



U.S. Department  
of Transportation

**National Highway  
Traffic Safety  
Administration**



---

DOT HS 812 912

November 2020

**Special Crash Investigations:  
On-Site Guardrail End Terminal  
Crash Investigation;  
Vehicle: 2002 Ford F-150;  
Location: Missouri;  
Crash Date: December 2017**

## DISCLAIMER

This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturers' names are mentioned, it is only because they are considered essential to the object of the publication and should not be construed as an endorsement. The United States Government does not endorse products or manufacturers.

Suggested APA Format Citation:

Indiana University Transportation Research Center. (2020, November). *Special Crash Investigations: On-Site Guardrail End Terminal Crash Investigation; Vehicle: 2002 Ford F-150; Location: Missouri; Crash Date: December 2017* (Report No. DOT 812 912). National Highway Traffic Safety Administration.

## Technical Report Documentation Page

<b>1. Report No.</b> DOT HS 812 912	<b>2. Government Accession No.</b>	<b>3. Recipient's Catalog No.</b>	
<b>4. Title and Subtitle</b> Special Crash Investigations: On-Site Guardrail End Terminal Crash Investigation; Vehicle: 2002 Ford F-150; Location: Missouri; Crash Date: December 2017		<b>5. Report Date:</b> November 2020	
		<b>6. Performing Organization Code</b>	
<b>7. Author</b> Indiana University Transportation Research Center		<b>8. Performing Organization Report No.</b> IN17037	
<b>9. Performing Organization Name and Address</b> Indiana University Transportation Research Center 501 South Madison Street, Suite 105 Bloomington, Indiana 47403		<b>10. Work Unit No. (TRAIS)</b>	
		<b>11. Contract or Grant No.</b> DTNH22-12-C-00270	
<b>12. Sponsoring Agency Name and Address</b> National Highway Traffic Safety Administration National Center for Statistics and Analysis (NSA-110) 1200 New Jersey Avenue SE Washington, DC 20590		<b>13. Type of Report and Period Covered</b> Technical Report Crash Date: December 2017	
		<b>14. Sponsoring Agency Code</b>	
<b>15. Supplementary Notes</b> 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.			
<b>16. Abstract</b> This report documents the on-site investigation of a Ford F-150's impact to a Soft Stop guardrail end treatment that is of interest to the Federal Highway Administration (FHWA). This crash occurred on the west roadside of a one-way, two-lane, undivided entrance ramp to an interstate highway. The Ford was a 4-wheel drive, Supercrew pickup truck equipped with redesigned frontal air bags, and an event data recorder (EDR). An unbelted 56-year-old male drove the vehicle. The Ford was traveling north and departed the left (west) side of the roadway where the front plane sideswiped a delineator post (Event 1). The vehicle continued north and the front plane struck the end terminal of a blocked-out W-beam guardrail. The impact damaged 14.2 m (46.7 ft) of guardrail and seven posts. The vehicle came to final rest heading west, with the front wheels on the shoulder and the rear wheels on the left lane of the ramp. The driver sustained police reported "B" (non-incapacitating) injuries and was transported by ambulance to a hospital, where he was treated in the emergency room and released. The Ford was towed from the crash site due to damage.			
<b>17. Key Words</b> Soft Stop guardrail end terminal, end terminal, motor vehicle traffic crash, police-reported "B" (non-incapacitating) injury		<b>18. Distribution Statement</b> Document is available to the public from the National Technical Information Service, www.ntis.gov.	
<b>19. Security Classif. (of this report)</b> Unclassified	<b>20. Security Classif. (of this page)</b> Unclassified	<b>21. No. of Pages</b> 28	<b>22. Price</b>

## Table of Contents

<b>BACKGROUND</b> .....	<b>1</b>
<b>SUMMARY</b> .....	<b>2</b>
Crash Site .....	2
Pre-Crash .....	2
Crash .....	2
Post-Crash .....	2
<b>END TERMINAL AND GUARDRAIL DAMAGE</b> .....	<b>3</b>
<b>2002 FORD F-150</b> .....	<b>3</b>
Description .....	3
Exterior Damage .....	4
Exterior Damage Event 1 .....	4
Damage Classification Event 1 .....	4
Exterior Damage Event 2 .....	4
Damage Classification Event 2 .....	5
Event Data Recorder .....	5
Interior Damage .....	5
Manual Restraint Systems .....	5
Supplemental Restraint Systems .....	5
<b>2002 FORD F-150 OCCUPANT</b> .....	<b>6</b>
Driver Demographics .....	6
Driver Injuries .....	6
Driver Kinematics .....	6
<b>CRASH DIAGRAM</b> .....	<b>8</b>
<b>APPENDIX A: FHWA Guardrail Form</b> .....	<b>A-1</b>
<b>APPENDIX B: 2002 Ford F150 Event Data Recorder (EDR) Report</b> .....	<b>B-1</b>

**Special Crash Investigations**  
**On-Site Guardrail End Treatment Investigation**  
**Case Number: IN17037**  
**Vehicle: 2002 Ford F-150**  
**Location: Missouri**  
**Crash Date: December 2017**

**BACKGROUND**

This report documents the on-site investigation of a Ford F-150's impact to a Soft Stop 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, 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 crash investigation was then initiated by the National Highway Traffic Safety Administration in December 2017 and assigned to the Special Crash Investigation team at the Indiana University Transportation Research Center. This single-vehicle crash involved a 2002 Ford F-150 Supercrew pickup truck (**Figure 2**). The crash occurred in Missouri in December 2017 during the early evening and was investigated by a local police agency. The guardrail and crash scene were inspected in December 2017. An in-person interview was conducted with the driver in December 2017.

This crash occurred on the west roadside of a one-way, two-lane, undivided entrance ramp to an interstate highway. The Ford was a 4-wheel-drive, Supercrew pickup truck equipped with redesigned frontal air bags, and an event data recorder (EDR). An unbelted 56-year-old male drove the vehicle. The Ford was traveling north and departed the left (west) side of the roadway, where the front plane sideswiped a delineator post (Event 1). The vehicle continued north and the front plane struck the end terminal of a blocked-out W-beam guardrail. The impact damaged 14.2 m (46.7 ft) of guardrail and seven posts. The vehicle came to final rest heading west, with the front wheels on the shoulder and the rear wheels on the left lane of the ramp. The driver sustained police reported "B" (non-incapacitating) injuries and was transported by ambulance to a hospital, where he was treated in the emergency room and released. The Ford was towed from the crash site due to damage.



**Figure 1.** The damaged guardrail, view north.



**Figure 2.** The damaged 2002 Ford F-150.

## SUMMARY

### *Crash Site*

This crash occurred during night hours on the west roadside of a lighted entrance ramp to an interstate highway. The weather conditions were light rain with west winds at 5 km/h (3 mph), a temperature of 1.7 °C (35 °F), and a dew point of -7.8 °C (18 °F) according to the local weather reports. The ramp was curved to the right and had two concrete northbound lanes. The grade in the area of the Ford's approach to the crash scene was 3 percent and the superelevation was 3 percent. Each lane was 3.7 m (12.1 ft) wide and each lane was bordered by a 2.0 m (6.6 ft) wide bituminous shoulder. A blocked-out, W-beam guardrail equipped with a Soft Stop end terminal was located on the west side of the ramp. The roadway pavement markings consisted of a solid white right edge line, broken white lane lines, and a solid yellow left edge line. There was no posted speed limit and none indicated on police crash report. The crash diagram is included at the end of this report.

### *Pre-Crash*

The Ford was traveling north in the left lane of the ramp (**Figure 3**) at a driver-reported speed of 97 km/h (60 mph) and the driver intended to negotiate the right curve and merge onto the northbound interstate. According to the driver, another vehicle in the right lane encroached into his lane and he steered left to a crash. The Ford then departed the west roadside.



**Figure 3.** Northwest view of the Ford's approach to guardrail head impact.

### *Crash*

The left front corner of the Ford sideswiped a delineator post (Event 1). The force direction on the Ford was in the 12 o'clock sector. The WinSMASH program could not be used to calculate delta V since a yielding object impact is out of scope for the program. The vehicle continued north and the front plane struck the end terminal (Event 2). The force direction on the Ford was in the 12 o'clock sector and the impact resulted in deployments of both frontal air bags. This also was an impact with a yielding object so WinSMASH was used to calculate a barrier equivalent speed (BES) of 14 km/h (9 mph) based on the crush to the front bumper. The Ford's EDR reported the maximum longitudinal cumulative delta V as -5.4 km/h (-3.3 mph) at 53 msec after algorithm enable (AE). The maximum longitudinal acceleration was reported as -25.7 g, at 30 msec after AE. The impact speed of the vehicle is unknown. No pre-crash data was recorded by the EDR. The vehicle remained engaged with the end terminal and continued in a northerly direction, damaging 14.2 m (46.7 ft) of guardrail and seven posts. The vehicle rotated counterclockwise approximately 90 degrees and came to final rest heading west, approximately 11 m (36.2 ft) northwest of the initial impact with the end terminal.

### *Post-Crash*

The driver exited the vehicle without assistance through the left front door. The police were notified and responded to the crash as well as rescue and medical personnel. The driver sustained police-reported "B" (non-incapacitating) injuries and was transported by ambulance to a hospital

where he was treated in the emergency room and released. The vehicle was towed from the crash scene due to damage.

### **END TERMINAL AND GUARDRAIL DAMAGE**

The front plane of the Ford struck the end terminal (**Figure 4**), which was mounted on top of an angular guide chute. The end of one 3.8 m (12.5 ft) long section of guardrail was routed through the guide chute and attached by a bolt to the ground anchor (Post 0, **Figure 5**). During a terminal impact, these guardrail sections are designed to enter the upstream end of the terminal and pass through the chute, which is angled downward and rearward. The rail is extruded underneath the vehicle, dissipating crash energy. During this crash, 10.5 m (34.5 ft) of guardrail was extruded through the chute onto the ground extending from the ground anchor to the end terminal. A total of 14.2 m (46.7 ft) of guardrail was damaged.

The end terminal was 18 cm (7.1 in) wide and 51 cm (20.1 in) high and sustained minor damage. Posts 1 and 2 collapsed downstream to the ground and detached from the damaged guardrail. Posts 3, 4, 5, and 6 were all bent downstream and were detached from the damaged guardrail. Post 7 was detached from the guardrail and slightly displaced in the ground. Posts 8 to 12 were not damaged and remained attached to the guardrail. Composite offset blocks were installed on all posts, except post 1. The offset blocks on posts 2 to 7 became detached as a result of the crash. The offset blocks for posts 8 to 12 were still firmly attached and were undamaged. There were no kinks to any of the guardrail sections. The FHWA guardrail form is attached to the end of this report as **Appendix A**.

### **2002 FORD F-150**

#### ***Description***

The Ford was a 4-wheel-drive, 6-occupant, 4-door Supercrew pickup truck with the Vehicle Identification Number 1FTRW08L32Kxxxxxx equipped with a 5.4-liter, V-8 engine, a 4-speed automatic transmission, and 4-wheel antilock brakes with electronic brake force distribution. The vehicle was also equipped with redesigned frontal air bags, an EDR, and a tilt steering column that was adjusted between the full up and center positions. The specified wheelbase was 353 cm (139.0 in)

The vehicle manufacturer's recommended tire size was P265/70R17. The vehicle was equipped with a Yokohama Geolandar tire on the left front wheel, and Goodyear Wrangler tires on the



**Figure 4.** The damaged Soft Stop end terminal, view north.



**Figure 5.** Post zero with anchoring bolt intact.

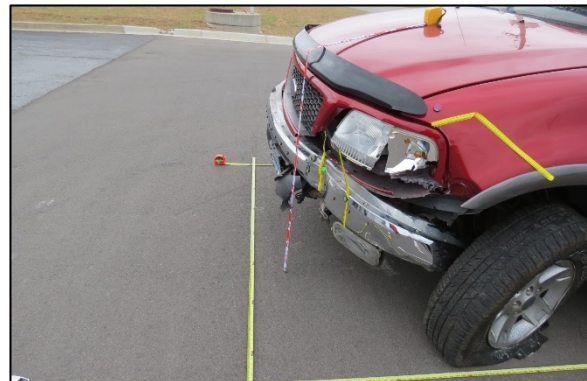
remaining wheels. All tires were the recommended size. The left front tire sustained tears to the tread and sidewall. The remaining tires were not damaged. All tires were in good condition prior to the crash.

The front row was equipped with a cloth-covered split bench seat and separate backs with adjustable head restraints at the outboard seating positions. The second row was also equipped with a cloth-covered split bench seat with folding backs and adjustable head restraints at the outboard seating positions. The driver's seat track was adjusted to the full rear position and the seat back was reclined 24 degrees aft of vertical. The top of the driver's head restraint was located 19 cm (7.4 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 Ford sustained direct damage to the left corner of the front bumper during the impact with the delineator post (**Figure 6**). The direct damage included the left head/turn signal assembly, left fender, and left front wheel well guard. Direct damage began at the left front bumper corner and the damage width was 12 cm (4.7 in). A crush profile could not be obtained since there was overlapping damage from the end terminal impact.



**Figure 6.** Front and left side damage from contact with delineator post.

#### ***Damage Classification Event 1***

The collision deformation classification (CDC) was 12FLEE2 (0 degrees). The severity of the damage was minor.

#### ***Exterior Damage Event 2***

The Ford sustained direct damage to the front plane during the impact with the end terminal. The front bumper, grille, and left headlamp/turn signal assembly were directly damaged (**Figure 7**). The direct damage width from the end terminal impact to the bumper began 37 cm (14.6 in) left of the vehicle's centerline and extended 17 cm (6.7 in) to the left on the bumper. The total width of the direct damage, which included damage above the bumper as the guardrail deformed, was 46 cm (18.1 in). The Field L was 168 cm (66.1 in). Crush measurements were taken at the bumper level and the maximum crush was 18 cm (7.1 in), occurring 85 cm (33.5 in) left of the vehicle's centerline. The crush values were  $C_1 = 18$  cm, (17.1 in),  $C_2 = 6$  cm (2.4 in),  $C_3 = 0$  cm,  $C_4 = 0$  cm,  $C_5 = 0$  cm, and  $C_6 = 0$  cm. 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



**Figure 7.** Damage from guardrail impact.

barrier algorithm of WinSMASH was used to calculate a Barrier Equivalent Speed (BES) based on the crush to the front plane. The calculated BES was 14 km/h (9 mph).

### ***Damage Classification Event 2***

The CDC was 12FLEW1 (0 degree). The severity of the damage was minor.

### ***Event Data Recorder***

The Ford's EDR was imaged with version 17.5.1 of the Bosch Crash Data Retrieval software and reported with version 19.1.1. Electrical power was supplied by the vehicle and the data was imaged via connection to the Diagnostic Link Connector. The EDR reported one deployment event.

The EDR was capable of recording longitudinal deceleration data and did not record any pre-crash data. The EDR would record data from some non-deployments which could be overwritten, but data from Deployment events were recorded and locked, and subsequent crashes could not be recorded.

*System Status at Deployment:* No diagnostic trouble codes were reported. The frontal air bags and pretensioner fire time was reported as 30.5 msec after AE. Maximum longitudinal acceleration was reported as -25.7 g at 30 msec after AE and maximum longitudinal delta V was recorded as -5.3 km/h (-3.3 mph) at 53 msec after AE. The EDR report is attached at the end of this report as **Appendix B**.

### ***Interior Damage***

The interior of the Ford did not sustain any damage from intrusion. Inspection of the vehicle's interior revealed a scuff on the left front window glazing, probably from contact by the driver's head. A scuff mark was also located on the left roof adjacent to the roof side rail, possibly from contact by the driver's head. There was a scuff on the lower left instrument panel from contact by the driver's left knee. His right knee also contacted and displaced an after-market trailer brake control located on the lower center instrument panel.

### ***Manual Restraint Systems***

The front row was equipped with three-point lap and shoulder seat belts with sliding latch plates, adjustable upper anchors, and retractor mounted pretensioners at the outboard seating positions. The middle seat was equipped with a lap belt. The second row was equipped with three-point lap and shoulder seat belts with sliding latch plates and non-adjustable upper anchors. The middle seat was equipped with a lap belt. The driver was not restrained by the lap and shoulder seat belt as evidenced by the seat belt webbing, which was retracted tightly by pretensioner actuation.

### ***Supplemental Restraint Systems***

The Ford was equipped with redesigned frontal air bags. Both air bags deployed during the crash. The driver's frontal air bag was located in the steering wheel hub and the deflated air bag was 55 cm (34.2 in) in diameter. No evidence of occupant contact was noted but there was a 6 cm (2.4 in) long melted portion of the fabric to the right of the tether stitching. This could have resulted from the fabric touching the hot inflator during deployment. The module cover was a two-flap configuration constructed of pliable vinyl, with a horizontal tear seam between the flaps.

The top flap was 20 cm (7.9 in) wide and 13 cm (5.1 in) high. The bottom flap was also 20 cm (7.9 in) wide and 8 cm (3.1 in) high. The cover flaps opened at the designated tear seams and were undamaged.

The passenger's frontal air bag was located in the mid-instrument panel and the deflated air bag was 56 cm (22 in) wide and 60 cm (23.6 in) high. The air bag was undamaged. The module cover was a one-panel configuration constructed of pliable vinyl, with tear seams on the bottom and sides. The flap was 39 cm (15.4 in) wide and 18 cm (7.1 in) high. The flap opened at the designated tear seams and was undamaged.

## 2002 FORD F-150 OCCUPANT

### *Driver Demographics*

Age/sex:	56-year-old/male
Height:	185 cm (73 in)
Weight:	122 kg (270 lb)
Eyewear:	Glasses
Seat type:	Split bench with separate backs
Seat track position:	Rear-most
Manual restraint usage:	None
Usage source:	Vehicle inspection
Air bags:	Frontal, deployed
Alcohol/drug data:	None
Egress from vehicle:	Exited without assistance
Transport from scene:	Ambulance
Medical treatment:	Treated and released

### *Driver Injuries*

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
1	Sprain of ligaments of lumbar spine, not further specified	640684.1	Isolated Interior - This occupants seat cushion	Possible
2	Strain of muscle, fascia, and tendon of lower back, not further specified	640678.1	Isolated Interior - This occupants seat cushion	Possible

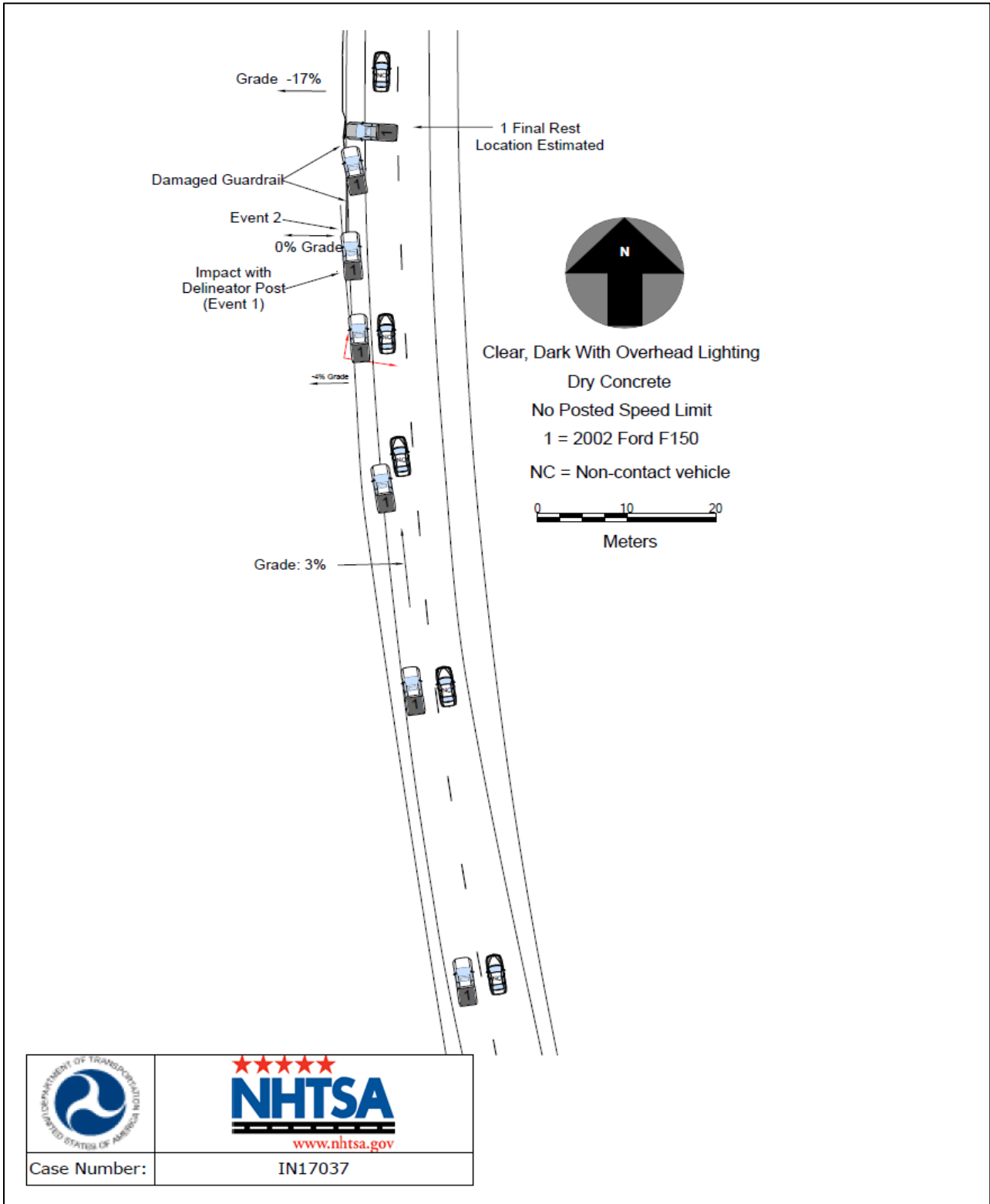
*Source: emergency room records.*

### *Driver Kinematics*

The driver was not restrained by the lap and shoulder seat belt and the seat track was adjusted to the rear-most position. The top of the head restraint was located 19 cm (7.5 in) above the top of the seat back. The front plane impact with the delineator post probably had little effect on the driver. The front plane impact to the end terminal resulted in deployment of the driver's frontal air bag. He was displaced forward, loaded the air bag, and rebounded back into his seat.

He sustained a sprain of ligaments of the lumbar spine plus strains of the muscle, fascia, and tendon of the lower back. He was transported by ambulance to a hospital where he was treated and released.

# CRASH DIAGRAM



**APPENDIX A: FHWA Guardrail Form**

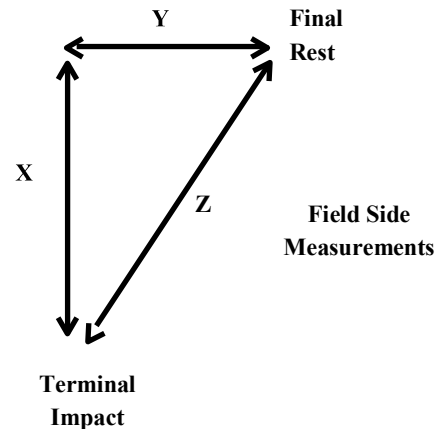
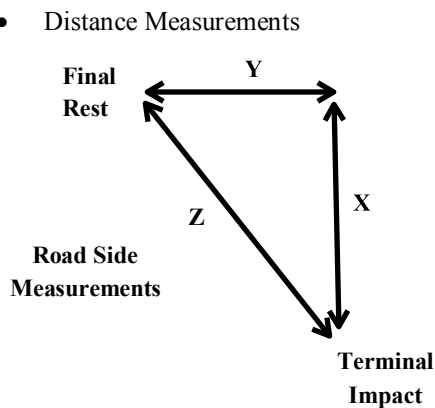
Case No.: IN17037

PREPOPULATED DATA (BY OTHERS)			
Date of Crash	December 2017	TIME OF CRASH (MILITARY)	Evening hours
Case Number	IN17037	State	MO
Traffic Route	Interstate on Ramp	Direction (Southbound = SB)	NB
Ambient Conditions (at time of crash)			
Temperature (°F)	35 °F	Lighting	Dark, with overhead lighting
Atmospheric	Light Rain		

SCENE INFORMATION	
Type of area where crash occurred	<input checked="" type="checkbox"/> Urban <input type="checkbox"/> Rural <input type="checkbox"/> Suburban
Terminal on a horizontal curve?	<input type="checkbox"/> No <input type="checkbox"/> Curve/LT <input checked="" type="checkbox"/> Curve/RT
Estimated or Reconstructed Speed at Impact (MPH)	Unknown
Est. distance (straight line) from terminal impact to COM final rest position (ft.)	Z = 31 ft
Est. distance (longitudinal) along guardrail from terminal impact to COM final resting location (ft.)	X = 31 ft
Est. distance (normal) from either 1. the white paint line; or 2. roadway/shoulder/pavement edge to COM rest position (ft.)	Y = 7 ft (to fog line)
Super elevation	<input checked="" type="checkbox"/> +2% <input type="checkbox"/> -2% <input type="checkbox"/> NONE or FLAT
Curve Radius (ft.)	1319'

**KEY:**

- COM - Center of Mass of Vehicle
- Distance Measurements



Case No.: IN17037

ON-SCENE INFORMATION	
End Treatment Type	<input checked="" type="checkbox"/> Extruder <input type="checkbox"/> ET2000 <input type="checkbox"/> ET-PLUS 4in <input type="checkbox"/> ET-PLUS 5in <input type="checkbox"/> SKT <input type="checkbox"/> FLEAT <input checked="" type="checkbox"/> SOFT STOP
	<input type="checkbox"/> Telescope <input type="checkbox"/> X-LITE <input type="checkbox"/> X-TENSION
Curb?	<input type="checkbox"/> No <input type="checkbox"/> Yes
	<input type="checkbox"/> AASHTO Type A <input type="checkbox"/> AASHTO Type B <input type="checkbox"/> AASHTO Type C <input type="checkbox"/> AASHTO Type D <input type="checkbox"/> AASHTO Type E <input type="checkbox"/> AASHTO Type F <input type="checkbox"/> AASHTO Type G <input type="checkbox"/> 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	Steel	----	N/A	N/A	Unknown		7		4' 8"	
1	Steel	6x4	N/A	N/A	Unknown		6.9		5' 8"	
2	Steel	6x4	Composite	Unk.	Unknown		7.8		6' 2"	

Case No.: IN17037

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.)					
3	Steel	6x4	Composite	Unk.	Unknown		7.7		6' 1"
4	Steel	6x4	Composite	Unk.	Unknown		7.5		6' 2"
5	Steel	6x4	Composite	Unk.	Unknown		7.5		6' 2"
6	Steel	6x4	Composite	Unk.	Unknown		7.5		6' 2"
7	Steel	6x4	Composite	Unk.	Unknown		7.5		6' 1"
8	Steel	6x4	Composite	7.5x4	Unknown		7.5		6' 3"

Case No.: IN17037

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	6x4	Composite	7.5x4	Unknown		7.5		3' 3"
10	Steel	6x4	Composite	7.5x4	Unknown		7.5		6' 3"
11	Steel	6x4	Composite	7.5x4	Unknown		7.5		6' 4"
12	Steel	6x4	Composite	7.5x4	Unknown		7.5		6' 4"

**Additional Comments:**

Case No.: IN17037

<b>EXTRUDER</b>			
Feeder Channel Width at impact head	<input type="checkbox"/> 4 inches <input type="checkbox"/> 5 inches <input checked="" type="checkbox"/> Other		
Guide Chute Exit Height (in.)			
Connection of feeder channels to head damaged?	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes	Are Welds Broken?	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes
Anchor Cable Present?	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes	Connected?	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes
Rail Extrusion?	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes	Length (ft. in.)	34' 6"
Rail Extrusion Direction	<input type="checkbox"/> Traffic Side <input type="checkbox"/> Field Side <input checked="" type="checkbox"/> Straight Down		
Total Length of Rail Damaged (ft.) [total length would include extruded rail plus damaged rail downstream from head.]	46' 8"		

<b>TELESCOPE</b>			
Rail Displacement	<input type="checkbox"/> No <input type="checkbox"/> Yes; Length:	No of Panels Displaced	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6

<b>ALL-SYSTEM PERFORMANCE</b>			
Railkinks Downstream of Head?	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes;	No. of Kinks in Rail:	0
Was there intrusion into the Occupant Compartment by foreign object (guardrail)?	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes		
Did vehicle impact other objects after impact with terminal?	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes		
Object Contacted			

<b>ALL-SYSTEM PERFORMANCE ENVIRONMENT</b>			
<b>SIDESLOPE</b>	<b>50 ft in Advance of Post 1</b>	<b>At Post 1</b>	<b>50 ft Past Post 1</b>
Percent - %	-4%	0%	-17%
Adjacent Lane Width (ft)	12'		
Lane Type (NAS EDS Variable: Sur. Type)	Concrete		
Shoulder Type	Bituminous		
Shoulder Width (ft)	6' 9"		

Case No.: IN17037

Guardrail Height (in)	29''
-----------------------	------

VEHICLE INFORMATION	
Vehicle Type (NHTSA Input)	2002 Ford F-150
Vehicle Identification Number (VIN)	1FTRW08L32Kxxxxxx
Vehicle Mass (NASS var.: veh.wgt)	
Vehicle orientation upon impact	<input checked="" type="checkbox"/> Case Type 1 <input type="checkbox"/> Case Type 2 <input type="checkbox"/> Case Type 3 <input type="checkbox"/> Case Type 4 <input type="checkbox"/> Case Type 5 <input type="checkbox"/> Case Type 6 <input type="checkbox"/> Case Type 7 <input type="checkbox"/> Case Type 8 <input type="checkbox"/> Other
If 'Other', describe	
Collision Deformation Classification	12FLEW1
Delta V	EDR = 3.3 mph max cumulative. Barrier Equivalent Speed from crush = 14 mph
Occupant Compartment Penetration of rail	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes; Describe:
Quarter Turns (NASS EDS variable: Rollover)	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9 <input type="checkbox"/> 10 <input type="checkbox"/> 11 <input type="checkbox"/> 12 <input type="checkbox"/> 13 <input type="checkbox"/> 14 <input type="checkbox"/> 15 <input type="checkbox"/> 16 <input type="checkbox"/> 17+
Object Precipitating Rollover, (NASS EDS variable: Rollobj)	N/A
Rollover Type, Terhune Scale, (NASS EDS variable: rolintyp)	N/A

## **APPENDIX B: 2002 Ford F-150 Event Data Recorder (EDR) Report<sup>1</sup>**

---

<sup>1</sup> 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	1FTRW08L32K*****
User	
Case Number	
EDR Data Imaging Date	12/14/2017
Crash Date	
Filename	201850S217037_V1_ACM.CDRX
Saved on	Thursday, December 14 2017 at 15:05:13
Imaged with CDR version	Crash Data Retrieval Tool 17.5.1
Imaged with Software Licensed to (Company Name)	NHTSA
Reported with CDR version	Crash Data Retrieval Tool 19.1.1
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
Event(s) recovered	Deployment

### Comments

No comments entered.

The retrieval of this data has been authorized by the vehicle's owner, or other legal authority such as a court order or search warrant, as indicated by the CDR tool user on Thursday, December 14 2017 at 15:05:13.

### Data Limitations

#### Important Limitations on Bosch Crash Data Retrieval (CDR) Tool Capabilities.

Disclaimer: This Restraint Control Module (RCM) records longitudinal deceleration data for the purpose of understanding the input data the Restraint Control Module used to determine whether or not to deploy restraint devices. This module does not record vehicle speed, throttle position, brake on-off, and other data, which may be recorded in some 1999 model year and later General Motors modules. The deceleration data recorded by Ford's module during a crash can subsequently be mathematically integrated into a longitudinal Delta-V. Delta-V is the change in velocity during the recording time and is NOT the speed the vehicle was traveling before the accident, and is also not the Barrier Equivalent Velocity. The Bosch CDR Tool will read and interpret both acceleration in G's and Delta-V in mph. RCM's in Ford vehicles that can be read by the Bosch CDR tool are listed in the Bosch Help Files.

#### Important

If there is any question that the restraint system did not perform as it was designed to perform, please read the system only through the diagnostic link connector. The Bosch CDR kit provides an RCM interface cable to plug directly into the restraint control module. The Bosch CDR RCM Interface Cable connects only power, ground, and memory read pins to the relevant vehicle restraint control module. The other RCM pins normally connect to inputs, such as sensors, and outputs, such as airbags, are not connected when you use the RCM Interface Cable to plug directly into the module. Since the vehicle restraint control module is constantly monitoring airbag system readiness (when powered), it will detect that the sensors and airbags are not connected. The restraint control module may record a new diagnostic trouble code into memory for each device that is not connected. These new diagnostic trouble codes may record over previously written diagnostic trouble codes present prior to the accident and spoil evidence necessary to determine if the restraint system performed in the accident as it was designed to perform. Not only could this prevent Ford from being able to determine if the system performed as it was designed to perform, but, regardless of innocent inadvertence, you could raise issues of evidence spoliation in any litigation that may arise out of the accident. If you cannot read the module via the diagnostic link connector, and if you suspect improper system performance, contact Ford Motor Company and request their assistance to read the module with a proper vehicle simulator attached.

While data stored in RCM's is accurate, accident reconstructionists must be aware of the limitations of the data recorded in Ford's control modules and should compare the recorded data with the physical evidence at the accident scene using professional accident reconstruction techniques (i.e. vehicle crush characteristics, skid marks, etc) before making any assumptions about the import and validity of the data recorded in the module with respect to the crash event being analyzed. The following describes specific limitations that must be considered when analyzing recorded data. Investigators should obtain permission of the vehicle owner or have sufficient legal authority prior to reading any data.

1. There may be no deceleration data recorded in the module.

1FTRW08L32K\*\*\*\*\*



Loss of power (cut wires, damaged battery, crushed fuse box) to the module during or immediately after the crash may prevent the crash data from being recorded. A backup power supply within the module has sufficient power to continue to analyze the deceleration data and deploy restraint devices if needed, but there is no backup power for recording.

If the deceleration input does not create a vehicle longitudinal Delta-V above 4 mph within 100 milliseconds, there may not be any data recorded.

2. In unusual circumstances, deceleration data stored in the module may be from a crash other than the one you are currently analyzing.

The module will record data from some non-deploy events. If, after the module has recorded data from a non-deploy event, and there is a subsequent event in which there is a loss of power and no new recording is made for that subsequent event, the deceleration data in the module's memory may be from the prior event. If the new, subsequent event is a deploy event and recording has occurred, the deployment times should be recorded. If there are no deployment times recorded, but airbags or other restraint devices are observed to have deployed, the recorded data that you read are most likely from a prior event.

Once an airbag or other restraint device has been commanded to deploy, the data recorded in connection with that deployment are "locked", and subsequent crashes cannot be recorded.

If a vehicle is being repaired, the RCM should be replaced after any crash in which restraint devices deploy. Early printed shop manuals refer to re-using modules by clearing the "crash data memory full" code, but this is no longer true and the latest on-line electronic shop manual directs that modules be replaced.

Crashes that involve multiple impacts will record only one of the impacts. If there is a deployment, the deployment event will be recorded and locked. If no restraint device is commanded to deploy, the recorded data are not "locked", and subsequent impacts may record over any previous recorded data. Further analysis will be required to determine which of the events was actually recorded.

3. The computed longitudinal Delta-V may understate the total Delta-V

Many real-world crashes can last longer than the memory has the capacity to record. Therefore, the actual Delta-V of the event may be higher than the Delta-V calculated and displayed by the Bosch CDR System output. Review the end of the longitudinal acceleration/deceleration pulse - if it has not settled to zero G's by the end of the recording, the vehicle longitudinal Delta-V is most likely understated. If there is a clear decaying trend line you may choose, at your own risk, to estimate the total Delta-V by extrapolating the decay trend to zero and to calculate the additional Delta-V not captured.

Under some circumstances where power is interrupted, during the recording of data, or the module re-sets during the recording of data, a partial recording may occur. This will be shown as "no data" in the data table and will not be plotted on the graph of acceleration. When some portion of the acceleration data is not recorded, the Delta-V during that time cannot be calculated. A Delta-V will be calculated for the points that are valid, but the user must be aware that the partial Delta-V calculated will further underestimate the actual event total Delta-V.

4. This module records only longitudinal acceleration/deceleration of the vehicle. You must compute lateral or resultant total acceleration based on your estimated Principal Direction of Force (PDOF).

5. Vertical acceleration/decelerations are not recorded. Vehicle spin about a point not centered on the Restraints Control Module sensor may add or subtract from bulk vehicle motion.

6. This module is not intended to record acceleration/deceleration in a side-impact event. If the side impact generates a longitudinal deceleration component sufficient to wake up the frontal deployment algorithm, there may be a recording of longitudinal deceleration in a side impact event.

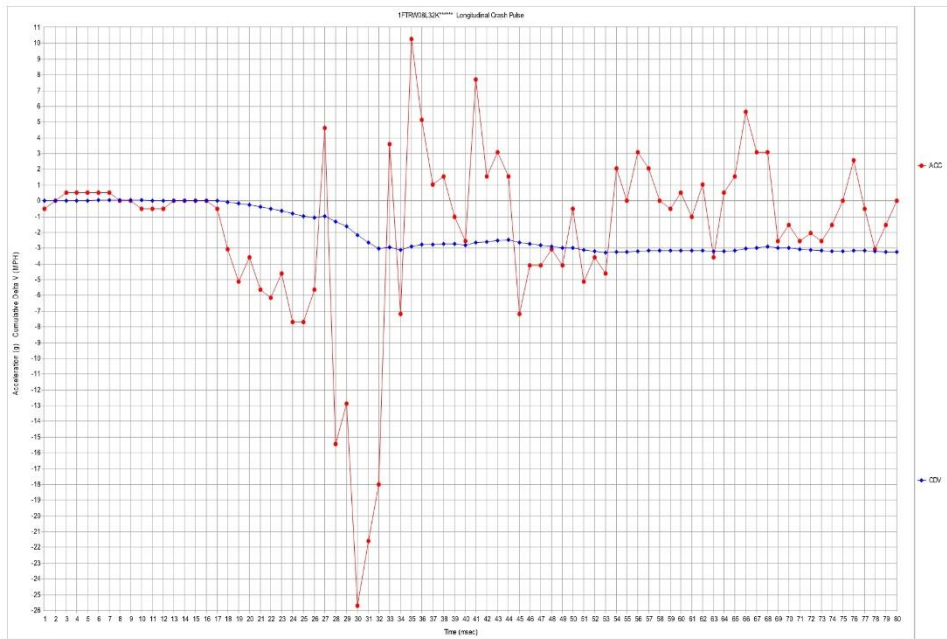
Any Longitudinal Delta-V determined by using data read from the air bag module should be verified with physical evidence from the crash (such as vehicle crush, skid marks) and assumed accident sequence. Multiple impacts, angular collisions, side impacts, vehicle spin, etc should be considered in addition to the data read from the air bag module.

02001\_RCM-1\_r002



### System Status At Deployment

Diagnostic codes active when event occurred	0
Passenger Airbag Switch Position During Event	Activated
Time From Side Safing Decision to Left (Driver) Side Bag Deployment (msec)	Not Deployed
Frontal and Pretensioner Fire time (ms)	30.5





### Crash Pulse Data

Milliseconds	Long. Acceleration (Gs)	Long. Cumulative Delta V (MPH)
1	-0.51	-0.01
2	0.00	-0.01
3	0.51	0.00
4	0.51	0.01
5	0.51	0.02
6	0.51	0.03
7	0.51	0.05
8	0.00	0.05
9	0.00	0.05
10	-0.51	0.03
11	-0.51	0.02
12	-0.51	0.01
13	0.00	0.01
14	0.00	0.01
15	0.00	0.01
16	0.00	0.01
17	-0.51	0.00
18	-3.08	-0.07
19	-5.14	-0.18
20	-3.60	-0.26
21	-5.65	-0.38
22	-6.17	-0.52
23	-4.63	-0.62
24	-7.71	-0.79
25	-7.71	-0.96
26	-5.65	-1.08
27	4.63	-0.98
28	-15.42	-1.32
29	-12.85	-1.60
30	-25.70	-2.17
31	-21.59	-2.64
32	-17.99	-3.04
33	3.60	-2.96
34	-7.20	-3.11
35	10.28	-2.89
36	5.14	-2.78
37	1.03	-2.75
38	1.54	-2.72
39	-1.03	-2.74
40	-2.57	-2.80
41	7.71	-2.63
42	1.54	-2.60
43	3.08	-2.53
44	1.54	-2.49
45	-7.20	-2.65
46	-4.11	-2.74
47	-4.11	-2.83
48	-3.08	-2.90
49	-4.11	-2.99
50	-0.51	-3.00
51	-5.14	-3.11
52	-3.60	-3.19
53	-4.63	-3.30



Milliseconds	Long. Acceleration (Gs)	Long. Cumulative Delta V (MPH)
54	2.06	-3.25
55	0.00	-3.25
56	3.08	-3.18
57	2.06	-3.14
58	0.00	-3.14
59	-0.51	-3.15
60	0.51	-3.14
61	-1.03	-3.16
62	1.03	-3.14
63	-3.60	-3.22
64	0.51	-3.20
65	1.54	-3.17
66	5.65	-3.05
67	3.08	-2.98
68	3.08	-2.91
69	-2.57	-2.97
70	-1.54	-3.00
71	-2.57	-3.06
72	-2.06	-3.10
73	-2.57	-3.16
74	-1.54	-3.19
75	0.00	-3.19
76	2.57	-3.14
77	-0.51	-3.15
78	-3.08	-3.22
79	-1.54	-3.25
80	0.00	-3.25

## 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 system.

```
0800: AD 42 40 5F 14 A2 58 2D 0D 23 0F 2D 38 57 C8 FF
0810: 10 FF F6 13 3C 78 32 9E 08 A2 F9 EF 19 99 52 49
0820: 2D 03 5F 0F 1E 0A F5 0A A1 5E 03 0E 1D 1E 00 25
0830: 0A 3C 80 28 05 28 56 0A 04 16 14 1E 03 84 B7 03
0840: 03 02 03 02 D5 5C 5A 01 F4 00 55 00 C0 12 5C 01
0850: 40 01 5E 02 6C 00 A5 00 A5 04 1F 00 2E 00 BD 07
0860: 08 13 88 03 E8 00 02 00 64 00 14 00 00 04 7E 7D
0870: 00 00 10 00 C8 01 F4 10 68 02 58 00 B4 04 28 01
0880: DC 00 02 00 66 00 FA 01 00 17 1D 08 41 11 E6 02
0890: 14 78 31 84 00 C8 0D 14 34 77 02 18 41 01 FF 7D
08A0: 14 FF 50 41 67 CC 40 FF FF FF FF FF FF FF FF 0F
08B0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
08C0: 04 FF FF FF FF FF 17 13 64 31 4C 33 41 02 03 06
08D0: 23 FC 80 08 FE 7E 32 FF 00 32 FF 00 32 FF 00 FF
08E0: 32 FF 00 02 FB 80 09 FC 80 0A FC 80 21 FC 80 FF
08F0: 04 07 00 00 0A 00 04 FF FF FF FF FF FF FF 00 00
0900: 02 FF 96 21 01 4A 11 FF FF FF FF FF 33 01 29 10
0910: FF 12 01 29 10 41 01 29 10 29 31 71 36 93 FF FD
0920: 9C 9D 9E 9E 9E 9E 9E 9D 9D 9C 9C 9C 9D 9D 9D 9D
0930: 9C 97 93 96 92 91 94 8E 8E 92 A6 7F 84 6B 73 7A
0940: A4 8F B1 A7 9F A0 9B 98 AC A0 A3 A0 8F 95 95 97
0950: 95 9C 93 96 94 A1 9D A3 A1 9D 9C 9E 9B 9F 96 9E
0960: A0 A8 A3 A3 98 9A 98 99 98 9A 9D A2 9C 97 9A 9D
0970: 9C 99 9D 9E 9F 9F 9D 9C 07 D0 07 D0 01 40 9D 9E
0980: 9E 9D 9D 9D 00 00 9C 9C 9C 9C 9C 9C 9C 9C 9C
0990: 9C 9D 9D 9E 9D 3C 00 11 F8 93 00 7A 00 00 00 00
09A0: 00 00 00 00 00 7F 00 00 00 79 00 A3 00 00 00 05
09B0: 00 00 01 0A 00 7A 00 B4 01 3E 00 00 00 00 00 00
09C0: 00 00 7A FF 00 FF FF 07 78 00 FF FF FF FF FF FF
09D0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
09E0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
09F0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
```

## 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.

DOT HS 812 912  
November 2020



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

