U.S. Department of Transportation
National Highway Traffic Safety Administration

NHTSA

DOT HS 812 551

August 2018

Special Crash Investigations On-Site Guardrail End Treatment Impact Investigation Vehicle: 2005 Chevrolet Cobalt Location: Missouri Crash Date: May 2016

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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. This report and associated case data are based on information available to the Special Crash Investigation team on the date the report was published.

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On-site X-Lite guardrail end treatment investigation involving a 2005 Chevrolet Cobalt.

16. Abstract

This report covers an on-site investigation of a passenger vehicle impact to an X-Lite telescoping guardrail end treatment that is of interest to the Federal Highway Administration (FHWA). This crash occurred on the west roadside of an exit ramp of a multi-lane, divided U.S. highway and involved a 2005 Chevrolet Cobalt. The Chevrolet was a two-door coupe equipped with dual-stage frontal air bags. An unbelted 28- year-old female driver occupied the vehicle. The Chevrolet was traveling northwest on an exit ramp that curved to the left. The vehicle rotated counterclockwise for unknown reasons and departed the left (west) side of the roadway. The front right corner impacted a delineator post (event 1) and the right plane then impacted the X-Lite end treatment of a blocked-out W-beam guardrail. This impact damaged and displaced the guardrail and the X-Lite head penetrated the passenger compartment. The vehicle continued northeast and came to final rest heading southwest on the left roadside. The driver sustained fatal injuries and was pronounced dead at the crash site. The Chevrolet was towed from the crash site due to damage.

17. Key Words		18. Distribution Statement
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INDIANA UNIVERSITY

TRANSPORTATION RESEARCH CENTER

ON-SITE X-LITE GUARDRAIL END TREATMENT INVESTIGATION

CASE NUMBER - IN16014
LOCATION - MISSOURI
VEHICLE - 2005 CHEVROLET COBALT
CRASH DATE - MAY 2016

BACKGROUND

This report covers an on-site investigation of a passenger vehicle impact to an X-Lite telescoping guardrail end treatment (**Figure 1**) that is of interest to the Federal Highway Administration (FHWA). This crash was identified by an engineer with the Missouri Department of Transportation (MoDOT), who submitted photographs of the vehicle and the damaged guardrail end treatment to the FHWA. The FHWA determined that the guardrail end treatment and crash type were of interest. This Special Crash Investigation (SCI) was then initiated by the National Highway Traffic Safety Administration (NHTSA) in May, 2016 and assigned to the SCI team at the Indiana University Transportation Research Center on the same date. This crash involved a 2005 Chevrolet Cobalt (**Figure 2**). The crash occurred in May 2016 at 2308 hours, in Missouri and was investigated by a local police agency. The guardrail, crash scene, and the Chevrolet were inspected in May, 2016. A partial interview with the owner (and friend of the driver) of the vehicle was conducted in August, 2016.

Figure 1: Overview of crash scene with X-Lite guardrail end treatment (detached)

Figure 2: 2005 Chevrolet Cobalt right side damage

This crash occurred on the west roadside of an exit ramp of a multi-lane, divided U.S. highway. The Chevrolet was a two-door coupe equipped with dual-stage frontal air bags. An unbelted 28-year-old female driver occupied the vehicle. The Chevrolet was traveling northwest on an exit ramp that curved to the left. The Chevrolet rotated counterclockwise for unknown reasons and departed the left (west) side of the roadway. The front right corner impacted a delineator post (event 1) and the right plane then impacted the X-Lite end treatment of a blocked-out W-beam guardrail. This impact damaged and displaced the guardrail and the X-Lite head penetrated the passenger compartment. The vehicle continued northeast and came to final rest heading southwest on the left roadside. The driver sustained fatal injuries and was pronounced dead at the crash site. The Chevrolet was towed from the crash site due to damage.

CRASH SUMMARY

Crash Site

This crash occurred during night hours on the west roadside of an unlighted exit ramp from a multi-lane, divided U.S. highway. The weather conditions were light rain with 16 km (10 miles), east winds at 21 km/h (13 mph), a temperature of 10.6 °C (51 °F), and a dew point of 8.9 °C (48 °F) according to the police reconstruction report. The exit ramp was curved to the left and had one bituminous northwestbound lane. The exit ramp grade in the area of the Chevrolet's approach to the crash site was negative 3% and the curve's superelevation was negative 11% toward the east. The exit ramp was 5.2 m (17.1 ft) wide and was bordered by 1.5 m (4.9 ft) wide bituminous shoulders. The roadway markings consisted of a solid white edge line on the east and a solid yellow edge line on the west. A blocked out-W-beam guardrail equipped with an X-Lite end treatment was located on the west side of the exit ramp. The exit ramp speed limit was 56 km/h (35 mph). The Crash Diagram is included on pages 10 and 11 of this report.

Pre-Crash

The Chevrolet was traveling northwest on the exit ramp (**Figure 3**) and the driver intended to negotiate the left curve and merge onto a northwestbound roadway. For unknown reasons, the Chevrolet began to rotate counterclockwise and departed the west (left) roadside.

Figure 3: Northwest approach to crash area

Crash

The front right corner of the vehicle impacted a delineator post (event 1) on the west roadside. The force direction on the Chevrolet was within the 2 o'clock sector. There was only superficial damage to the Chevrolet and no crush. The vehicle continued northwest while rotating counterclockwise and the right door impacted the head of the X-Lite guardrail end treatment (event 2). The force direction on the Chevrolet was within the 3 o'clock sector and the impact resulted in a latch/striker separation of the right front door as the door was crushed and intruded 88 cm (34.6 in) into the front seating row. The WinSMASH program could not be used to calculate Delta V since yielding object impacts are out of scope for the program. However, WinSMASH was used to calculate a Barrier Equivalent Speed (BES) of 32 km/h (19.9 mph) based on the crush to the right plane. The vehicle remained engaged with the guardrail and continued in a northwesterly direction, damaging 11.4 m (37.5 ft) of guardrail and four guardrail posts. Based on the statement from a passerby and autopsy information, the driver was found after the crash partially ejected through the windshield. The vehicle came to final rest heading southwest, approximately 5.9 m (19.3 ft) northwest of the impact with the X-Lite head.

Post-Crash

The police were notified of the crash at 2309 hours and arrived at 2323 hours. Rescue and medical personnel also responded. The driver was partially ejected through the windshield according to a witness account and the autopsy. Rescue personnel cut guardrail panels 1 and 2 (**Figure 4**) and removed the X-Lite head and guardrail which remained inside the vehicle after the crash. A road crew subsequently unbolted the remaining damaged guardrail and moved it to the roadside.

Figure 4: Guardrail panels 1 and 2, cut by rescue personnel

Figure 5: End of guardrail panel 2, beginning of panel 3. Note unsheared splice bolts

The driver sustained fatal injuries and was pronounced dead at the scene. The autopsy blood test reported no presence of alcohol. The blood test did indicate a positive result for Carboxy-THC 50 ng/ml. The vehicle was towed from the crash scene due to damage.

Figure6: X-Lite impact head

GUARDRAIL DAMAGE

The right plane of the Chevrolet impacted the X-Lite head, which was mounted directly onto the end of a 3.8 m (12. 5 ft) long section of guardrail. During an end impact, the three 3.8 m (12. 5 ft) long sections of W-beam guardrail are designed to "telescope" downstream from the impact head, dissipating energy through friction. Special yellow shear bolts are installed at guardrail splices at the downstream ends of panels 2 and 3 (Posts 5 and 7), facilitating the telescoping action. During this crash, the first section of guardrail slid to within 15 cm (5.5 in) of the downstream end of the second guardrail panel (Post 3). However, the shear bolts at the downstream end of the second guardrail section (Post 5) did not shear and the guardrails did not slide any further (**Figure 5**). The X-Lite impact head measured 35 cm (13. 8 in) wide and 61 cm (24.0 in) high (**Figure 6**) and is designed to be mounted to the end of the guardrail at Post 1. Post 1 (**Figure 7**) collapsed in the downstream direction nearly to the ground and detached from the damaged guardrail. The ground strut was detached. Post 2 was also bent downstream approximately 60 degrees from vertical and was detached from the damaged guardrail. The ground strut was still attached near the base of the post. Post 3 had a composite block-out still firmly

Figure 7: Post 1, view is toward field side

attached and the post was bent downstream, flush to the ground and detached from the damaged guardrail. The bending of posts 1-3 was facilitated by the crimps near the bottom of the posts (**Figure 8**). Block-outs were present on Posts 3-12. Post 4 was displaced downstream approximately 20 degrees from vertical and detached from the damaged guardrail. Based on photos in the police reconstruction report, the right plane of the Chevrolet was in contact with this post at final rest. The composite block-out was still attached by the connecting bolt but was not flush against the post (**Figure 9**) and the connecting bolt pulled through the bolt hole. Post 5 and its block-out were undamaged. Compliant to manufacturer specification, there was no connection bolt installed at this post. The shear bolts at this post that spliced rails 2 and 3 together did not shear during the crash. Post 6 was undamaged and the connection bolt pulled through the guardrail. Post 7 was undamaged. The third of the 3.8 m (12. 5 ft) long sections of X-Lite guard rail was bolted to this post. Maintenance crews unbolted the shear bolts and separated the damaged guardrail from this post. Undamaged guardrail remained but was unconnected at this post. Posts 8-12 were undamaged and undamaged guard rail was connected at each post. Steel block-outs were installed at Posts 9, 11, and 12 and there was a composite block- out at Post 10. All three lengths of X-Lite guardrail, each 3.8 m (12. 5 ft) in length and 11.4 m (37.5 ft) in total length, were damaged. There was one kink (see **Figure 5**) which occurred at the splice of guardrail panels 2 and 3. The "In-Service End Treatment Evaluation Data Collection Form" is attached to the end of this report as Attachment A.

Figure 8: Crimp at base of Post 3

Figure 9: Post 4 (final rest of vehicle)

2005 CHEVROLET COBALT

DESCRIPTION

The Chevrolet was a front wheel drive, five-occupant, two-door coupe (VIN: 1G1AL12F657xxxxxx) that was equipped with a 2.2-liter I-4 engine, a four-speed automatic transmission, and four-wheel anti-lock brakes with electronic brake force distribution. The vehicle was also equipped with dual-stage frontal air bags, an Event Data Recorder (EDR), and a tilt steering column that was set at an unknown position. The windshield glazing was AS1 laminated. The remainder of the glazing was AS2 tempered with after market tint. The specified wheelbase was 262 cm (103.3 in).

The vehicle manufacturer's recommended tire size was P205/65R16. The vehicle was equipped with a Goodyear Eagle tire on the left front wheel, a Sumitomo Tour Plus ST tire on the left rear wheel, a Hankook Optimo H426 tire on the right rear wheel, and a Finalist Radial F109 tire on the

wheel, a Hankook Optimo H426 tire on the right rear wheel, and a Finalist Radial F109 tire on the right front wheel. All tires were size P205/55R16. The manufacturer's recommended cold tire pressure for the front and rear tires was 207 kPa (30 psi). All tires were deflated and there were sidewall cuts on the left front and both right side tires. All tires were in good condition except the right front, which had 2 mm (2/32 in) of tread remaining.

The front row was equipped with driver and front right occupant cloth-covered bucket seats with adjustable head restraints. The second row was equipped with a cloth-covered bench seat with folding backs and integral head restraints at the outboard seating positions. The driver's seat track was adjusted between the forward most and middle positions and the recline position of the seat back was 62 degrees aft of vertical, most likely was been adjusted during extrication efforts. The top of the driver's head restraint was adjusted to 23 cm (9.1 in) above the top of the seat back. The remaining seats were unoccupied at the time of the crash.

EXTERIOR DAMAGE

Exterior Damage Event 1

The Chevrolet sustained direct damage to the front bumper fascia and right headlamp assembly during the impact with the delineator post. The direct damage began 3 cm (1.2 in) left of the right bumper corner and extended 8 cm (3.1 in) to the left. The damage was minor and there was no crush to any structure.

Figure 10: Intruded right door

Damage Classification, Event 1

The Collision Deformation Classification (CDC) was 02FREN1 (60 degrees).

Exterior Damage Event 2

The Chevrolet sustained direct damage to the right plane during the impact with the X-Lite guardrail head. The right door, sill, B-pillar, and side panel rear of the B-pillar were directly damaged (**Figures 10** and **11**). The direct damage started 46 cm (18.1 in) rear of the right front axle and extended 166 cm (65.3 in) rearward. The Field L was 174 cm (68.5 in). Crush measurements were taken at the sill and mid- door levels and averaged where necessary, according to NASS vehicle measurement protocol, since there was latch/striker failure. The maximum crush to the door was 97 cm (38.2 in), occurring 5 cm (2 in) forward of C3. The residual averaged crush values were $C_1 = 0$ cm, $C_2 = 29$ cm (11.4 in), $C_3 = 49$ cm (19.3 in), $C_4 = 27$ cm (10.6 in), $C_5 = 6$ cm (2.4 in), $C_6 = 0$ cm.

Figure 11: Guardrail damage to panel rear of right B- pillar

Damage Classification Event 2: The CDC was 03RPEW6 (80 degrees). The severity of the damage was severe.

EVENT DATA RECORDER

The Chevrolet's EDR information was not obtained. Wiring damage at the Diagnostic Link Connector (DLC) prevented communication with the EDR and the intruded right front door prevented access to the EDR module and fuse block.

INTERIOR DAMAGE

The interior of the Chevrolet sustained severe damage from intrusion. The most severe intrusions into the front row involved the right front door and window frame, which intruded laterally 88 cm (34.6) and 68 cm (27.1 in), respectively. The steel guardrail and X-lite head intruded laterally into the passenger compartment 84 cm (33 in). The front right seat back and seat base were also displaced to the left 21 cm (8.3 in) and 10 cm (3.9 in), respectively by the intruding door. No discernable evidence of occupant contact was observed.

The right door sustained a latch/striker failure during the impact with the X-Lite guardrail head. The the left door remained closed and operational. All non-fixed glazing was closed at the time of the crash. According to a witness, the driver was partially ejected through the windshield glazing near the right A-pillar. At the SCI inspection, the windshield glazing was found to be cut along the A-pillar and windshield header by rescue personnel, likely done to facilitate removal of the driver. The right front glazing disintegrated during the crash and the remainder of the glazing was undamaged.

MANUAL RESTRAINT SYSTEMS

All seating positions were equipped with three-point lap and shoulder safety belts with sliding latch plates and non-adjustable upper anchors. The front row safety belts were also equipped with retractor-mounted pretensioners.

The driver was not restrained by the lap and shoulder safety belt. There were no discernable load marks on the safety belt webbing, latch plate, or D-ring. The police reconstruction report stated that the driver was sitting on top of the buckled safety belt at the time of the crash. The safety belt was unbuckled at the time of SCI inspection.

SUPPLEMENTAL RESTRAINT SYSTEMS

The Chevrolet was equipped with dual-stage frontal air bags. Neither frontal air bag deployed during the crash.

2005 CHEVROLET COBALT OCCUPANT

DRIVER DEMOGRAPHICS

Age/Sex:	28-year-old/female
Height:	160 cm (63 in)
Weight:	77 kg (170 lb)
Eyewear:	Unknown
Seat Type:	Bucket
Seat Track Position:	Between forward-most and middle
Manual Restraint Usage:	None
Usage Source:	Vehicle inspection, police reconstruction report
Air Bags	Driver frontal, not deployed
Alcohol/Drug Involvement:	Tested positive for Carboxy-THC
Egress from Vehicle:	Removal by rescue personnel
Transport from Scene:	Transported to medical examiner
Medical Treatment:	None, pronounced deceased at crash scene

DRIVER INJURIES

Injury Number	Injury	AIS 2005/08	Injury Source	IPC Confidence Level
1	Lacerations aorta, one 2 cm (0.8 in), V-shaped, above the aortic value, one 3 cm (1.2 in), horizontal, in ascending segment causing an aortic dissection[1] extending from the ascending cross to the descending aorta in the abdo-men, not further specified	420218.6,4	Right front door panel, rear upper quadrant	Certain
2	Laceration (rupture) left pericardium, not further specified	441602.2,4	Right front door panel, rear upper quadrant	Certain
3	Fractured ribs: left 1st through 8th posteriorly; right 1st through 9th posteriorly, right 4th through 6th laterally; bilaterally 1st through 4th anteriorly	450203.3,3	Right front door panel, rear upper quadrant	Certain
4	Laceration (fragmentation) right middle lobe of lung with a separate fragment measuring 10 by 7 cm (3.9 x 2.75 in), and perihilar and intraparenchymal hemorrhage on both lungs, not further specified	441431.3,1	Right front door panel, rear upper quadrant	Certain

[1] The following terms are defined in DORLAND'S ILLUSTRATED MEDICAL DICTIONARY as follows:

dissect (di-sekt/): to cut apart, or separate; especially, the exposure of structures of a cadaver for anatomical study or to other cutting of tissues of the body.

dissecion (di-sek/shen): 1. the act of dissecting. 2. a part or whole of an organism prepared by dissecting.

aortic d.: one resulting from hemorrhage that causes longitudinal splitting of the arterial wall, producing a tear in the intima and establishing communication with the lumen; it usually affects the thoracic aorta but may also affect the abdominal aorta. Called also *dissecting aneurysm*.

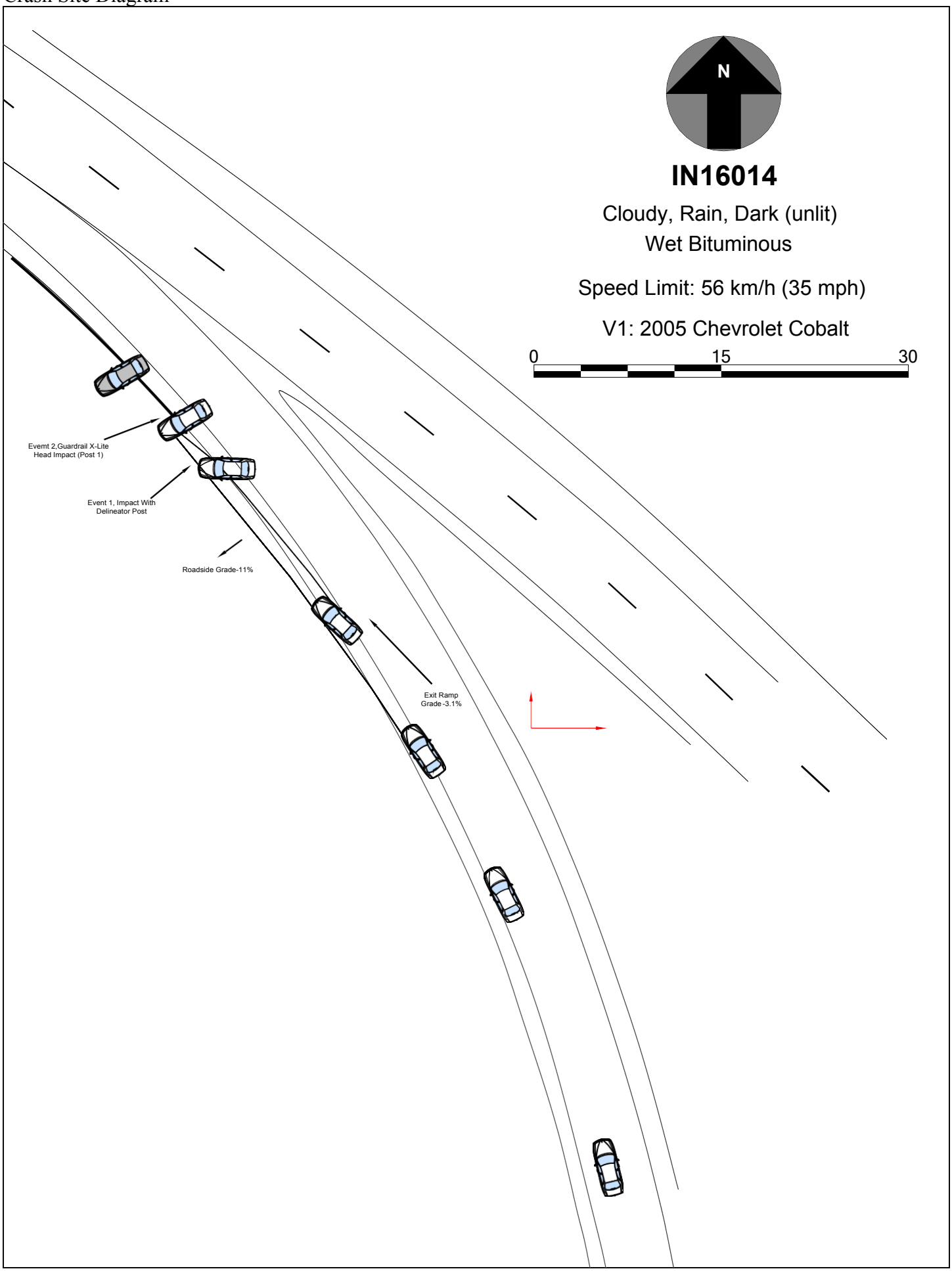
Injury Number	Injury	AIS 2005/08	Injury Source	IPC Confidence Level
5	Hemothoraces, bilaterally, 350 ml right pleural cavity, 300 ml left pleural cavity, not further specified	442200.3,3	Right front door panel, rear upper quadrant	Certain
6	Lacerations, liver, right lobe and caudate lobe, 2 by 1 cm (0.8 x 0.4 in) up to 9 by 6 cm (3.5 x 2.4 in), with 50 ml of hemoperitoneum, not further specified	541822.2,1	Right front door panel, rear upper quadrant	Certain
	Hematoma, retroperitoneal, 20 by 20 by 4 cm (7.9 x 7.9 x 1.6 in) surround-ing left kidney and left adrenal and extending to medial right kidney, not further specified	Not coded		
7 8	Abrasion, 0.6 cm (0.25 in) surrounded by a contusion, 1.3 cm (0.5 in) on right forehead, not further specified	210202.1,7 210402.1,7	Right front door panel, rear upper quadrant	Probable
9 10	Abrasions, multiple, small, on right side of face and right side of neck	210202.1,1 310202.1,1	Noncontact injury: flying glass, right front glazing	Probable
11	Contusion, 6.4 by 3.8 cm (2.5 x 1.5 in), on right cheek, not further specified	210402.1,1	Right front door panel, rear upper quadrant	Probable
12	Lacerations x 2, small, 0.6 cm (0.25 in), on right side of neck, not further specified	310602.1,1	Noncontact injury: flying glass, right front glazing	Probable
13	Abrasion, 1.9 by 0.6 cm (0.75 x 0.25 in) on left lower abdominal wall, not further specified	510202.1,8	Steering wheel hub and/or spokes and rim	Probable
14	Laceration (tear) right middle finger nail, not further specified	710602.1,1	Right front door panel, rear upper quadrant	Probable
15	Abrasions, multiple, on posterior right thigh	810202.1,1	Seat cushion, driver's	Probable
16	Abrasion, 5.1 cm (2 in) in diameter on posterior left thigh, not further specified	810202.1,2	Seat cushion, driver's	Probable
17	Abrasion, 3.8 by 1.3 cm (1.5 x 0.5 in) on right knee, not further specified	810202.1,1	Right front door panel, rear lower quadrant	Probable
18 19	Abraded contusion, 6.4 by 3.8 cm (2.5 x 1.5 in) below left knee, not further specified	810202.1,2 810402.1,2	Center lower instrument panel	Probable
20	Laceration, 1.9 by 1.3 cm (0.75 x 0.5 in) on anterior right thigh, not further specified	810602.1,1	Center instrument panel	Probable

Sources: Autopsy Records and Medical Examiner Records. Injury Numbers from ***Autopsy Records****.*

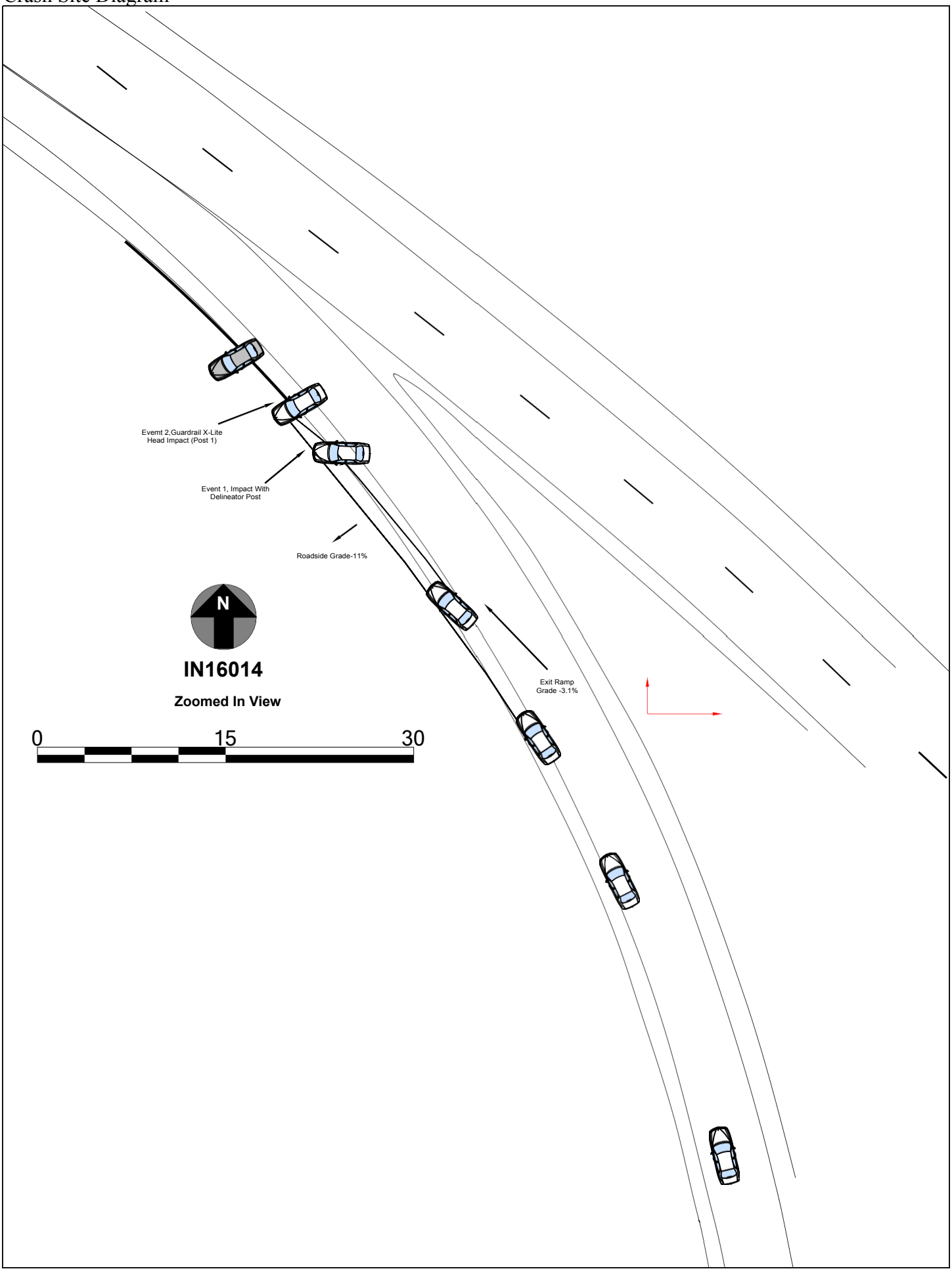
DRIVER KINEMATICS

The driver was not restrained by the lap and shoulder safety belt and the seat track was adjusted to between the forward-most and middle positions. The top of the head restraint was adjusted to 23 cm (9.1 in) above the top of the seat back. The right plane impact with the X-Lite guardrail head displaced the driver to the right and was partially ejected near the right A-pillar. She contacted the intruding right front door and sustained lacerations to her aorta, left pericardium, right lung, and liver. She also sustained bilateral fractured ribs, hemothoraces of the right and left pleural cavities, and a retroperitoneal hematoma in the area surrounding both kidneys. The contact to the right front door also resulted in contusions about the forehead, face, an abrasion to the right knee, and a laceration to the right middle finger nail. Flying glass from the right front window resulted in abrasions and lacerations to the right side of the neck and face. She contacted the steering wheel and sustained an abrasion to her left lower abdominal wall. She sustained abrasions to the posterior thighs from contact from the seat cushion. Contact to the center instrument panel resulted in an abraded contusion below the left knee and a laceration of the anterior right thigh. The driver was pronounced dead at the crash site.

Crash Site Diagram



Crash Site Diagram



Appendix A
In-Service End Treatment Evaluation
Data Collection Form

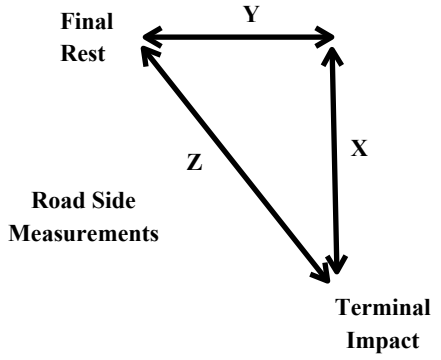
Case No.: IN16014

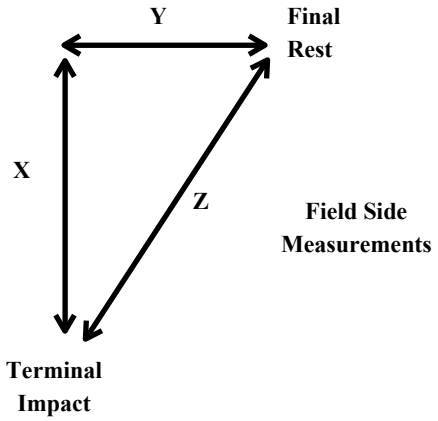
PREPOPULATED DATA (BY OTHERS)			
Date of Crash	May 2016	**TIME OF CRASH (MILITARY)**	Night Time Hours
Case Number	IN16014	**State**	MO
Traffic Route	US Hwy	**Direction (Southbound = SB)**	NWB
Ambient Conditions (at time of crash)			
Temperature (°F)	51°	**Lighting**	Dark (unlit)
Atmospheric			

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)	
Est. distance (straight line) from terminal impact to COM final rest position (ft.)	Z = 19 ft
Est. distance (longitudinal) along guardrail from terminal impact to COM final resting location (ft.)	X = 19 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
Curve Radius (ft.)	N/A

KEY:

- COM - Center of Mass of Vehicle
- Distance Measurements





Case No.: IN16014

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
1	Steel	N/A	N/A	N/A	Unknown		61	N/A	67’
2	Steel	6 x 4	N/A	N/A	Unknown		64	N/A	79’

Case No.: IN16014

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.)					
3	Steel	6 x 4	Composite	8 x 4	Unknown		73.5	N/A	75’
4	Steel	6 x 4	Composite	7.5 x 4	Unknown		69	N/A	66’
5	Steel	6x4	Composite	7.5 x 4	Unknown		69	N/A	76’
6	Steel	6x4	Composite	7.5 x 4	Unknown		65	N/A	74’ 6”
7	Steel	6 x 4	Composite	7.5 x 4	Unknown		66	N/A	75’ 9”
8	Steel	6 x 4	Composite	7.25 x 3.75	Unknown		67	N/A	74’

Case No.: IN16014

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	6 x 4	Steel	6 x 4	Yes	Back end of post is slightly bent	67	N/A	35’ 9”
10	Steel	6 x 4	Composite	7.25 x 4	No		67	N/A	37’ 9”
11	Steel	6 x 4	Steel	3.75 x 6	Yes	Post and blockout bent	66	N/A	38’ 9”
12	Steel	6 x 4	Steel	6 x 4	Yes	Improperly positioned bolt	67	N/A	40’ 6”

Additional Comments

Case No.: IN16014

EXTRUDER			
Feeder Channel Width at impact head	❒4inches ❒5 inches ❒Other _____		
Guide Chute Exit Height (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.)	
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.]			

TELESCOPE				
Rail Displacement	❒No	√ Yes; Length:12.5 (rail 1 pushed to end of rail 2)	No of Panels Displaced	√1 ❒2 ❒3 ❒4 ❒5 ❒6

ALL-SYSTEM PERFORMANCE			
Railkinks Downstream of Head?	❒No	√Yes;	No. of Kinks in Rail: 1
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	posts		

ALL-SYSTEM PERFORMANCE ENVIRONMENT			
SIDESLOPE	**50 ft in advance of Post 1**	**At Post 1**	**50 ft Past Post 1**
Percent - %	-35%	-11%	+43%
Adjacent Lane Width (ft)	17.1		
Lane Type (NAS EDS Variable: Sur. Type)	Bituminous		
Shoulder Type	Bituminous		
Shoulder Width (ft)	4.9		
Guardrail Height (in)	28		

Case No.: IN16014

VEHICLE INFORMATION		
Vehicle Type (NHTSA Input)	2005 Chevrolet	
Vehicle Identification Number (VIN)	1G1AL12F657656617	
Vehicle Mass (NASS var.: veh.wgt)	2868 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	03RPEW6	
Delta-V	Uknown (impact with yielding object)	
Occupant Compartment Penetration of rail	❒No	√ Yes; Describe: Head (and rail) came through RF door
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)		
Rollover Type, Terhune Scale, (NASS EDS variable: rolintyp)		

DOT HS 812 551
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U.S. Department
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**National Highway
Traffic Safety
Administration**

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