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Special Crash Investigations On-Site Guardrail End Terminal Crash Investigation Vehicle: 2011 Ford Edge Location: Missouri Crash Date: October 2017

DISCLAIMER

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15. Supplementary Notes

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.

16. Abstract

This report documents the on-site investigation of a SoftStop guardrail end terminal during an impact with a 2011 Ford Edge. The Ford was traveling north on a limited-access interstate highway driven by a 21-year-old male during the dark, early morning hours. The crash occurred when the Ford departed the right side of the roadway and struck the guardrail end treatment with its front plane. The vehicle displaced the end terminal 2.6 m (8.5 ft) and then engaged the guardrail system for approximately 24 m (78.7 ft), separating the W-beam from multiple posts as it rotated counterclockwise. The Ford then traveled down a steep embankment on the east roadside to final rest. A post-crash fire developed in the vehicle. The driver of the Ford exited the vehicle unassisted and walked from the crash scene to his residence located five blocks away. Several hours after the crash, a family member transported the driver by private vehicle to a local hospital for treatment of police-reported B-level (non-incapacitating) injuries.

17. Key Words	18. Distribution Statement
SoftStop end terminal,W-beam, road departure, fire	Document is available to the public from the National Technical Information Service, www.ntis.gov.

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SPECIAL CRASH INVESTIGATIONS
ON-SITE GUARDRAIL END TERMINAL CRASH INVESTIGATION
CASE NUMBER: CR17030
VEHICLE: 2011 FORD EDGE
LOCATION: MISSOURI
CRASH DATE: OCTOBER 2017

BACKGROUND

This report documents the on-site investigation of a SoftStop guardrail end terminal during an impact with a 2011 Ford Edge. The crash was identified by the Missouri Department of Transportation (MODOT), which in turn submitted notification to the Federal Highway Administration (FHWA). The FHWA determined that the crash type and guardrail end treatment met the criteria for further research and subsequently forwarded the notification to the Crash Investigation Division of the National Highway Traffic Safety Administration in October 2017. The CID assigned an on-site investigation of the crash to the Special Crash Investigations (SCI) team at Crash Research & Analysis, Inc., on the same day. The SCI team initiated contact and established cooperation with the MODOT to conduct the on-site investigation.

Figure 1. Northeast-facing on-scene image of the crash site. Image supplied by MODOT.

The Ford was traveling north on a limited-access interstate highway driven by a 21-year-old male during the dark, early morning hours. The crash occurred when the Ford departed the right side of the roadway and struck the guardrail end terminal (**Figure 1**) with its front plane. The vehicle displaced the end terminal 2.6 m (8.5 ft) and then engaged the guardrail system for approximately 24 m (78.7 ft), separating the W-beam from multiple posts as it rotated counterclockwise. The Ford then traveled down a steep embankment on the east roadside to final rest. A post-crash fire developed in the vehicle. The driver of the Ford exited the vehicle unassisted and walked from the crash scene to his residence located five blocks away. Several hours after the crash, a family member transported the driver by private vehicle to a local hospital for treatment of police-reported B-level (non-incapacitating) injuries. The driver was not located by the police until the day following the crash.

The on-site investigation focused on the documentation of the SoftStop end terminal and the damaged guardrail system, and an assessment of its performance. The physical environment of the roadway and the guardrail was also documented. The Ford was inspected, including measurement of the structural deformation and intrusion and the severity of damage caused by

the ensuing fire. The Ford was equipped with an event data recorder (EDR) that was supported by the Bosch Crash Data Retrieval (CDR) tool. The fire consumed the EDR, rendering the module damaged beyond the capability of being imaged with available cables/connectors.

SUMMARY

Crash Site

This crash occurred on a physically divided, limited-access roadway during dark, early morning hours. At the time of the crash the National Weather Service listed the conditions as clear with a temperature of 10 ºC (50 ºF), 68 percent humidity, clear visibility, and wind speed of 6.5 km/h (10.4 mph) from the south-southwest. The police reported the conditions as clear and dry. In the area of the crash, artificial overhead lighting illuminated the roadway. The roadway consisted of four lanes in the northbound direction and three lanes in the southbound direction, separated by a Jersey median barrier. **Figure 2** is a northbound view at the crash site. Approaching the crash site, the roadway was straight and then curved to the left (**Figure 3**). The radius of curvature measured 675 m (2,215 ft). The travel lanes then transitioned back to a straight section of roadway after the short curve. The grade measured 3.5% positive to the north.

Figure 2. Overall view of Ford's northbound approach to the crash site at 150 m prior to impact with the end terminal.

Figure 3. South-facing look back view for the point of impact depicting the roadway curvature.

The northbound travel lanes were delineated by broken white lane lines with a solid yellow west edge line and a solid white east edge line. The travel lanes were 3.7 m (12.1 ft) in width and were bordered by paved shoulders. The west shoulder was 1.0 m (3.3 ft) in width and the east shoulder was 2.5 m (8.2 ft) wide. All travel lanes were asphalt while shoulder surfaces were concrete. A guardrail system was located adjacent to the east shoulder and protected northbound traffic from the steep embankment. The embankment, populated with tall brush and small diameter trees, began approximately 2 m (6.5 ft) east of the road edge and had a negative grade that measured 60%. The posted speed limit in the area of the crash was 89 km/h (55 mph). Crash diagrams are included at the end of this technical report.

Pre-Crash

The 21-year-old male driver of the Ford was traveling in a northerly direction in the right-center lane at a witness-estimated speed of 105 km/h (65 mph). A witness to the crash reported to the police that she was ahead of the Ford traveling approximately 89 km/h (55 mph) in the left-center lane and it approached her vehicle at higher speed. She stated to the police that as the vehicles entered the shallow left curve, it was her perception that the Ford passed her on the right and then departed the road to the right for an unknown reason. The SCI reconstruction of the crash determined that, due to the road curvature, the Ford would have appeared to pass the non-contact vehicle on the right, but it simply continued along a straight path at the entry to the left curve. The Ford passed through the rightmost lane, onto the shoulder and approached the guardrail in a tracking manner (**Figure 4**).

Figure 4. North-facing trajectory view of the Ford approaching the guardrail.

Crash

The front plane/center aspect of the Ford struck the SoftStop end terminal and the impact momentum of the vehicle began to displace the end terminal to the north along the W-beam. The driver's air bag most likely deployed due to the force of the impact, although air bag deployment could not be confirmed due to the consequence of the fire. The witness reported that the fire began immediately at impact.

As the Ford displaced the end terminal, the terminal separated the W-beam from the guardrail posts and flattened the W-corrugation, thus absorbing the energy of the crash. The end of the beam was attached to Post 0 by a bolted connection that was seated in a U-shaped slot designed into the post. This bolted connection was designed to support and maintain the tension in the W-beam as the end terminal was displaced. During the crash, the build-up of tension in the W-beam by the force of the impact also caused a northward displacement in the foundation of Post 0. A 10 cm (3.9 in) displacement of the ground was noted during the SCI scene inspection.

The northward movement of Post 0 and the (sudden) reduction in the tension along the W-beam allowed the end of the W-beam to separate at its U-shaped connection to the post. The lack of tension allowed the W-beam to bend and kink, restricting the movement of the end terminal after approximately 2.6 m (8.5 ft) of displacement (**Figure 5**). The end terminal and W-beam were displaced into the northbound traffic lanes as the Ford continued to the north along the field side of the guardrail and began to rotate counterclockwise.

Figure 5. East-facing image depicting the end terminal and deformed W-beam. Note: end terminal was moved to this location by fire fighters.

Figure 6. North-facing view depicting the vehicle's path along the field side of the guardrail. The red arrow referenced the small diameter tree contacted by the Ford.

The Ford continued along the field side of the guardrail (**Figures 6** and **7**) with impact damage that extended to Post 13. The damage consisted of the separation of the W-beam from the block-outs at each post and each post was deformed (bending/displacement) to the north. As the vehicle reached Post 13, the right plane and undercarriage of the Ford overran a small diameter tree planted in the embankment. The tree was located 1.6 m (5.2 ft) east of the guardrail. Abrasions to the tree trunk and its branches were noted approximately 2.5 m (8.3 ft) above the ground. It was apparent that the tree bent over during the impact and then sprung back upright. Dried and singed leaves denoted the evidence of the vehicle's fire as it overrode the tree.

Figure 7. North-facing view depicting the vehicle's path along the field side of the guardrail and the tree contact.

Figure 8. West-facing view from the area of the Ford's final rest up the embankment slope toward the guardrail.

The Ford then traveled down the embankment to its final rest position that was located perpendicular to Post 18. At rest, the vehicle was facing northwest near the base of the

embankment approximately 11.6 m (38.0 ft) east of the guardrail (**Figure 8**). A large area of burnt and charred earth denoted its position.

Post-Crash

Witnesses called the emergency response center to report the crash. Police, firefighters, and emergency medical personnel responded to the scene. The driver apparently exited the vehicle unassisted and fled the scene as the fire began to spread. As the firefighters extinguished the fire, a search of the scene was initiated in an attempt to locate the driver. It was initially unknown if he had remained in the vehicle or was ejected. The police investigation later determined that the driver walked to his residence located approximately five blocks from the crash site. Approximately five hours after the crash, he was transported by a private vehicle to a local hospital where he was examined, treated, and released.

The guardrail was cut into several sections by the firefighters and removed from the roadway. These sections were lying on the east roadside at the time of the SCI scene inspection. At daylight, a local tow facility used a heavy-duty tow truck with an extendable boom to reach and lift the Ford from its final rest position. The vehicle was lifted over the guardrail system, placed on the pavement, and towed from the scene to the police impound where it was inspected for this investigation.

SOFTSTOP GUARDRAIL END TERMINAL AND GUARDRAIL

The SoftStop end terminal was an energy absorbing end device used to terminate a W-beam guardrail. The SoftStop was manufactured by Trinity Highway Products, and the end terminal was a MASH TL-3 system. Manufacturer literature and installation manuals for the SoftStop system can be found at www.highwayguardrail.com/products/SoftStop.html. The SoftStop installation consisted of a SoftStop rail flattening head, SoftStop anchor W-beam guardrail, anchor post (Post 0), two steel yielding terminal posts (SYTP) at locations 1 and 2, and six standard posts at post locations 3-8 that supported the W-beam with a composite block-out and carriage bolt. Beyond the end terminal, the continuation of the guardrail was also supported by standard posts and composite block-outs. The W-beam height measured 82 cm (32.5 in) at an undamaged section adjacent to Post 19.

During the crash, the guardrail system sustained regions of direct contact and induced damage that required replacement of the W-beam to the splice located between Post 18 and Post 19. The total length of the required repair measured approximately 34.5 m (113.2 ft). The Ford's direct contact to the guardrail damaged the installation from Post 0 to Post 13. Separation of the W-beam from the block-outs at Post 14 and 15 was considered induced damage. Post 16 through 18 did not appear to be damaged.

Post 0 was a 16 x 16 cm (6.3 x 6.3 in) I-beam (**Figure 9**) that was embedded into the ground and anchored the W-beam through a paddle attachment. A ground angle strut located between Post 0 and 1 also tensioned the system. During the crash, Post 0 deformed to the north approximately 10 cm (4.0 in). The bolted connection between the angle strut and Post 1 sheared during the impact. This movement allowed the paddle anchor attachment of the W-beam to separate from the U-shaped slot at the top of Post 0.

Figure 9. East-facing image depicting Post 0, Post 1, and the ground strut.

Post 1 was a yielding 15 x 10 cm (5.9 x 3.9 in) I-beam that supported the end terminal pre-crash. This post was weakened by holes stamped through the end plates of the I-beam. These holes were approximately at ground level. During the impact, this post fractured through the weakening holes and deformed 90 degrees longitudinally, in the direction of the Ford's travel.

Post 2 was also a yielding 15 x 10 cm (5.9 x 3.9 in) I-beam. This post deformed by bending deformation through the weakening holes that were (originally) located approximately at ground level. The post appeared to be partially displaced from the ground and had deformed 90 degrees to the north.

Standard 15 x 10 cm (5.9 x 3.9 in) I-beams with a composite block-out and carriage bolt supported the W-beam beginning at Post 3. During the crash, the head of the carriage bolts pulled through the W-beam by deforming the hanger slot in the rail at Post 3 through 13. The composite block-outs at Post 3 through 6 fractured and were missing. The block-outs on Post 7 through 13 remained attached to the posts. Each I-beam was deformed by bending. The magnitude of bending at each post decreased in the direction of the Ford's travel. The bending of Post 3 was nearly 80 degrees and the bending at Post 13 was approximately 30 degrees.

The lateral displacement of the W-beam into the northbound lanes resulted in a separation of the W-beam from Post 14 and 15. There was no evidence of direct vehicle contact to these posts or to the W-beam. Post 14 remained vertical and did not appear to be deformed. Post 15 was rotated CCW when viewed from above due to induced loading.

The Ford struck the impact-face of the end terminal (originally supported by Post 1). The force of the impact displaced the end terminal (**Figure 10**) approximately 2.6 m (8.5 ft) along the rail. The separation of the paddle anchor from Post 0, due to the movement of the post in the ground, resulted in a loss of tension in the W-beam. This loss of tension allowed the W-beam to begin to bend and kink ahead of the end terminal. As this section of the deformed W-beam entered the chute of the end terminal, the system became restricted. The edge of the end terminal chute cut into the corrugation of the W-beam and restricted further movement (**Figure 11**). The continued movement of the Ford to the north along the field side of the guardrail displaced the end terminal and W-beam into the northbound lanes of the roadway. Inspection of the end terminal for

impact-related damage was unremarkable. No welds were broken and it was relatively undeformed. The FHWA guardrail forms are included at the end of this report, **Appendix A**.

Figure 10. Northwest-facing view of the end terminal and deformed W-beam.

Figure 11. Close-up west-facing view of the restricted W-beam in the end terminal.

2011 FORD EDGE

Description

The 2011 Ford Edge (**Figure 12**) was identified by the Vehicle Identification Number 2FMDK3JC4BBxxxxxx and was equipped with an SEL-level trim. The vehicle's unibody design was built on a 282 cm (111.2 in) wheelbase and was powered by a 3.5-liter gasoline engine linked to a 6-speed automatic transmission with front-wheel drive. Standard features included traction control, electronic stability control, electronic brake force distribution, emergency braking assist, a post-collision safety system, a tire pressure monitoring system, and rear ultrasonic parking sensors. Specifications listed the gross vehicle weight rating (GVWR) at 2,263 kg (4,991 lb). The curb weight was 1,852 kg (4,083 lb) and the vehicle manufacturer recommended tire size was P245/50R20. The left front, right rear and right front tires were completely consumed by the post-crash fire. The left rear tire was partially consumed by the fire and was identified as a Pirelli. All other tire data is unknown.

Figure 12. Left front oblique view of the Ford.

The interior of the Ford was configured for seating of five occupants (2/3) and consisted of front row bucket seats and a split forward folding second row seat. All seating positions were configured with adjustable head restraints. The Ford was configured with a Vista roof that consisted of two large glazing panels. The forward operating panel opened over the front row while the aft panel was fixed over the second-row seating area. Safety systems consisted of

manual 3-point lap and shoulder seat belts for the five designated seat positions with front row retractor pretensioners. Supplemental restraint was provided by Certified Advanced 208-Compliant (CAC) frontal air bags for the driver and front row right positions, front seat-mounted side impact air bags, and dual sensing (side impact and rollover) inflatable curtain (IC) air bags.

Exterior Damage

The front plane center aspect of the Ford (**Figure 13**) struck the face of the end terminal (Event 1). The direct contact damage began 10 cm (3.9 in) left of the vehicle's centerline and extended 18 cm (7.1 in) to the right. The direction of force was in the 12 o'clock sector and resulted in a U-shaped area of deformation to the bumper reinforcement beam. The combined induced and direct contact damage (Field L) was 92 cm (36.2 in) that extended between the bumper beam corners. Maximum crush at bumper level was 28 cm (11.0 in) located 3 cm (1.2 in) left of the centerline. A crush profile was documented by the Total Station and was as follows: C1 = 0 cm, C2 = 12 cm (4.7 in), C3 = 28 cm (11.0 in), C4 = 22 cm (8.7 in), C5 = 8 cm (3.1 in), C6 = 0 cm. The Collision Deformation Classification (CDC) assigned to the frontal impact was 12FCEN2. An analysis of the crash dynamics was beyond the scope of WinSMASH program analysis due to the yielding properties of the struck guardrail.

The Ford overrode the guardrail posts as it continued on its northbound trajectory. It was probable that the deformed posts damaged the base of the engine and the fuel or oil lines the resulting in the development of the post-crash fire (Event 2).

Figure 13. Front view of the Ford depicting the deformation.

Figure 14. Right view of the Ford depicting the door deformation.

The right plane, specifically, the right front door and the leading edge of the right rear door contacted an undetermined post of the guardrail system (Event 3). The post tore the sheet metal of the doors and creased the upper aspect of the doors in a diagonal pattern from the beltline across the B-pillar area. The width of the holed deformation pattern measured 15 cm (5.9 in). This measurement was consistent with the dimensions of a post. The tear in the sheet metal of the front door measured 75 cm (29.5 in) in length (**Figure 14**). The estimated CDC of this damage pattern was 02RPEW1.

The undercarriage of the Ford overrode the small diameter tree as the vehicle traveled down the embankment to final rest (Event 4). The fire damage to the vehicle obscured any residual evidence of this contact. The estimated CDC of this contact was 00U99999, where the use of 9 represents unknowns.

Event Data Recorder

The Ford was equipped with an air bag control module (ACM) that had EDR capabilities. The ACM was mounted to the forward aspect of the center tunnel under the console and the mid-instrument panel (**Figure 15**). The outer case to the ACM was aluminum and was exposed to the intense fire. The connector, wiring and internal circuitry was consumed by the fire. It was not possible to image the module with available cables/connectors.

Interior Damage

The crash-induced fire totally consumed the interior of the Ford (**Figure 16**). The fire also obliterated any evidence of driver contact in the vehicle and the deployment of the air bag system. There was no intrusion to the occupant compartment that could be attributed to the exterior forces of the crash sequence. The severity of the fire melted the alloy tilt joint of the steering wheel. Consequently, the steering wheel separated from the column and fell to the floor of the Ford. The fire rendered the doors inoperable (after the driver's egress) and consumed all the window glazing. The forward aspect of the roof structure sagged due to the heat of the fire.

Fuel System

The 2011 Ford Edge was powered by a gasoline engine that was supplied by a 63-liter (18.0 gal) high-density polyethylene fuel tank. The fuel tank was molded in an H-shape and fitted to the undercarriage forward of the rear axle location beneath the second-row seat location based on

Figure 15. Image depicting the ACM located at the base of the center instrument panel in the Ford.

Figure 16. Forward-looking interior view depicting row 1 of the Ford and its consumption by the fire.

examination of an exemplar vehicle. The tank was secured to the undercarriage by two steel band straps. The fire completely consumed the fuel tank in the vehicle under investigation. The steel fuel supply lines were routed along the left aspect of the undercarriage and remained intact. The filler tube was positioned on the left rear quarter panel aft of the axle location.

Manual Restraint Systems
The Ford was equipped with continuous loop 3-point lap and shoulder seat belts for the five designated seat positions. Specifications and an inspection of an exemplar vehicle determined that all seat belts in the Ford were configured with sliding latch plates. The driver's seat belt retracted onto an emergency locking retractor (ELR) while the other four systems used switchable ELR/automatic locking retractors (ALR). Both front row positions were equipped with adjustable D-rings. The fire consumed the seat belt webbing and the polymer components of the systems. Therefore, it was not possible to determine if the driver was belted at the time of the crash.

Supplemental Restraint Systems
The Ford was equipped with six air bags that provided supplemental occupant protection in frontal, side, and rollover crashes. The front CAC air bags consisted of dual stage frontal air bags for the driver and front row right occupant position. In addition to the air bags, the CAC system included seat track positioning sensors, seat belt buckle switches, and a front row right occupant presence/classification sensor. Based on specifications, the driver's frontal air bag was conventionally mounted in a steering wheel module. The passenger's frontal air bag was mounted in the upper aspect of the right instrument panel. Due to the severity of the fire that consumed the entire interior inclusive of the Ford's EDR, it is unknown if the driver's frontal air bag deployed during the crash. The passenger's frontal air bag should have been suppressed by the vehicle's occupant presence detection system at the time of the crash, as the driver was the sole occupant of the vehicle. However, its deployment status remains unknown due to the consequence of the fire.

Side impact protection was provided by front row seat-mounted air bags and roof side rail mounted IC air bags. The Ford was equipped with rollover sensing that deploys the IC air bags during rollover crashes. Again, due to the lack of EDR data and the severity of the fire, it is unknown if the seat-mounted or IC air bags deployed during the crash events.

2011 FORD EDGE OCCUPANT

Driver Demographics

Age/Sex:	21 years/male
Height:	168 cm (66 in)
Weight:	73 kg (160 lb)
Eyewear:	None
Seat type:	Forward-facing bucket seat with adjustable head restraint
Seat track position:	Rear track position
Manual restraint usage:	Unknown
Usage source:	Unknown
Air bags:	Frontal, seat-mounted side-impact and IC air bags available; Unknown if air bags deployed
Alcohol/drug involvement:	Admitted to alcohol and cocaine use; no drug or BAC test
Egress from vehicle:	Exited vehicle unassisted
Transport from scene:	Walked to his residence, private vehicle from the residence to a local hospital approximately 5 hours post-crash
Type of medical treatment:	Treated and released

Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Superficial small left ear laceration	210602.1	Unknown	Unknown
2	Abrasion to left ear canal	240204.1	Unknown	Unknown
3	Facial abrasions, NFS	210202.1	Unknown	Unknown
4	Chest wall contusion	410402.1	Unknown	Unknown
5	Contusion to right hand	710402.1	Unknown	Unknown
6	Contusion to left hand	710402.1	Unknown	Unknown
7	Abrasions to right fingers	710202.1	Unknown	Unknown

Source: Emergency room records.

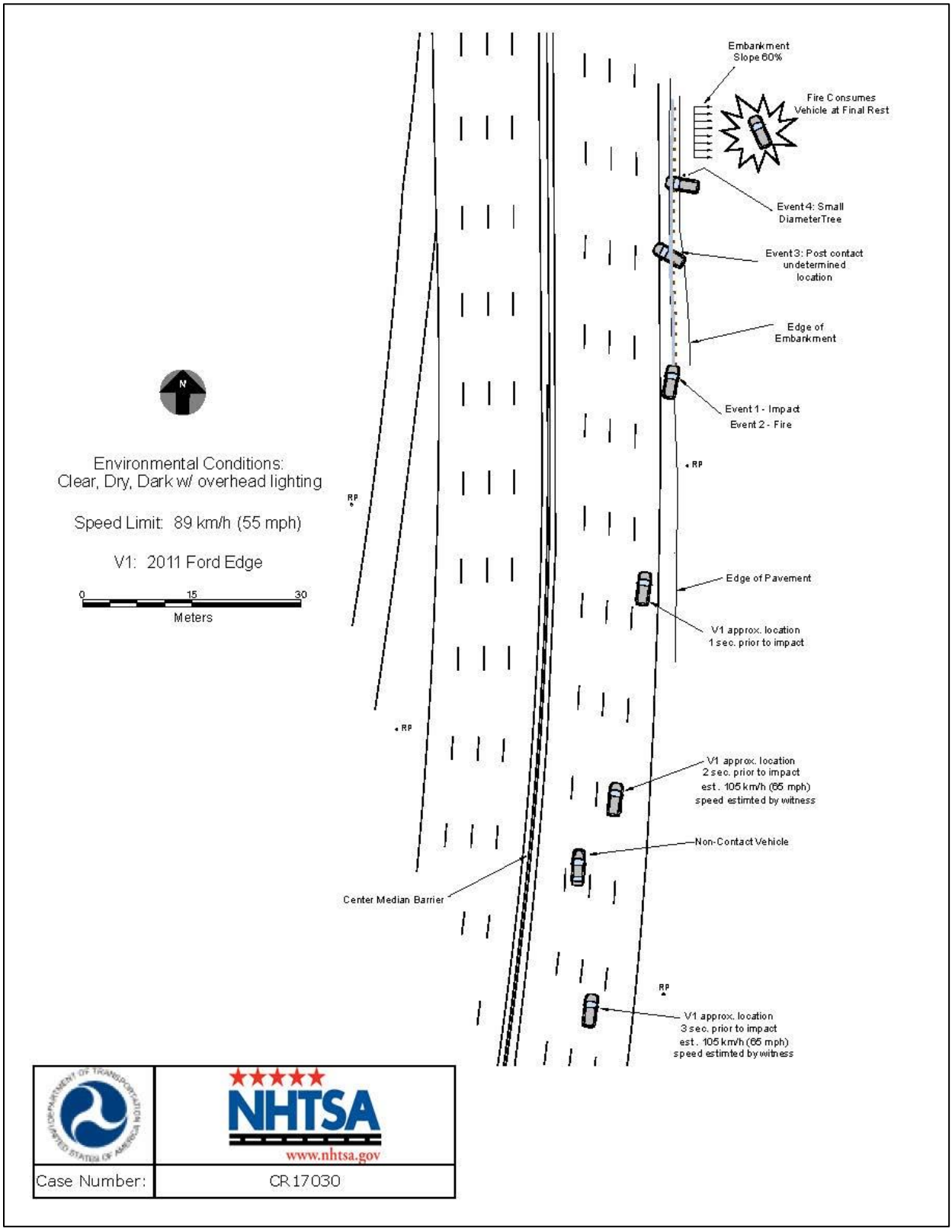
Driver Kinematics

The 21-year-old male driver of the Ford was seated in an unknown posture at the time of the crash. The medical records stated that he had consumed alcohol and illicit drugs prior to the crash. The driver stated to the police that he had fallen asleep, precipitating the crash and had no other recollection. Due to the severity of the fire and the total consumption of the vehicle's interior, it is unknown if he was restrained by the manual seat belt system.

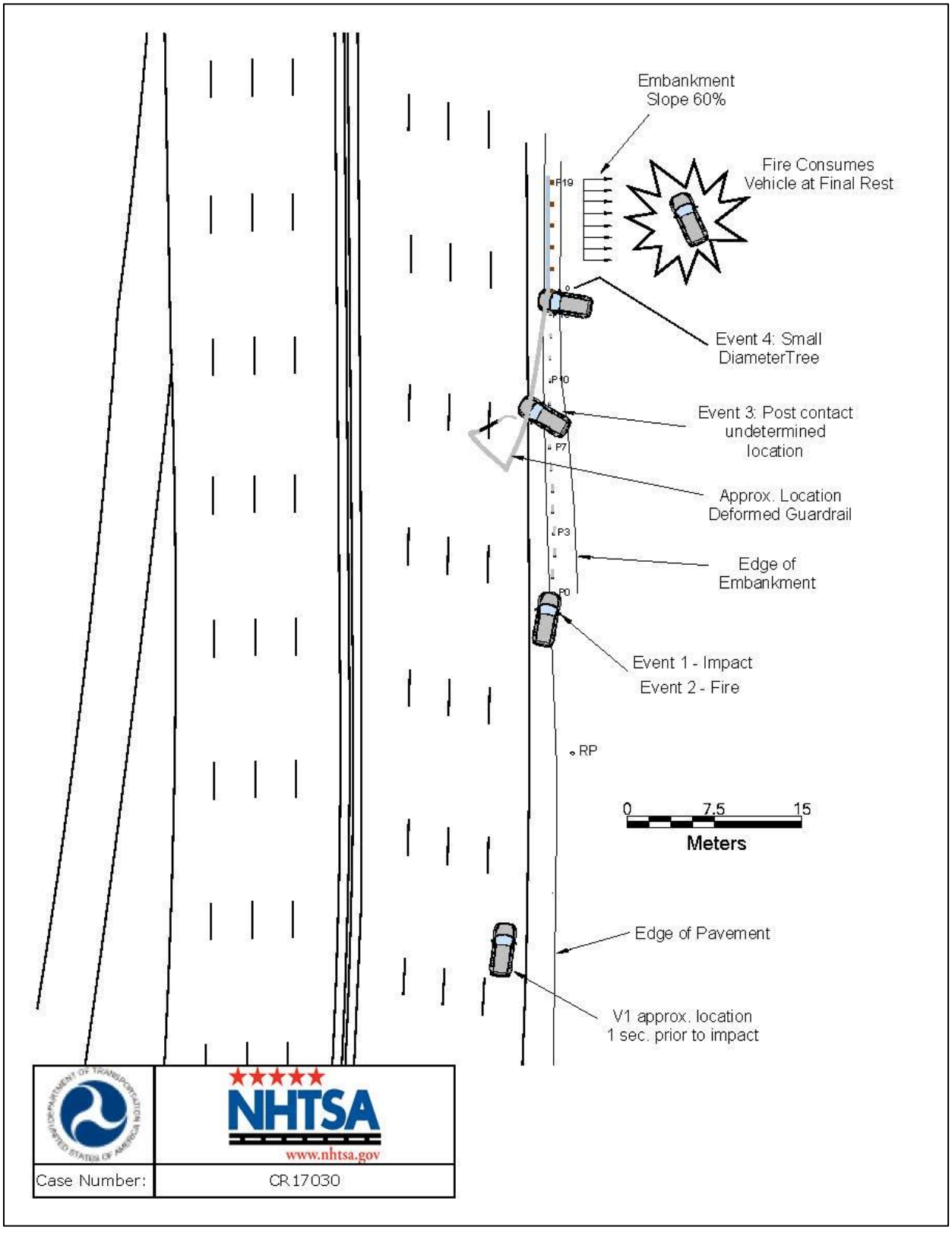
Based on the reconstruction of the crash events, the driver's frontal air bag probably deployed during the engagement with the guardrail end treatment. The driver would have initiated a forward trajectory in response to the 12 o'clock direction of the impact force. He would have loaded the seat belt (if used) and the deployed air bag during the early stages of the crash. As the Ford rotated counterclockwise off the barrier and traveled down the embankment, the driver possibly contacted the center console and the left front door panel. The particular sources of his minor injuries remain unknown as the consequence of the fire consumed the interior of the Ford.

The driver awoke due to the force of the crash. After the vehicle came to final rest, he exited the vehicle unassisted. The driver left the scene and walked to his residence located approximately five blocks from the crash site. Approximately 5 hours after the reported time of the crash, a family member transported him by private vehicle to the emergency room of a local hospital where he was examined, treated, and released after 4 hours.

CRASH DIAGRAM



DETAILED CRASH DIAGRAM



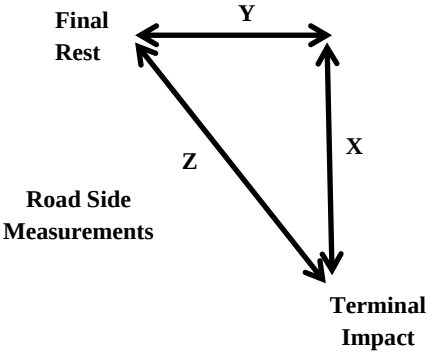
APPENDIX A:
Federal Highway Administration Guardrail Forms

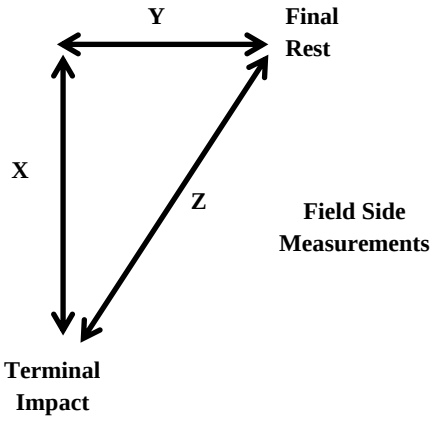
PREPOPULATED DATA (BY OTHERS)			
Date of Crash	October 2017	**Time of Crash (Military)**	Nighttime
Case Number	CR17030	**State**	MO
Traffic Route	Limited Access	**Direction (Southbound = SB)**	NB
Ambient Conditions (at time of crash)			
Temperature (°F)	50°	**Lighting**	Dark; lighted
Atmospheric	Clear		

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. 65 mph
Est. distance (straight line) from terminal impact to COM final rest position (ft.)	Z = 114.2 ft ❑ Road side ☒ Field Side
Est. distance (longitudinal) along guardrail from terminal impact to COM final resting location (ft.)	X = 109.3ft
Est. distance (normal) from either 1. the white paint line; or 2. roadway/shoulder/pavement edge to COM rest position (ft.)	Y = 38 ft
Super elevation	❒ +2% ❒ -2% ☒ NONE or FLAT
Curve Radius (ft.)	Pre-crash 2,215 ft

KEY:

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





Case No.: CR17030

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: N/A		

GUARDRAIL INSTALLATION									
Post No.	Post		Block-Out		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	7.1 x 6.5	None	N/A	No	None	6.9	N/A	

Case No.: CR17030

1	Steel	4 x 6	None	N/A	No	None	6.7	N/A	4’-9”
2	Steel	4 x 6	Composite (fractured)	4 x 7.5 x 14	No	None	7.3	N/A	6’-10”
3	Steel	4 x 6	Composite (fractured)	4 x 7.5 x 14	No	None	7.2	N/A	6’-5”
4	Steel	4 x 6	Composite (fractured)	4 x 7.5 x 14	No	None	6.8	N/A	5’-8”
5	Steel	4 x 6	Composite (fractured)	4 x 7.5 x 14	No	None	6.8	N/A	5’-7”
6	Steel	4 x 6	Composite (fractured)	4 x 7.5 x 14	No	None	6.4	N/A	5’-8”

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7	Steel	4 x 6	Composite	4 x 7.5 x 14	No	None	5.9	N/A	6’-3””
8	Steel	4 x 6	Composite	4 x 7.5 x 14	No	None	5.8	N/A	6’-2”
9	Steel	4 x 6	Composite	4 x 7.5 x 14	No	None	6.1	N/A	5’-9”
10	Steel	4 x 6	Composite	4 x 7.5 x 14	No	None	6.2	N/A	6’-3”
11	Steel	4 x 6	Composite	4 x 7.5 x 14	No	None	6.5	N/A	6’-3”
12	Steel	4 x 6	Composite	4 x 7.5 x 14	No	None	6.6	N/A	6’-3”
13	Steel	4 x 6	Composite	4 x 7.5 x 14	No	None	6.6	N/A	6’-3”
14	Steel	4 x 6	Composite	4 x 7.5 x 14	No	None	6.7	N/A	6’-5”

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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.)					
15	Steel	4 x 6	Composite	4 x 7.5 x 14	No	None	6.8	N/A	6’-2”
16	Steel	4 x 6	Composite	4 x 7.5 x 14	No	None	6.9	N/A	6’-5”

Additional Comments:

W-beam separated from Post 0 during the crash, W-beam deformed and kinked, jammed in End terminal. End terminal and W-beam displaced into roadway.
Guardrail Cut-up post-crash and removed to roadside by fire department to clear roadway.
Vehicle contact to W-beam through Post 13. W-beam separated from Post 14 and 15. No direct contact to P14 or P15.
W-beam remained attached at Post 16 and beyond.
System requires replacement to the splice between P18 and P19.
Splices in guardrail are located between posts (not at a post).

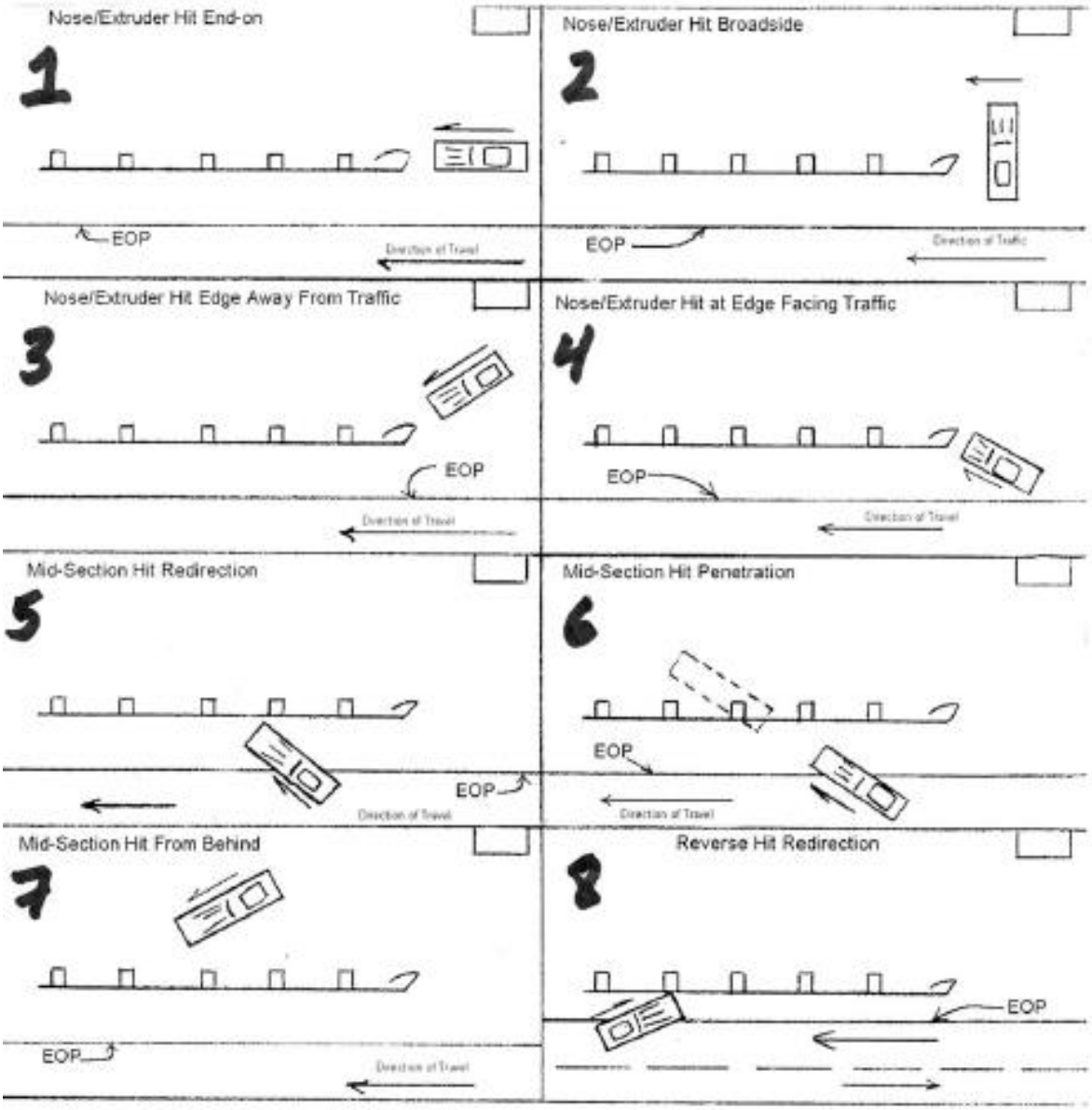
EXTRUDER			
Feeder Channel Width at impact head	❒4inches ❒5 inches ☒Other 5.25" soft stop		
Guide Chute Exit Height (in.)	5.25 inches		
Connection of feeder channels to head damaged?	☒No Yes	Are Welds Broken?	☒No ❒Yes
Anchor Cable Present?	❒No ❒Yes	Pre-crash Connected?	❒No ❒Yes
Rail Extrusion?	❒No Yes	Length (ft. in.)	8.5 ft
Rail Extrusion Direction	❒Traffic Side ❒Field Side ☒N/A		
Total Length of Rail Damaged (ft.) [total length would include extruded rail plus damaged rail downstream from head.]	8.5 ft extrusion plus 83 ft separated from block-out plus 18.3 ft to splice		

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: 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	Small diameter Tree on embankment		

ALL-SYSTEM PERFORMANCE ENVIRONMENT			
SIDESLOPE	**50 ft in advance of Post 1**	**At Post 1**	**50 ft Past Post 1**
Percent - %	0	0	0
Adjacent Lane Width (ft)	12.1 ft		
Lane Type (NAS EDS Variable: Sur. Type)	Asphalt		
Shoulder Type	Asphalt		
Shoulder Width (ft)	8.2 ft		
Guardrail Height (in)	32.5 in (*measured at post 19*)		

VEHICLE INFORMATION		
Vehicle Type (NHTSA Input)	2011 Ford Edge	
Vehicle Identification Number (VIN)	2FMDK3JC4BBxxxxxx	
Vehicle Mass (NASS var.: veh.wgt)	4,275 lb	
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	N/A	
Collision Deformation Classification	12FCEN1, 02RPEN1	
Delta-V	Unknown	
Occupant Compartment Penetration of rail	☒No	❒Yes Describe:
Did the Vehicle Rollover?	❒Yes ☒No	
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)	N/A	
Rollover Type, Terhune Scale, (NASS EDS variable: rolintyp)	N/A	


Nose/Extruder Hit End-on
1
EOP
Direction of Travel
Nose/Extruder Hit Broadside
2
EOP
Direction of Traffic
Nose/Extruder Hit Edge Away From Traffic
3
EOP
Direction of Travel
Nose/Extruder Hit at Edge Facing Traffic
4
EOP
Direction of Travel
Mid-Section Hit Redirection
5
EOP
Direction of Travel
Mid-Section Hit Penetration
6
EOP
Direction of Travel
Mid-Section Hit From Behind
7
EOP
Direction of Travel
Reverse Hit Redirection
8
EOP

DOT HS 812 833
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U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

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