant Compartment Penetration of rail	☒No	❒Yes; Describe:
Quarter Turns (NASS EDS variable: Rollover)	❒1 ❒2 ❒3 ❒4 ❒5 ☒6 ❒7 ❒8 ❒9 ❒10 ❒11 ❒12 ❒13 ❒14 ❒15 ❒16 ❒17+	
Object Precipitating Rollover, (NASS EDS variable: Rollobj)	Ground	
Rollover Type, Terhune Scale, (NASS EDS variable: rolintyp)	Trip Over (See Crash section of report beginning on page 2 of report)	

DOT HS 812 835
November 2019

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

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