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**National Highway
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Special Crash Investigations On-Site Guardrail End Terminal Impact Investigation Vehicle: 2004 Ford Freestar Location: Missouri Crash Date: February 2016

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

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

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16. Abstract This report documents the on-site investigation of a guardrail end treatment impact and subsequent rollover crash by a 2004 Ford Freestar. The crash occurred on a limited access roadway when the Ford, operated by an unbelted 29-year-old male driver, traveled off the right edge of the roadway and struck the Softstop end treatment. Clockwise rotation was induced to the Ford by its engagement with the end terminal, which tripped the vehicle into a left-side-leading rollover. The Ford came to final rest in the roadway, on its roof. The driver of the Ford sustained police-reported incapacitating (A-level) injuries as a result of the crash and was transported by ambulance to a local hospital.			
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TABLE OF CONTENTS

SPECIAL CRASH INVESTIGATIONS
CASE NO.: CR16006
ON-SITE GUARDRAIL END TREATMENT IMPACT INVESTIGATION
VEHICLE: 2004 FORD FREESTAR
LOCATION: MISSOURI
CRASH DATE: FEBRUARY 2016

BACKGROUND

This report documents the on-site investigation of a guardrail end treatment impact and subsequent rollover crash by a 2004 Ford Freestar (**Figure 1**). The crash occurred on a limited access roadway when the Ford, operated by an unbelted 29-year-old male driver, traveled off the right edge of the roadway and struck the Softstop end treatment. That impact caused the Ford to rotate clockwise, which tripped the vehicle into a left-side-leading rollover. The Ford came to final rest in the roadway on its roof. The driver of the Ford sustained police-reported incapacitating (A-level) injuries as a result of the crash and was transported by ambulance to a local hospital.

Figure 1: Front right oblique view of the Ford Freestar depicting the vehicle deformation.

This crash was identified by an engineer with the Missouri Department of Transportation (MoDOT), who submitted photographs of the damaged guardrail end treatment and the vehicle to the Federal Highway Administration (FHWA) in February 2016. The FHWA determined that the crash type and end terminal were of interest for further investigation, and forwarded the notification to the Crash Investigation Division (CID) of the National Highway Traffic Safety Administration. The CID then 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 contacted the MoDOT and established cooperation to conduct an on-site investigation. The on-site portion of this investigation occurred during February 2016, and involved an inspection of the physical environment and the guardrail system at the crash site. Photographs and a Nikon total station mapping system were used to document the condition of the guardrail system. The Ford was located at a local tow yard, where it was inspected to quantify the exterior condition, deformation, and occupant compartment intrusion, identify points of occupant contact in the interior, and assess the use and status of the vehicle's safety systems. The Ford was not equipped with an event data recorder (EDR) supported by the Bosch Crash Data Retrieval (CDR) tool/software; therefore, EDR data could not be obtained. As part of this investigation, medical records concerning the driver's injuries and course of treatment were obtained from the treating medical facility.

CRASH SUMMARY

Crash Site

This single-vehicle crash occurred during the night in February 2016 on the southbound lanes of a two-lane, divided, interstate highway. In the rural locale, the highway's speed limit was 113

km/h (70 mph). The police–reported environmental conditions at the time of the crash were dark, clear, and dry. The National Weather Service reported a temperature of 5.0 ˚C (43 ˚F), 66 percent relative humidity, and north winds at 26 km/h (16 mph). The sky condition was not reported. The physical environment of the crash site and guardrail was documented during the SCI inspection using a Nikon Nivo 5.M+ total station mapping system.

The asphalt-surfaced north/south interstate was straight and level in the area of the crash. The respective travel directions were separated by a depressed grass median. The two southbound lanes were separated by a broken white line. The width of the right lane measured 3.7 m (12.1 ft), while the width of the left lane measured 3.9 m (12.8 ft). The right shoulder was 2.3 m (7.5 ft) wide and separated from the travel lanes by a solid white line. A 20 cm (8 in) wide rumble strip was cut into the road surface along the white line. The left shoulder was 1.4 m (4.6 ft) wide, and it was separated from the left lane by a solid yellow line. A rumble strip was also cut into the pavement along this line. The roadway's surface was in newer condition, and MoDOT reported that it had been resurfaced in the prior 18-month period preceding the crash. The sides of the road were bordered by W-beam guardrail systems, as this section of the roadway approached a bridge that was located approximately 0.4 km (0.25 mi) south of the crash site. As a result of the resurfacing project, the vertical drop-off from the roadway surface at the east and west pavement edges was approximately 10 cm (4 in).

Figure 2 depicts a north-facing lookback view from the Ford's approach, while **Figure 3** depicts the Ford's southbound trajectory toward the guardrail and end terminal. A crash diagram is included at the end of this report on **Page 13**.

Figure 2: View of the roadway looking north from the crash site (lookback of approach).

Figure 3: Southbound trajectory view approaching the crash site.

Pre-Crash

The 29-year-old male operated the Ford southbound in the right lane of the roadway. He was not using the vehicle's manual 3-point lap and shoulder seat belt. As he drove the Ford south, the driver fell asleep and allowed the Ford to drift right in its travel lane. The Ford then departed the right lane, crossed over the rumble strip, and departed the right (west) side of the roadway without driver input. Based on the physical evidence at the scene, the departure angle was estimated to be 5 degrees. The vehicle's departure aligned the front plane of the Ford with the SoftStop end terminal of the guardrail. **Figure 4** is a trajectory view of the guardrail along the Ford's approach. There was no evidence of any pre-crash avoidance maneuver by the driver prior to impact.

Figure 4: Southbound trajectory view of the Ford approaching the guardrail.

Crash

The Ford struck the end terminal at an estimated 97 to 113 km/h (60 to 70 mph). Associated crash forces resulted in the deployment of the Ford's driver frontal air bag. The vehicle's front plane/right aspect engaged the impactor face, and its momentum began to translate the vertical loader end terminal to the south. The offset force of the impact induced a clockwise rotation to the Ford, evidenced by an arcing left rear tire mark located on the roadway's west shoulder adjacent to Post 1.

The Ford displaced the end terminal approximately 9.8 m (32.0 ft) along the guardrail, and the terminal vertically compressed (on y-axis) and flattened the W-beam as it traversed down the rail. Forces associated with the end terminal's deformation to the W-beam reduced the vehicle's momentum as it rode along the rail. The I-beam posts supporting the guardrail along this length were displaced to the southwest. The Ford followed a south and slightly west trajectory as it deformed the guardrail and began to climb the structure. As the front right undercarriage area of the vehicle climbed the deformed guardrail and posts, the off-balance forces initiated a left side leading rollover. The end terminal engaged the Post 7 I-beam and stopped (**Figure 5**).

Figure 5: South-looking image of the end terminal stopped at guardrail Post 7.

The abrupt stop transferred the linear momentum of the Ford to rotational momentum, which accentuated the vehicle's clockwise rotation (about the vertical axis) and the left side leading rollover. The Ford separated from the guardrail on a southeast trajectory and rolled one-quarter turn. A tire mark/gouge from the left rear tire/wheel (**Figure 6**), as well as gouges and scratches from the left roof side rail, evidenced these dynamics.

Figure 6: Southeast-facing view along the Ford's rollover trajectory, depicting the left rear tire mark and gouges which evidenced the ground contact.

Figure 7: A lookback view along the Ford's rollover trajectory to the northwest from the final rest position, facing back toward the guardrail impact.

The Ford rolled an additional quarter turn onto its roof as it continued its clockwise rotation and slid across the roadway. The vehicle came to rest in the left southbound lane facing east, 36.1 m (118.4 ft) from the initial end terminal impact (**Figure 7**). The rollover was classified as a flip-over with an uninterrupted rollover distance was approximately 25 m (66 ft).

Post-Crash

Police, fire, and emergency medical services (EMS) personnel responded to the crash scene. The driver exited the Ford without assistance. He reported to the police he had fallen asleep and had no recollection of the crash. An ambulance transported the driver to a local hospital by for evaluation and treatment of reported incapacitating (A-level) injuries. A local towing service recovered the Ford from the crash scene and transferred to a local yard, where it was located at the time of the SCI inspection.

SOFTSTOP END TERMINAL AND GUARDRAIL

The SoftStop was an energy absorbing vertical loader terminal used to terminate 79 cm (31 in) high W-beam guardrail. The installation consisted of a SoftStop rail flattening head, SoftStop anchor W-beam guardrail, anchor post (Post 0), two steel yielding terminal posts (SYTP) at post locations 1 and 2, and six standard posts at post locations 3 to 8 that supported the W-beam with a composite block-out and carriage bolt. The SoftStop is a trade-name given by its manufacturer, Trinity Highway Products. It was a TL-3 type system, according to the Manual for Assessing Safety Hardware (MASH). Manufacturer literature and installation manuals for the SoftStop system can be found at www.highwayguardrail.com/products/SoftStop.html.

A typical roadway profile and exemplar SoftStop end terminal installation is depicted in **Figure 8.** The involved guardrail end treatment was a tangent system with a measured W-beam height of 77 cm (30.5 in). This height was measured at an undamaged section between Post 11 and 12. The Ford struck the impact face of the end terminal (originally located at Post 1) and displaced it along the W-beam. The impact face measured 18 x 51 cm (7 x 20 in), width x height. Due to its design, the terminal vertically crushed and flattened the W-beam during its displacement, thus absorbing energy of the impact.

Figure 8: Image depicting an exemplar SoftStop end terminal and guardrail located approximately 5 km (3 miles) south of the crash site.

Figure 9 depicts the struck guardrail end treatment. The posts numbered 0 to 10 of the installation were damaged, with W-beam damage that extended to the splice located at Post 11. The total length of damaged W-beam measured 18.7 m (61.5 ft). The length of flattened rail measured 9.8 m (32 ft), from Post 0 to the stopped end terminal at Post 7. The deformed guardrail was inspected and documented through measurements and photographs. A diagram depicting the deformed guardrail is included on **Page 14**. The completed FHWA Guardrail Form is included at the end of this report as **Appendix A**.

Figure 9: Overall image of the guardrail deformation looking south along the edge of pavement.

Post 0 was a 16 x 16 cm (6.25 x 6.25 in) I-beam that was embedded in the ground and anchored the W-beam through a turnbuckle attachment. During the crash, the anchor remained intact and provided tension to the deforming rail. A ground angle strut located between Post 0 and 1 also tensioned the system. The bolted connection between the angle strut and Post 1 sheared during the impact. It was noted during inspection that the vertically crushed and flattened rail was twisted approximately 360 degrees over its flattened length. The rail twisted at Post 0 through the treaded connection of the turnbuckle. It was theorized that the rail twisted as the W-beam deformed to the field side and tension in the component increased.

Post 1 was a yielding 15 x 10 cm (6 x 4 in) I-beam that supported the end terminal pre-crash. This post was weakened by holes drilled through the end plates of the I-beam. The manufacturer's instructions indicated that the weakening holes were to be installed at ground level. At inspection these holes were approximately 10 cm (4 in) above ground level. During the

impact, this post fractured through the weakening holes and deformed longitudinally, in the direction of the Ford's travel.

Post 2 was also a yielding 15 x 10 cm (6 x 4 in) I-beam. Its weakening holes were located approximately 15 cm (6 in) above the ground. This post deformed by bending deformation at the ground; it did not yield through the holes. Based on the observations at inspection, the W-beam was bolted to this post through a composite block-out. The carriage bolt was deformed, and the composite block-out was fractured and separated (**Figure 10**). The installation directions indicated that this post should have a block-out; however, the W-beam was <u>not</u> to be attached to the post.

Figure 10: East-looking image depicting the Post 2 deformation and the deformed carriage bolt.

Figure 11: North-lookback view depicting the end of damage to the guardrail.

Posts 3 through 8 of the installation were standard 15 x 10 cm (6 x 4 in) I-beams that supported the W-beam with a composite block-out and carriage bolt. During the crash, the bolt head at these posts pulled through the W-beam by deforming the hanger slot in the rail. The composite block-out at Post 3 fractured and was missing, but block-outs on Post 4 through 8 remained attached to the posts. Each I-beam was deformed through bending, with post movement at ground level in the direction of the vehicle's travel path.

The W-beam remained attached through the block-outs to Posts 9 and 10, but was slightly deformed surrounding each block-out. Both posts were displaced to the south approximately 4 cm (1.8 in) at ground level. Post 11 appeared to be undamaged (**Figure 11**).

Figure 12: South-looking view of the struck and displaced end terminal.

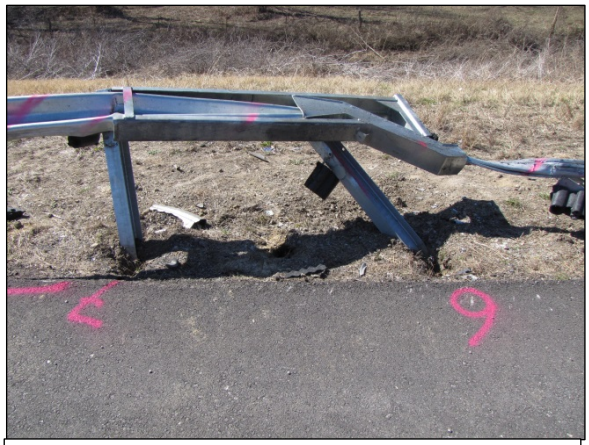


Figure 13: Image depicting the location and condition of the end terminal at Post 7 looking to the west.

The end terminal (**Figures 12 and 13**) was displaced 9.8 m (32 ft) to the south by the Ford. The downstream end of the terminal struck and deformed Post 7. This interference stopped the end terminal and restricted any further movement (**Figure 14**). Inspection of the SoftStop end terminal was unremarkable. No welds were broken, and it was relatively undeformed.

Figure 14: Close-up image of the end terminal depicting how it stopped at Post 7.

Figure 15: Front view of the Ford Freestar.

2004 FORD FREESTAR

Description

The 2004 Ford Freestar (**Figure 15**) was a 7-passenger minivan identified by the VIN 2FMZA51664xxxxxx. It was manufactured in October 2003, and was equipped with the SE trim package. The digital odometer reading was unknown due to electrical system inoperability. The body was configured on a 308 cm (121.4 in) wheelbase, with hinged front doors, second row sliding doors, and a rear lift gate. The front-wheel drive platform was powered by a 3.9 liter, V6, gasoline engine linked to a 4-speed automatic transmission, with a steering column-mounted shifter. Service brakes were power-assisted front disc and rear drum brakes with ABS.

The Ford's gross vehicle weight rating was placarded at 2,567 kg (5,660 lb), with front and rear gross axle weight ratings of 1,322 kb (2,915 lb) and 1,252 kg (2,760 lb rear), respectively. It's curb weight was 1,939 kg (4,275 lb). The manufacturer's recommended tire size was

P225/60R16 at all four axle positions, with recommended cold tire pressures of 241 kPa (35 psi). At the time of the SCI inspection, the Ford was equipped with four P215/60R16 tires, each produced by different manufacturers. Specific tire data measured at the time of the SCI inspection were as follows:

	Manufacturer / Model	Measured Tread Depth	Restriction	Damage
LF	Bridgestone Turanza	4 mm (5/32 in)	No	None
LR	Goodyear Assurance	5 mm (6/32 in)	No	Rim abraded
RR	Hankook Road Handler	5 mm (6/32 in)	No	None
RF	MastercraftAC-44	3 mm (4/32 in)	No	None

The interior of the Ford was configured with three rows for the seating of up to seven occupants (2/2/3). The front seats were bucket seats with reclining seat backs and integral head restraints. At the time of the SCI inspection, the driver's seat was adjusted to its full-rear track position. The second-row and third-row bench seats were folded down. Manual restraint systems consisted of 3-point lap and shoulder seat belts for all seat positions. Both front seat belts were equipped with buckle pretensioners. Supplemental restraints consisted of driver and passenger frontal air bags.

Exterior Damage

The Ford sustained impact damage to its front, left, and top planes, consistent with the events of the crash. Direct contact damage on the front plane (Event 1) began 28 cm (11 in) right of center and extended 18 cm (7 in) to the right. The front bumper cover was fractured and separated during the impact. The frontal impact involved the forward right structures of the engine compartment. Crush (**Figure 16**) was noted to the right aspect of the radiator core, and it extended vertically 18 cm (7.0 in) from the bumper onto the hood face. All the Ford's doors remained closed during the crash sequence and were operational post-crash. There was no change in the wheelbase dimensions.

Figure 16: Overhead view of the Ford depicting the frontal deformation.

A residual crush profile was documented by the SCI investigator using a Nikon Nivo 5.M+ total station mapping system. Measured along the bumper beam reinforcement, this profile produced the following measurements: C1 = 0 cm, C2 = 4 cm (1.6 in), C3 = 8 cm (3.2 in), C4 = 14 cm (5.5 in), C5 = 20 cm (8.0 in), C6 = 16 cm (6.1 in).

The Collision Deformation Classification (CDC) assigned to this damage pattern was 12FREN1. This crash type was out of the scope for analysis by the WinSMASH program due to the yielding property of the impact. A borderline analysis of the crash severity (delta-V) was calculated using the WinSMASH damage algorithm for comparison purposes only. The total delta-V was 23 km/h (14 mph) with longitudinal and lateral components of -23 km/h (-14 mph) and 0 km/h, respectively.

Rollover damage was present on the left and top planes, and consisted of body panel deformation and surface abrasions. Heavy abrasions were noted to the left quarter panel aft of the left-rear axle, which extended vertically along the D-pillar to the roof side rail. The left outside mirror mount was fractured and the separated mirror had deformed the left-front door panel. Heavy surface abrasions were noted to the metal structure of the roof. Oriented in multiple directions, this was indicative of the Ford sliding and rotating about its vertical axis along the roadway. The hood was similarly abraded and flattened.

The maximum vertical deformation measured 5 cm (2.0 in) and was observed at the right A-pillar. There was no lateral deformation of the roof structure. The windshield laminate was fractured with minor bond separation at the right A-pillar and along the header. The glazing of the left quarter panel, backlight, right second row and right front had disintegrated during the rollover. The CDC assigned to the rollover damage was 00TDD02. During the crash, the Ford rolled over two-quarter turns along an uninterrupted distance of approximately 25 m (66 ft). **Figures 17 and 18** depict the rollover damage to the Ford.

Figure 17: Left rear oblique view of the Ford depicting the rollover damage.

Figure 18: Image depicting the rollover abrasions and deformation to the Ford's roof.

Event Data Recorder

The 2004 Ford Freestar was not equipped with an EDR supported by the Bosch Crash Data Retrieval tool/software. No EDR data could be obtained by the SCI investigator.

Interior Damage

The interior of the Ford (**Figure 19**) sustained minimal damage, which consisted of driver air bag deployment and vertical intrusion of the roof at the front row right position. The roof intrusion measured 5 cm (2 in), located above the front row right seat. At the time of the SCI inspection, the driver's seat was adjusted to the full rear track position and the seat back was reclined 20-degrees. There was no deformation of the steering wheel rim or movement of the steering column shear capsules. The only discernable occupant contact consisted of a scuff to the knee bolster right of the steering column, possibly from right lower extremity contact by the driver. The Ford's interior surfaces were heavily soiled due to its age and overall condition, which prevented identification of any further occupant contact points.

Figure 19: Interior image of the Ford.

Manual Restraint Systems

The Ford was equipped with 3-point lap and shoulder seat belts for all seat positions. The driver's seat belt system consisted of continuous-loop webbing, a sliding latch plate, an adjustable D-ring, an emergency locking retractor (ELR), and a buckle pretensioner. At the time of the SCI vehicle inspection, the driver's D-ring was adjusted fully upward.

Inspection of the driver's seat belt system found the webbing extended from the retractor and wrapped behind the driver's seat back (**Figure 20**). The latch plate was buckled at the time of the crash and released during the crash when the buckle pretensioner actuated. The plastic casing surrounding the buckle mechanism was missing. Similar to the driver's seat belt, the front row right seat belt (**Figure 21**) was also wrapped around the seat back and buckled at the time of the crash. It was apparent that the driver was unbelted when the crash occurred.

Figure 20: View of the Ford driver's seat belt webbing routed behind the seat back.

Figure 21: Interior image of the front right seat belt of the Ford.

Supplemental Restraint Systems
The Ford was equipped with dual-stage frontal air bags for the driver and front row right occupant. This advanced air bag system used a weight sensor in the front row right seat to assist with the deployment logic for the passenger's frontal air bag. As a result of the end terminal impact, the driver air bag deployed from its module located in the center hub of the steering wheel rim. There was no damage or evidence of occupant contact to the module cover flaps or the air bag. Examination of the deployed driver air bag was unremarkable.

2004 FORD FREESTAR OCCUPANT DATA
Driver Demographics

Age/Sex:	29 years/male
Height:	193 cm (76 in)
Weight:	84 kg (185 lb)
Eyewear:	Unknown
Seat Type:	Forward-facing bucket seat with non-adjustable head restraint
Seat Track Position:	Rearmost
Manual Restraint Usage:	None; 3-point lap and shoulder seat belt system available
Usage Source:	Vehicle inspection, PAR
Air Bags:	Dual stage frontal air bag deployed
Alcohol/Drug Involvement:	Alcohol involvement; no BAC test given
Egress From Vehicle:	Exited vehicle under own power
Transport From Scene:	Ambulance to a local hospital
Type of Medical Treatment:	Treated and released

Driver Injuries

Injury No.	Injury	AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Cervical strain	640278.1	Roof	Possible
2	Lumbosacral strain	640678.1	Roof	Possible
3	Small abrasion to left lower back	410202.1	Roof	Possible
4	Left shoulder contusion	710402.1	Left roof side rail	Possible
5	Left knee contusion	810402.1	Lower left instrument panel	Possible
6	Left knee abrasions	810202.1	Lower left instrument panel	Possible
7	Left hip contusion	810402.1	Roof	Possible

Source – Emergency Room records

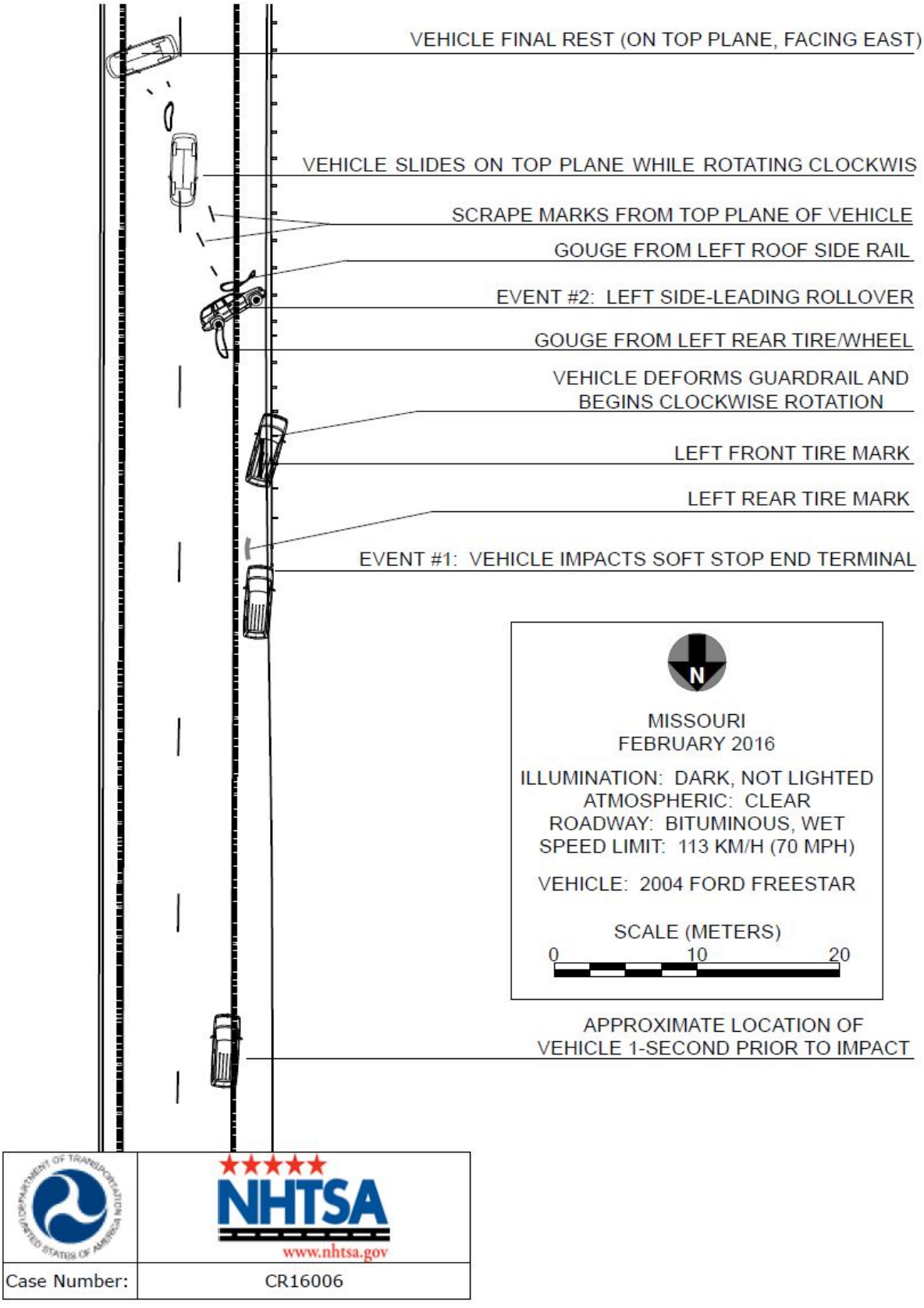
Driver Kinematics
The 29-year-old male was seated unbelted in the driver's seat of the Ford. Based on the observations of the SCI inspection, the driver's seat belt webbing was extended and wrapped around the seat back, with the latch plate fastened into the buckle.

The driver reported to the police that he fell asleep and had no recollection of the crash. The Ford drifted to the right and departed the roadway without driver input, where it struck the end treatment of the guardrail. Crash forces resulted in the deployment of the Ford's driver frontal air bag. The driver initiated a forward trajectory in response to the 12 o'clock direction of the impact

forces. As he was displaced forward from position, he likely contacted the deployed air bag with his torso. His lower extremities possibly contacted the knee bolster, evidenced by the scuff identified during the SCI vehicle inspection.

As the vehicle struck the SoftStop end terminal and rode down the force of the crash, it initiated a clockwise rotation that was suddenly accentuated when the end terminal stopped at Post 7. The rapid rotation displaced the driver upward and to the right. He probably contacted the roof with his head/neck and upper back. The contact to the roof possibly resulted in his reported soft tissue injuries and the cervical and lumbosacral strain. Following the crash, the driver exited the vehicle under his own power. He was transported by ambulance to a local hospital where he was treated and released within 24 hours of the crash.

CRASH DIAGRAM



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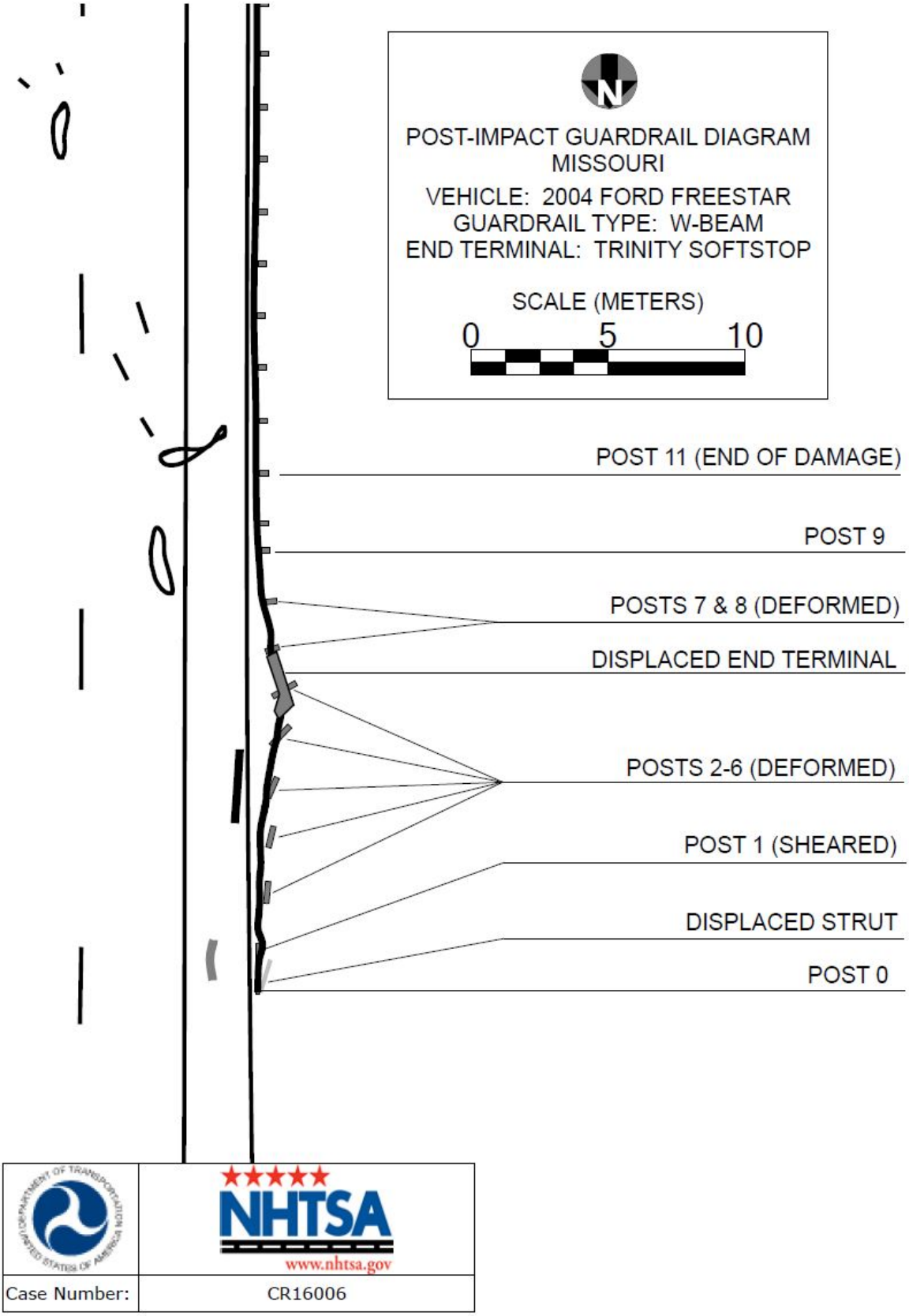
Case Number:	CR16006

POST-IMPACT GUARDRAIL DEFORMATION DIAGRAM



APPENDIX A:

Federal Highway Administration Guardrail Forms

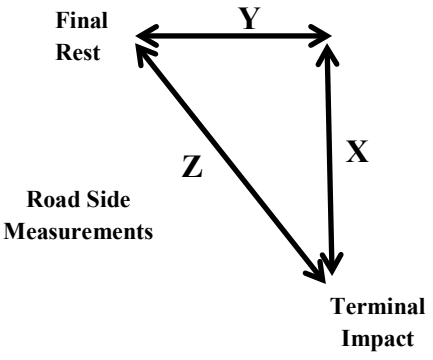
Case No.: CR16006

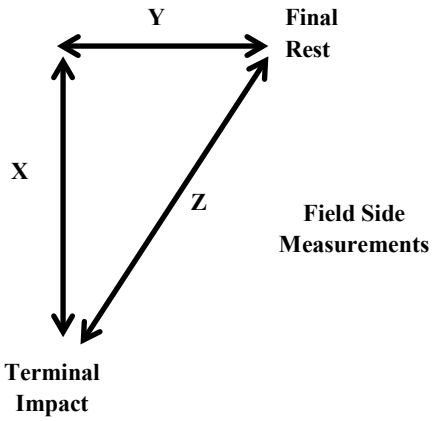
PREPOPULATED DATA (BY OTHERS)			
Date of Crash	February 2016	**Time of Crash (Military)**	Evening
Case Number	CR16006	**State**	MO
Traffic Route	Limited Access	**Direction (southbound = SB)**	SB
Ambient Conditions (at time of crash)			
Temperature (°F)	43	**Lighting**	None
Atmospheric	Clear		

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)	60 – 70 mph
Est. distance (straight line) from terminal impact to COM final rest position (ft.)	Z = 118.4 ft ❒Field side ☒Road side
Est. distance (longitudinal) from terminal impact to COM final resting location (ft.)	X = 115.2 ft
Est. distance (normal) from either 1. the white paint line; or 2. roadway/shoulder/pavement edge to COM rest position (ft.)	Y = 28.2 ft (*from west edge of pavement*)
Super elevation	❒+2% ❒-2% ☒ NONE or FLAT
Curve Radius (ft.)	N/A

KEY:

- COM - Center of Mass of Vehicle
- Distance Measurements





Case No.: CR16006

ON-SCENE INFORMATION		
End Treatment Type	☒ Vertical Loader	☒SOFTSTOP
	❒Extruder	❒ET2000 ❒ET-PLUS 4in ❒ET-PLUS 5in ❒SKT ❒FLEAT
	❒Telescoping	❒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		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	6.25 x 6.25	None	N/A	No	N/A	8 ft 8 in	N/A	4 ft 3 in
1	Steel	6 x 4	None	N/A	Unknown	N/A	8 ft 8 in	N/A	6 ft 9 in
2	Steel	6 x 4	Fractured/ Missing	N/A	Unknown	N/A	9 ft 10 in	N/A	6 ft 10 in
3	Steel	6 x 4	Fractured/ Missing	N/A	Unknown	N/A	9 ft 7 in	N/A	5 ft 11 in

Case No.: CR16006

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.)					
4	Steel	6 x 4	Composite	7.5 x 4	Unknown	N/A	9 ft 5 in	N/A	6 ft 3 in
5	Steel	6 x 4	Composite	7.5 x 4	Unknown	N/A	9 ft 6 in	N/A	5 ft 9 in
6	Steel	6 x 4	Composite	7.5 x 4	Unknown	N/A	9 ft 4 in	N/A	5 ft 5 in
7	Steel	6 x 4	Composite	7.5 x 4	No	N/A	9 ft 2 in	N/A	5 ft 10 in
8	Steel	6 x 4	Composite	7.5 x 4	No	N/A	9 ft 1 in	N/A	6 ft 2 in
9	Steel	6 x 4	Composite	7.5 x 4	No	N/A	9 ft 1 in	N/A	3 ft 2 in
10	Steel	6 x 4	Composite	7.5 x 4	No	N/A	9 ft 1 in	N/A	6 ft 2 in

Case No.: CR16006

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.)					
11	Steel	6 x 4	Composite	7.5 x 4	No	N/A	9 ft 1 in	N/A	6 ft 3 in
12	-	-	-	-	-	-	-	-	-

Additional Comments:

End terminal translated along W-beam, and the downstream end of the end terminal stopped at Post 7. Flattened rail remained anchored at Post 0, and extended from the anchor to downstream of Post 5 (almost to Post 6). The W-beam was separated from bolt head at Post 7 and 8, but remained attached to Posts 9-11 with slight deformation to W-beam. Damage ended at Post 11.

Case No.: CR16006

VERTICAL LOADER			
Channel Width at impact head	❒4inches ❒5 inches ☒Other 5.625 in		
Guide Chute Exit Height (in.)	4.75 in		
Connection of feeder channel to head damaged?	☒No ❒Yes	Are Welds Broken?	☒No ❒Yes
Anchor Present?	❒No ☒Yes	Connected?	❒No ☒Yes
Rail flattened?	❒No ☒Yes	Length (ft. in.)	32.0 ft
Total Length of Rail Damaged (ft.) [total length would include flattened rail plus damaged rail downstream from end terminal head.]	Total = 61.5 ft *[32 ft (Post 0 to location of end terminal) + 29.5 ft (end terminal to Post 11)]*		

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: N/A	
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	N/A		

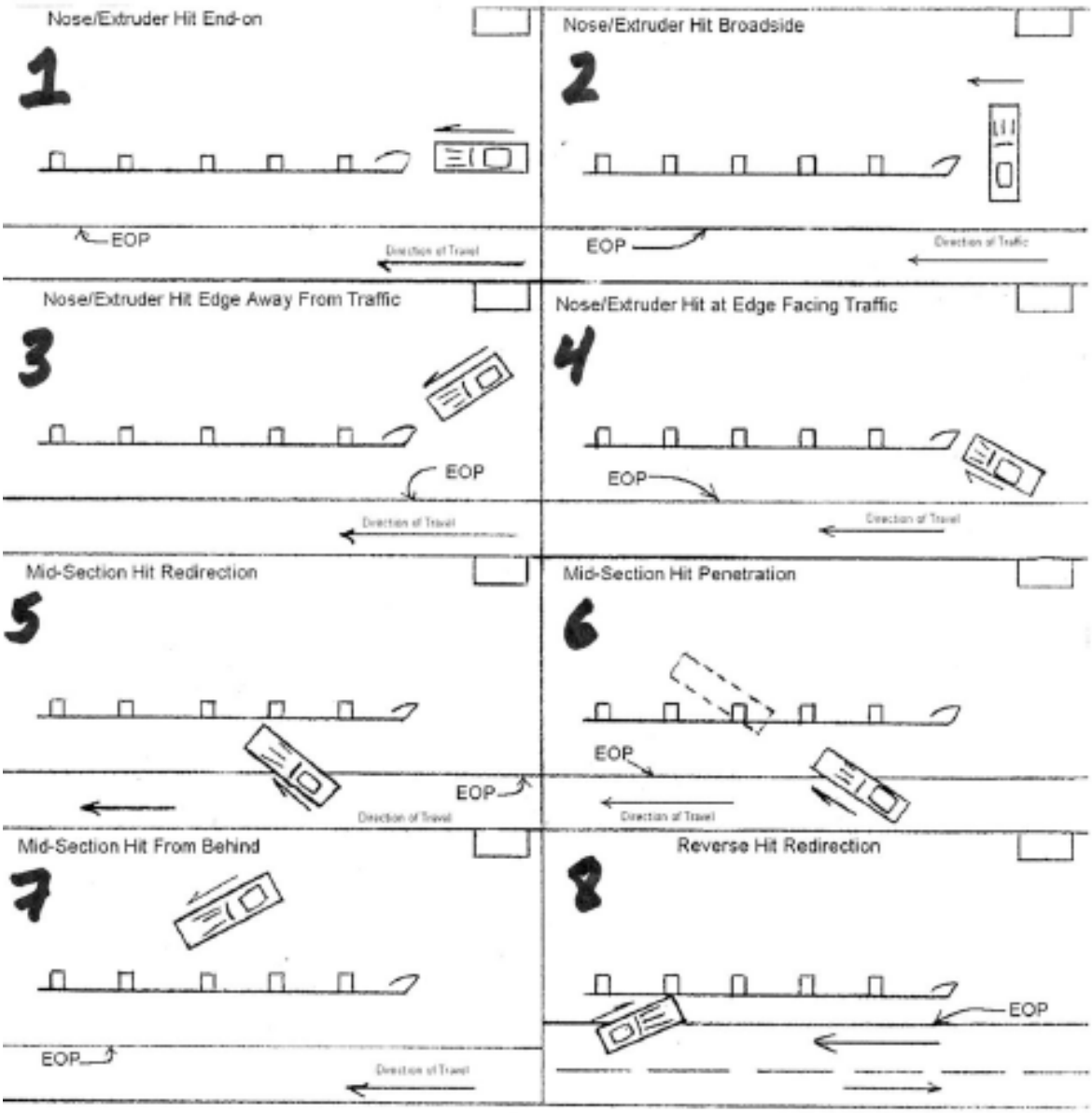
ALL-SYSTEM PERFORMANCE ENVIRONMENT				
SIDESLOPE	**50 ft in advance of Post 1**	**At Post 1**	**50 ft Past Post 1**	
Percent - %	16.3%	16.8%	16.8%	
Adjacent Lane Width (ft)	12.1 ft			
Lane Type (NAS EDS Variable: Sur. Type)	Asphalt			
Shoulder Type	Asphalt			
Shoulder Width (ft)	7.5 ft			
Guardrail Height (in)	30.5 in (*measured between Post 11 and 12*)			
Pavement Drop-Off?	❒No ☒Yes		Height (in):	4 in

VEHICLE INFORMATION	
Vehicle Type (NHTSA Input)	2004 Ford Freestar

Case No.: CR16006

Vehicle Identification Number (VIN)	2FMZA51664BXXXXXX	
Vehicle Mass (NASS var.: veh.wgt)	4,266 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	Event 1 - 12FREN1 Event 2 - 00TDDO2	
Delta-V	Event 1 - Less than 20 mph	
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)	Collision with a fixed object - Guardrail	
Rollover Type, Terhune Scale, (NASS EDS variable: rolintyp)	Flip over	

Case No.: CR16006



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**National Highway
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