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May 2020

Special Crash Investigations: On-Site Guardrail End Terminal Investigation; Vehicle: 1999 Chevrolet Blazer; Location: Missouri; Crash Date: May 2017

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15. Supplementary Notes Each crash represents 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 this report was published.			
16. Abstract This on-site investigation documents an SUV impact to a 5-inch model ET-Plus guardrail end terminal for the Federal Highway Administration that occurred on a four-lane, divided highway. The Chevrolet was a 4-door SUV equipped with redesigned frontal air bags and an event data recorder. A belted 16-year-old female drove the vehicle. The Chevrolet was traveling north in the right northbound through lane. The driver told the police that she intentionally drove the vehicle off the right side of the roadway and into the guardrail in an attempt to commit suicide. The front plane struck the end terminal resulting in deployment of both frontal air bags. The impact resulted in a damaged portion of the guardrail impacting a second separate area of the front plane with the damage extending onto the left plane. The vehicle then rolled over, right-side-leading, two quarter turns, coming to final rest on its top plane. The driver sustained police-reported "A" (incapacitating) level injuries and was transported by ambulance to a hospital where the driver was hospitalized for one day.			
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Special Crash Investigations
On-Site Guardrail End Terminal Investigation
Vehicle: 1999 Chevrolet Blazer
Case Number: IN17021
Location: Missouri
Crash Date: May 2017

BACKGROUND

This on-site investigation documents an SUV impact to an ET-Plus 13 cm (5 in) model guardrail end terminal (**Figures 1** and **2**) for the Federal Highway Administration (FHWA). This crash was identified by an engineer with the Missouri Department of Transportation, who submitted images of the damaged guardrail end terminal and vehicle to the FHWA. The FHWA determined that the guardrail end terminal and crash type met their research criteria. This crash investigation was then initiated by the National Highway Traffic Safety Administration in May 2017 and assigned to the Special Crash Investigation team at the Indiana University Transportation Research Center. This single-vehicle crash involved a 1999 Chevrolet Blazer (**Figure 3**). The crash occurred in Missouri in May 2017; the guardrail, crash scene, and vehicle were inspected in the same month.

Figure 1. The damaged ET-Plus and guardrail.

Figure 2. The damaged posts and guardrail, view north.

This crash occurred on the east side of the northbound lanes of a four-lane, divided State highway. The Chevrolet was a 4-door SUV equipped with redesigned frontal air bags and an event data recorder (EDR). A belted 16-year-old female drove the vehicle. The Chevrolet was traveling in the right northbound through lane. The driver told the police that she intentionally drove the vehicle off the right side of the roadway and into the guardrail in an attempt to commit suicide. The front plane struck the end terminal (Event 1), resulting in deployment of both frontal air bags.

The impact resulted in a damaged portion of the guardrail impacting a second separate area of the front plane with the damage extending onto the left plane (Event 2). The vehicle then rolled over (Event 3), right side leading, two-quarter turns coming to final rest on its top plane facing southwest. The driver sustained police-reported “A” (incapacitating) injuries and was transported by ambulance to a hospital where she was hospitalized for one day. The Chevrolet was towed from the crash scene due to damage.

SUMMARY

Crash Site

This crash occurred during daylight hours on the east side of the northbound lanes of a four-lane, divided State highway. The weather conditions were cloudy with south-southeast winds at 16 km/h (10 mph), temperature of 28.3 °C (83 °F), and dew point of 17.2 °C (63 °F), according to local weather reports. The highway was straight and traversed in a north/south direction and had two concrete through lanes in each direction that were divided by a grass median. The northbound roadway was border by a 1.5 m (4.9 ft) wide concrete median shoulder and a 3.2 m (10.5 ft) wide concrete outside shoulder. The right northbound lane was 3.4 m (11.2 ft) wide and the left northbound lane was 3.6 m (11.8 ft) wide. A blocked-out W-beam guardrail equipped with an ET-Plus 13 cm (5 in) model end terminal was located on the right side of the road adjacent to the shoulder. The speed limit was 97 km/h (60 mph). A crash diagram is included at the end of this report.

Figure 3. The damaged 1999 Chevrolet Blazer.

Figure 4. Damage to the front plane of the Chevrolet from the impact with the ET-Plus.

Pre-Crash

The Chevrolet was traveling in the right northbound lane. The vehicle departed the right side of the lane onto the shoulder at an estimated distance of 44 m (144 ft) prior to impact with the end terminal.

Crash

The right aspect of the vehicle's front plane (**Figure 4**) struck the ET-Plus (Event 1) and extruded 5.2 m (17.1 ft) of guardrail to the field side. The speed of the vehicle at impact is not known. The shape of the ET-Plus was stamped into the bumper and hood. The force direction on the Chevrolet was in the 12 o'clock sector and the impact resulted in deployment of both frontal air bags. The vehicle's EDR reported the maximum longitudinal velocity change as -33.2 km/h (20.62 mph). The damage algorithm of the WinSMASH program could not be used to calculate delta V since an impact with a yielding object is out of scope for the program. However, the barrier equivalent speed (BES) algorithm of WinSMASH was used to calculate a velocity change of 34 km/h (21 mph) based on the crush to the front bumper.[1]

[1] The crush to the left portion of the front bumper from the subsequent impact with the damaged guardrail was excluded from the crush profile used for the BES run.

A damaged portion of the guardrail then struck and the left portion of the front plane (Event 2). The damage to the vehicle from this impact continued down the left plane (**Figures 5** and **6**) as the guardrail continued to deform. The exterior sheet metal of the left front door was crushed 18 cm (7.1 in) mid-door and the sheet metal of the left rear door was crushed and torn, but the guardrail did not penetrate into the occupant compartment nor cause intrusion of the interior surfaces of either door. The vehicle separated from the guardrail after traveling approximately 14 m (46 ft) displacing and fracturing eight wood posts and 15.2 m (50.0 ft) of guardrail. The vehicle then traveled an additional 10.5 m (34.4 ft) on the field side of the guardrail, rotated counterclockwise and tripped into a right side leading, two-quarter turn rollover event (Event 3) over a distance of 7.5 m (24.6 ft), coming to final rest on its top plane heading southwest.

Figure 5. Damage to the left corner of the Chevrolet's front bumper and left plane from the impact with the damaged guardrail.

Figure 6. Side view of damage to the Chevrolet's front bumper and left plane.

Post-Crash

The police were notified of the crash and arrived on scene in minutes. The investigating police officer interviewed the driver at the crash scene as emergency medical personnel were preparing to transport her to a hospital. She told the police officer that she intentionally drove the vehicle into the guardrail in an attempt to commit suicide. The driver sustained police-reported "A" (incapacitating) injuries and was transported by ambulance to a hospital where she was hospitalized for one night. The Chevrolet was towed from the crash scene due to damage.

Figure 7. Extruded guardrail from the ET-Plus.

END TERMINAL AND GUARDRAIL DAMAGE

The front plane impact of the Chevrolet to the ET-Plus extruded 5.2 m (17.1 ft) of guardrail to the field side (**Figure 7**) and damaged 15.2 m (50.0 ft) of guardrail and eight posts. The direct damage involved the full height and width (71 cm [28.0 in] and 38 cm [15.0 in]) of the face of the ET-Plus. Posts 1 to 7 were constructed of wood. The remaining posts were constructed of steel. Post 1 and 2 were not equipped with offset blocks. The remaining posts had wood offset blocks. Posts 1 to 7 were fractured and displaced during the crash. The offset blocks were

separated from posts 3 and 4 and remained attached to posts 5 to 7. Post 8, which was constructed of steel was bent downstream approximately 30 degrees off vertical. The offset block was slightly damaged but remained attached to the post, and the bolt was pulled through the guardrail. The remaining posts were undamaged. The guardrail was slightly bent and displaced at post 9, but remained bolted to the post. The guardrail was kinked in seven locations (**Figures 1** and **8**) with one kink located at the entrance to the feeder channel, two in the feeder channel, and one each at posts 5 – 8. The width of the feeder channel was 12.7 cm (5.0 in) and the guide chute exit height was 39.4 cm (15.5 in). The connection of the feeder channel to the head was not damaged and no welds were broken. The anchor cable was present but was disconnected from its anchor. It was found during the SCI crash scene investigation on the field side of the guardrail adjacent to post 9 and located 5.2 m (17.1 ft) east of the guardrail. The height of the undamaged guardrail was 70 cm (27.5 in). The In-Service End Terminal Evaluation Data Collection Form is attached to the end of this report as **Appendix A**.

Figure 8. Kinks in guardrail, view north.

1999 CHEVROLET BLAZER

Description

The Chevrolet was a rear-wheel-drive, 5-occupant, 4-door SUV with the Vehicle Identification Number 1GNCS13W0XKxxxxxx manufactured in June 1999. The vehicle was powered by a 4.3-liter, V-6 engine gasoline engine linked to a 4-speed automatic transmission. Its wheelbase was 272 cm (107.1 in). The Chevrolet was equipped with redesigned frontal air bags and an EDR that was supported by the Bosch Crash Data Retrieval (CDR) tool.

The vehicle manufacturer's recommended tire size was P205/75R15. The vehicle was equipped with General Altimax RT43 tires size P235/70R15. The manufacturer's recommended cold tire pressure for the front and rear tires was 241 kPa (35 psi). The left rear tire was in poor condition with the wear bars showing. The remaining tires were in fair condition prior to the crash.

The front row was equipped with driver and passenger cloth-covered bucket seats with integral head restraints. The second row was equipped with a cloth-covered split bench seat with folding backs and adjustable head restraints in the outboard seating positions. The driver's seat track was adjusted between the middle and rear-most positions and the seat back was reclined 30 degrees aft of vertical. The remaining seating positions were not occupied at the time of the crash.

Exterior Damage

Exterior Damage Event 1

The Chevrolet sustained damage to the front plane (**Figure 9**) during the impact with the end terminal. The bumper, right headlamp/turn signal assembly, grille, and hood were directly damaged and the imprint of the end terminal was stamped in the bumper and hood. The direct damage began 14 cm (5.5 in) left of the right bumper corner and extended 35 cm (13.7 in) to the

left across the bumper. The Field L was 137 cm (53.9 in). Crush measurements were taken at the bumper level and the maximum residual crush was 42 cm (16.5 in) occurring 49 cm (19.2 in) left of the right bumper corner. The crush values were C_1 = 0 cm, C_2 = 0 cm, C_3 = 13 cm (5.1 in), C_4 = 42 cm (16.5 in), C_5 = 35 cm (13.8 in), and C_6 = 23 cm (9.1 in). The Collision Deformation Classification (CDC) was 12FRES2 (0 degree). The severity of the damage was moderate.

Figure 9. Front view of damage to the Chevrolet's front bumper.

Exterior Damage Event 2

The front plane sustained a second impact with the guardrail as the guardrail was deforming. The direct damage began 38 cm (15.0 in) right of the left bumper corner and was extended 38 cm (15.0 in) in length. The direct damage also extended 283 cm (111.4 in) down the left plane and involved the left fender and both left side doors. Crush measurements were taken at the bumper level and the maximum residual crash was 31 cm (12.2 in) occurring 75 cm (29.5 in) left of the vehicle's centerline. The crush values were C_1 = 31 cm (12.2 in), C_2 = 25 cm (9.8 in), C_3 = 13 cm (5.1 in), C_4 = 0 cm, C_5 = 0 cm, and C_6 = 0 cm. The CDC was 12FLEE9. The severity of the damage was moderate.

Exterior Damage Event 3

Damage from the rollover involved the right and top planes (**Figure 10**). The direct damage on the right plane extended from the right front door to the back of the quarter panel. The direct damage on the top plane extended from the hood onto the windshield and roof. The maximum vertical and lateral crush occurred at the windshield header and top of the left A-pillar, respectively. The vertical crush was 21 cm (8.3 in) and the lateral displacement was 8 cm (3.1 in). The CDC was 00TYDO3. The extent of the damage was moderate.

Figure 10. Rollover damage to the right and top planes.

Event Data Recorder

The Chevrolet's EDR was imaged with version 17.3 of the Bosch Crash Data Retrieval software and reported with version 19.3.1. The vehicle was powered with an auxiliary 12-volt power source through the fuse block and the data was imaged via connection to the diagnostic link connector. The EDR reported a deployment event and a non-deployment event. Both events were recorded on the same ignition cycle indicating that the non-deployment event was related to this crash. The ignition cycles at the time of the crash and when the data was imaged were 12,119 and 12,120, respectively. The EDR report is attached at the end of this report as **Appendix B**.

Deployment Event
This event was recorded when the front plane struck the ET-Plus. The driver's seat belt switch circuit status was reported as "Buckled" and the supplemental inflatable restraint warning lamp status was reported as "On." The time from algorithm enable (AE) to deployment command was reported as 1.25 msec. The maximum longitudinal velocity change was reported as -33.2 km/h (-20.61 mph) occurring 300 msec following AE.

Non-Deployment Event
The time between the non-deployment event and the deployment event was reported as "N/A." The EDR data limitations stated that "N/A" will be recorded if the time between the two events is greater than 5 seconds, which suggested that the non-deployment event may have been recorded when vehicle removal personnel were righting the vehicle for removal from the crash scene.

Interior Damage
The interior of the Chevrolet sustained moderate damage from intrusion of the roof and windshield header. The most severe intrusion of these components occurred in the driver's seating position where the windshield header and roof intruded vertically 49 cm (19.3 in). Several scuff marks were present on the lower instrument panel under the steering column related to occupant knee contact. All doors were jammed shut. The windshield was cracked from impact forces and had partially collapsed due to weathering. The right front glazing was disintegrated. The remaining glazing was undamaged.

Manual Restraint Systems
The front and second row seating positions were equipped with manual 3-point lap and shoulder seat belts with sliding latch plates and fixed upper D-rings. The driver's seat belt webbing and D-ring showed no discernable evidence of usage. The EDR data reported that the driver's seat belt switch circuit status was "Buckled."

Supplemental Restraint Systems
The Chevrolet was equipped with redesigned frontal air bags. Both air bags deployed during the impact with the end terminal.

The driver's frontal air bag was located in the steering wheel hub. The deflated air bag measured at 60 cm (23.6 in) in diameter and there was no damage and no discernable evidence of occupant contact. The module cover was a two-flap configuration constructed of pliable vinyl with a vertical tear seam in the middle and horizontal tear seams at the top and bottom. Each flap measured 11 cm (4.3 in) in height and 7 cm (2.8 in) in width.

The passenger frontal air bag was located at the middle instrument panel level. The deflated air bag measured at 35 cm (13.7 in) in height and 54 cm (21.2 in) in length and there was no damage and no discernable evidence of occupant contact. The module cover was a one-flap configuration with tear seams at the front and both sides. The flaps were 13 cm (5.1 in) in height and 33 cm (12.9 in) in width. The cover flap opened at the designated tear seams and was undamaged.

1999 CHEVROLET BLAZER OCCUPANT

Driver Demographic

Age/sex:	16 years/female
Height:	170 cm (67 in)
Weight:	59 kg (130 lb)
Eyewear:	Unknown
Seat type:	Bucket
Seat track position:	Between middle and rear-most
Manual restraint usage:	Lap and shoulder seat belt
Usage source:	EDR
Air bags:	Driver's frontal, deployed
Alcohol/drug data:	None
Egress from vehicle:	Unknown
Transport from scene:	Ambulance
Medical treatment:	Hospitalized 1 day

Driver Injuries

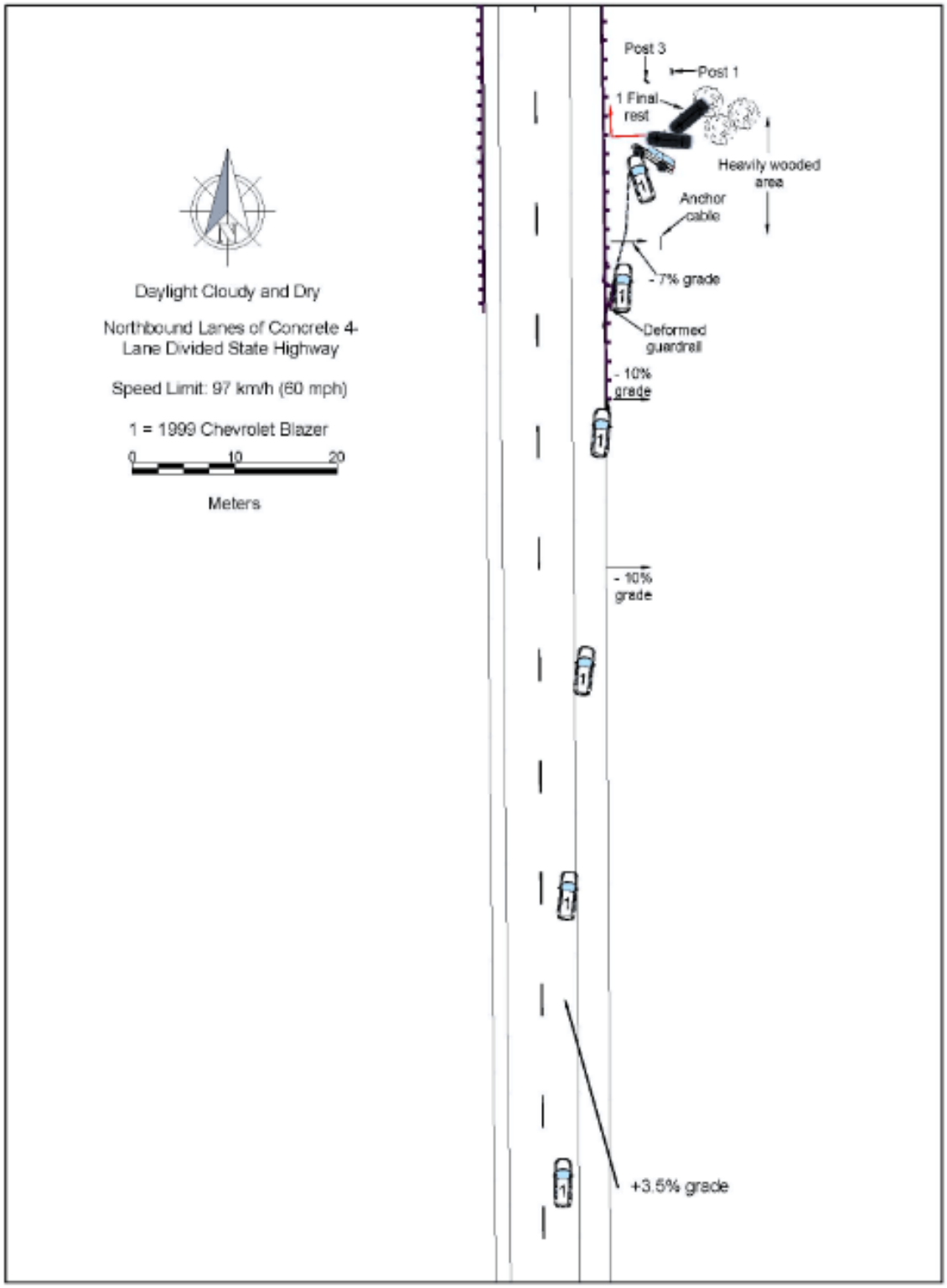
Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Abrasion to left abdomen	510202.1	Lap belt	Probable
2	Abrasion to right thumb	710202.1	Center instrument panel	Possible
3	Abrasion to right knee	810202.1	Left lower instrument panel	Certain
4	Abrasion to left knee	810202.1	Left lower instrument panel	Certain

Source: emergency room records.

Driver Kinematics

The driver was restrained by the manual lap and shoulder seat belt system. Belt usage was determined from the lack of occupant contact in the Chevrolet, the prevention of occupant ejection, the minor severity injuries sustained by the driver and the "buckled" status of the EDR output. Her seat track was adjusted to between the middle and rear-most positions and the seat back was reclined 30 degrees aft of vertical. The driver was displaced forward during the impact with the end terminal. Her pelvic and thoracic regions loaded the seat belt, and her face and chest probably contacted the deployed frontal air bag. The driver's knees contacted and scuffed the lower instrument panel below the steering column causing knee abrasions. She rebounded and was redirected toward the roof as the vehicle rolled over. The driver sustained an abdominal abrasion from seat belt loading and a right thumb abrasion from possible contact to the center instrument panel. She was transported by ambulance to a hospital where she was hospitalized for one night.

CRASH DIAGRAM



APPENDIX A: FHWA In-Service End Treatment Evaluation Data Collection Form

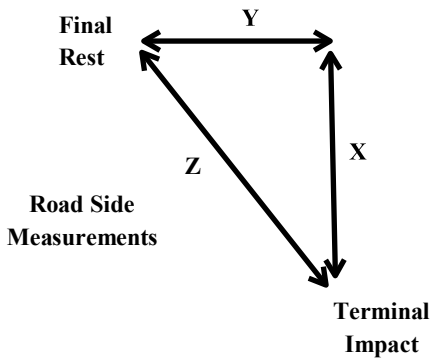
Case No.: IN17021

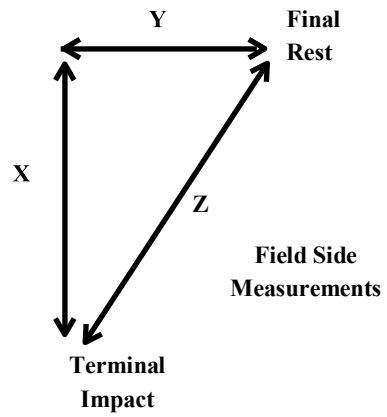
PREPOPULATED DATA (BY OTHERS)			
Date of Crash	May 2017	**TIME OF CRASH (MILITARY)**	Evening
Case Number	IN17021	**State**	Missouri
Traffic Route	State Highway	**Direction (Southbound = SB)**	NB
Ambient Conditions (at time of crash)			
Temperature (°F)	83	**Lighting**	Daylight
Atmospheric	Cloudy		

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 = 95.7 ft
Est. distance (longitudinal) along guardrail from terminal impact to COM final resting location (ft.)	X = 91.5 ft
Est. distance (normal) from either 1. the white paint line; or 2. roadway/shoulder/pavement edge to COM rest position (ft.)	Y = 38.4 ft
Super elevation	❒+2% ❒-2% ☒ NONE or FLAT
Curve Radius (ft.)	N/A

KEY:

- COM - Center of Mass of Vehicle
- Distance Measurements





Case No.: IN17021

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	☐ AASHTO Type A	☐ AASHTO Type B	☐ AASHTO Type C	☐ AASHTO Type D	☐ AASHTO Type E		
	☐ Yes	☐ 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	Wood	8 x 5.5	N/A	N/A	Unk		11.5	N/A	6’ 9”
2	Wood	8 x 5.5	N/A	N/A	Unk		11.4	N/A	6’ 4”

Case No.: IN17021

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.					
	Steel Wood Other	D x W (in.) or Dia. (in.)	Steel Wood Composite	D x W (in.)	Yes No Unknown	Describe	Travel Way	Curb	
3	Wood	8 x 6	Wood	7.75 x 6	Unk		12.0	N/A	6’ 5”
4	Wood	8 x 6	Wood	Unk	Unk		12.0	N/A	6’ 5”
5	Wood	8 x 6	Wood	7.75 x 6	Unk		11.9	N/A	6’ 6 “
6	Wood	8 x 6	Wood	7.75 x 6	Unk		11.8	N/A	6’ 2”
7	Wood	8 x 6	Wood	7.75 x 6	Unk		11.7	N/A	6’ 2”
8	Steel	6 x 4	Wood	7 x 5.5	No		11.8	N/A	6’ 2”

Case No.: IN17021

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.					
	Steel Wood Other	D x W (in.) or Dia. (in.)	Steel Wood Composite	D x W (in.)	Yes No Unknown	Describe	Travel Way	Curb	
9	Steel	6 x 4	Wood	7 x 5.5	No		11.8	N/A	6’ 6”
10	Steel	6 x 4	Wood	7 x 5.5	No		11.8	N/A	6’4”
11	Steel	6 x 4	Wood	7.5 x 5.5	No		11.8	N/A	6’ 1”
12	Steel	6 x 4	Wood	7.5 x 5.75	No		11.8	N/A	6’ 1”

Additional Comments:

Case No.: IN17021

EXTRUDER			
Feeder Channel Width at impact head	❒4inches ☒5 inches ❒Other _____		
Guide Chute Exit Height (in.)	15.5 ft		
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.)	17.1 ft
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.]	50 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: 7
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 - %	-37%	-34%	-30%
Adjacent Lane Width (ft)	11.2 ft		

Lane Type (NAS EDS Variable: Sur. Type)	Concrete
Shoulder Type	Concrete
Shoulder Width (ft)	10.5 ft
Guardrail Height (in)	27.5 in

VEHICLE INFORMATION		
Vehicle Type (NHTSA Input)	Sport utility vehicle	
Vehicle Identification Number (VIN)	1GNCS13W0XKxxxxxx	
Vehicle Mass (NASS var.: veh.wgt)	3,812 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	12FREW2	
delta-V	-20.62 mph longitudinal (EDR)	
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	

APPENDIX B: 1999 Chevrolet Blazer Event Data Recorder Report[2]

[2] The EDR report contained in this technical report was imaged using the current version of the Bosch CDR software at the time of the vehicle inspection. The CDR report contained in the associated Crash Viewer application may differ relative to this report.

IMPORTANT NOTICE: Robert Bosch LLC and the manufacturers whose vehicles are accessible using the CDR System urge end users to use the latest production release of the Crash Data Retrieval system software when viewing, printing or exporting any retrieved data from within the CDR program. Using the latest version of the CDR software is the best way to ensure that retrieved data has been translated using the most current information provided by the manufacturers of the vehicles supported by this product.

CDR File Information

User Entered VIN User	1GNCS13W0XK******
Case Number EDR Data Imaging Date	05/25/2017
Crash Date Filename	IN17021_V1_ACM.CDRX
Saved on Imaged with CDR version	Thursday, May 25 2017 at 10:24:37 Crash Data Retrieval Tool 17.3
Imaged with Software Licensed to (Company Name)	NHTSA
Reported with CDR version Reported with Software Licensed to (Company Name) EDR Device Type	Crash Data Retrieval Tool 19.3.1 NHTSA Airbag Control Module
Event(s) recovered	Deployment Non-Deployment

Comments

No comments entered.

Data Limitations

Recorded Crash Events:

There are two types of Recorded Crash Events. The first is the Non-Deployment Event. A Non-Deployment Event records data but does not deploy the air bag(s). The SDM can store up to one Non-Deployment Event. This event can be overwritten by an event that has a greater SDM recorded longitudinal velocity change. This event will be cleared by the SDM, after approximately 250 ignition cycles. This event can be overwritten by a second Deployment Event, referred to as a Deployment Level Event, if the Non-Deployment Event is not locked. The data in the Non-Deployment Event file will be locked, if the Non-Deployment Event occurred within five seconds before a Deployment Event. A locked Non Deployment Event cannot be overwritten or cleared by the SDM.
The second type of SDM recorded crash event is the Deployment Event. The SDM can store up to two different Deployment Events, if they occur within five seconds of one another. If a Deployment Level Event occurs within five seconds after the Deployment Event, the Deployment Level Event will overwrite any non-locked Non-Deployment Event. Deployment Events cannot be overwritten or cleared by the SDM. Once the SDM has deployed an air bag, the SDM must be replaced.

Data:

-SDM Recorded Vehicle Longitudinal Velocity Change reflects the change in longitudinal velocity that the sensing system experienced during the recorded portion of the event. SDM Recorded Vehicle Longitudinal Velocity Changeis the change in velocity during the recording time and is not the speed the vehicle was traveling before the event, and is also not the Barrier Equivalent Velocity. The SDM records the first 300 milliseconds of Vehicle Longitudinal Velocity Change after Algorithm Enable. The maximum value that can be recorded for Vehicle Longitudinal Velocity Change is 56 MPH. Velocity Change data is displayed in SAE sign convention.
-Driver's Belt Switch Circuit Status indicates the status of the driver's seat belt switch circuit.
-The Time between Non-Deployment and Deployment Events is displayed in seconds. If the time between the two events is greater than five seconds, "N/A" is displayed in place of the time.
-If power to the SDM is lost during a crash event, all or part of the crash record may not be recorded. An indication of a loss of power would be if the ignition cycles at the event is recorded as zero. Data recorded after that may not be reliable, such as Time Between Non-Deployment and Deployment Events, Driver Belt Switch Circuit Status,and Passenger SIR Suppression Switch Circuit Status.
-All data should be examined in conjunction with other available physical evidence from the vehicle and scene.

Data Source:

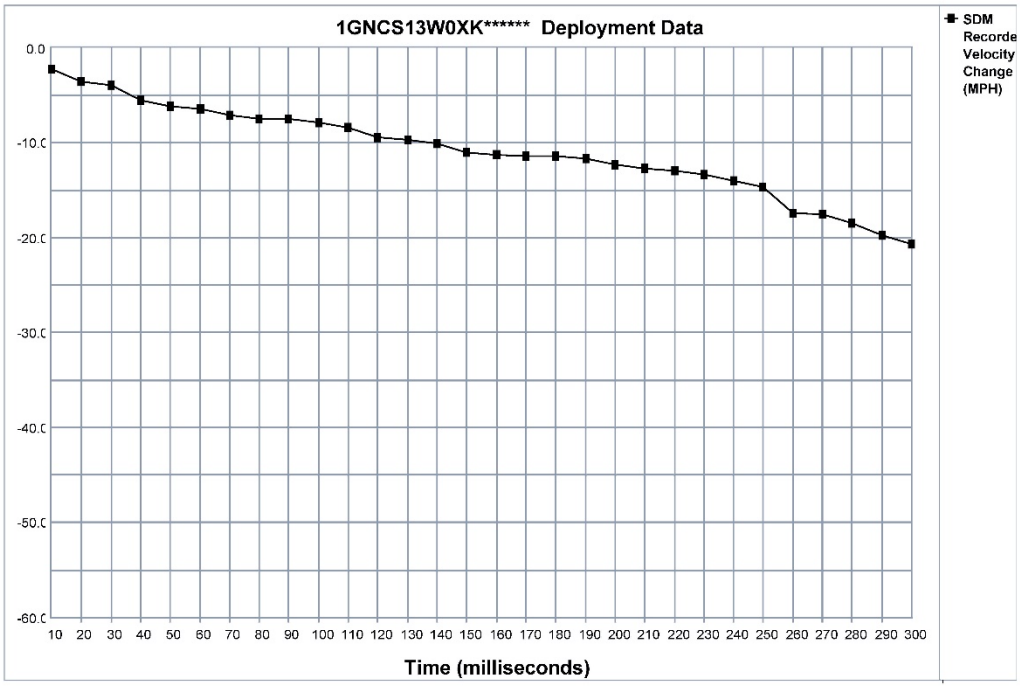
All SDM recorded data is measured, calculated, and stored internally, except for the following:
-The Driver's Belt Switch Circuit is wired directly to the SDM.
-The Passenger Front Air Bag Suppression Switch Circuit is wired directly to the SDM.

Hexadecimal Data:
Data that the vehicle manufacturer has specified for data retrieval is shown in the hexadecimal data section of the CDR report. The hexadecimal data section of the CDR report may contain data that is not translated by the CDR program. The control module contains additional data that is not retrievable by the CDR tool.

01033_SDMRSXX_r003

System Status At Deployment

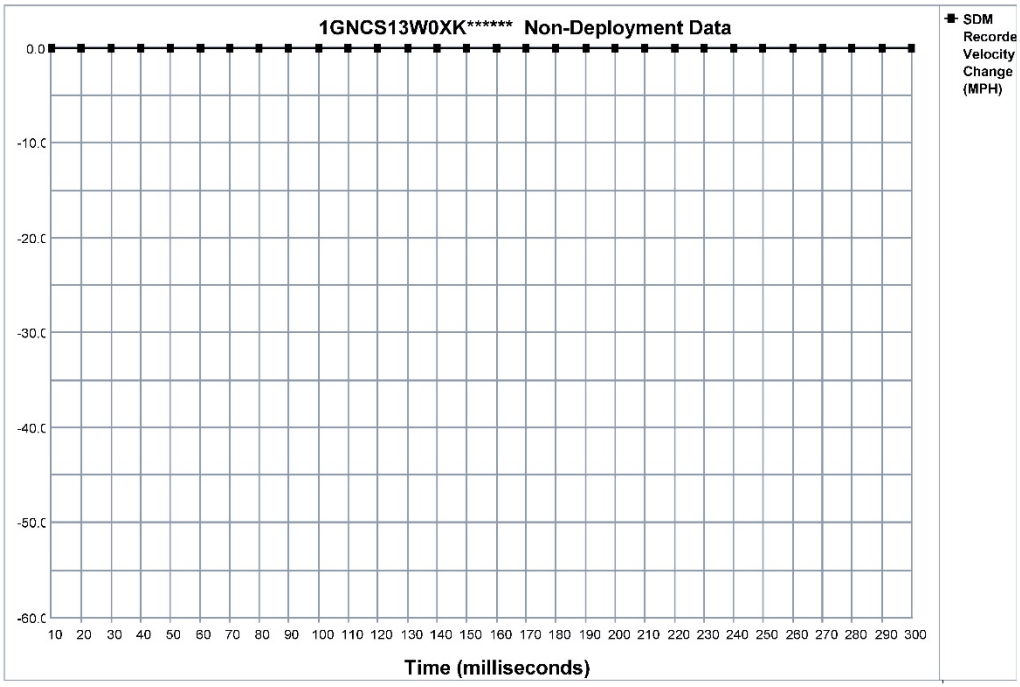
SIR Warning Lamp Status	ON
Driver's Belt Switch Circuit Status	BUCKLED
Passenger SIR Suppression Switch Circuit Status (if equipped)	Air Bag Not Suppressed
Ignition Cycles At Deployment	12119
Ignition Cycles At Investigation	12120
Time From Algorithm Enable To Deployment Command (msec)	1.25
Time Between Non-Deployment And Deployment Events (sec)	N/A



Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Recorded Velocity Change (MPH)	-2.19	-3.51	-3.95	-5.49	-6.14	-6.36	-7.02	-7.46	-7.46	-7.90	-8.34	-9.43	-9.65	-10.09	-10.97
Time (milliseconds)	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
Recorded Velocity Change (MPH)	-11.19	-11.41	-11.41	-11.63	-12.29	-12.73	-12.94	-13.38	-14.04	-14.70	-17.33	-17.55	-18.43	-19.75	-20.62

System Status At Non-Deployment

SIR Warning Lamp Status	ON
Driver's Belt Switch Circuit Status	BUCKLED
Passenger SIR Suppression Switch Circuit Status (if equipped)	Air Bag Not Suppressed
Ignition Cycles At Non-Deployment	12119
Ignition Cycles At Investigation	12120
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	8.75
Maximum SDM Recorded Velocity Change (MPH)	0.00
A Deployment was Commanded Prior to this Event	Yes



Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Time (milliseconds)	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Hexadecimal Data

```
B600:  00 40 48 00 00 AA 00 00
B608:  00 00 00 00 00 AA 00 00
B610:  00 00 00 00 00 30 78 F9
B618:  F9 F9 F9 F9 F9 F9 FF 00
B620:  AA AA AA 00 AA 48 6A FD
B628:  00 00 48 01 0A 10 12 19
B630:  1C 1D 20 22 22 24 26 2B
B638:  2C 2E 32 33 34 34 35 38
B640:  3A 3B 3D 40 43 4F 50 54
B648:  5A 5E 2F 57 07 00 00 FF
B650:  00 55 AA AA AA 55 03 AA
B658:  48 6B FD 00 40 48 07 00
B660:  00 00 00 00 00 00 00 00
B668:  00 00 00 00 00 00 00 00
B670:  00 00 00 00 00 00 00 00
B678:  00 00 00 00 00 00 2F 57
B680:  00 00 00 55 AA AA AA AA
B688:  03 00 00 00 00 00 43 C1
B690:  FD 00 44 35 FD 00 44 C1
B698:  FD 00 45 33 FD 00 46 87
B6A0:  FD 00 46 88 FD 00 48 8B
B6A8:  FD 00 00 00 00 00 00 00
B6B0:  00 00 00 00 00 00 00 00
B6B8:  00 00 00 00 00 9E 60 C4
B6C0:  3B 19 0E 00 00 64 02 00
B6C8:  00 AA 00 00 00 00 01 01
B6D0:  BE C9 B7 B5 A7 CA BE AC
B6D8:  7B BA B4 E6 EB E0 00 00
B6E0:  00 00 00 60 AA 00 02 54
B6E8:  01 AA 00 00 00 00 00 00
B6F0:  FF 06 F0 05 50 04 0C 00
B6F8:  58 FF FF FF FF FF FF FF
B700:  FF FF FF FF FF FF FF FF
B708:  FF FF FF FF FF FF FF FF
B710:  FF FF FF FF FF FF FF FF
B718:  FF FF FF FF FF FF FF FF
B720:  FF FF FF FF FF FF FF FF
B728:  FF FF FF FF FF FF FF FF
B730:  FF FF FF FF FF FF FF FF
B738:  FF FF FF FF FF FF FF FF
B740:  FF FF FF FF FF FF FF FF
B748:  FF FF FF FF FF FF FF FF
B750:  FF FF FF FF FF FF FF FF
B758:  FF FF FF FF FF FF FF FF
B760:  FF 00 01 02 1C 14 10 02
B768:  0E AA 01 50 51 21 21 21
B770:  29 2E 2E 2E 2E 2E 3E 41
B778:  41 41 41 41 42 46 46 46
B780:  46 46 46 46 46 46 46 46
B788:  46 46 46 46 46 46 46 46
B790:  46 46 46 46 46 46 46 46
B798:  46 46 46 46 46 46 46 46
B7A0:  46 46 46 46 46 46 46 46
B7A8:  46 46 46 46 46 46 46 46
B7B0:  46 46 46 46 46 46 46 46
B7B8:  46 46 46 46 46 00 00 00
B7C0:  00 00 D8 00 00 00 00 00
B7C8:  00 00 00 00 00 00 00 00
B7D0:  00 00 00 00 00 00 00 00
B7D8:  00 00 00 00 00 00 00 00
B7E0:  00 00 00 00 00 00 00 00
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B7E8:  00 00 00 00 00 00 00 00
B7F0:  00 00 00 00 00 00 00 00
B7F8:  00 00 A5 A5 A5 A5 75 FD
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Disclaimer of Liability

The users of the CDR product and reviewers of the CDR reports and exported data shall ensure that data and information supplied is applicable to the vehicle, vehicle's system(s) and the vehicle ECU. Robert Bosch LLC and all its directors, officers, employees and members shall not be liable for damages arising out of or related to incorrect, incomplete or misinterpreted software and/or data. Robert Bosch LLC expressly excludes all liability for incidental, consequential, special or punitive damages arising from or related to the CDR data, CDR software or use thereof.

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U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

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