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**Special Crash Investigations:
On-Site Ambulance Crash
Investigation;
Vehicle: 2008 Ford Econoline E350
Super Duty Type II Ambulance;
Location: South Dakota;
Crash Date: August 2020**

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16. Abstract This report documents the investigation of a crash involving a 2008 Ford Econoline E350 Super Duty Type III Ambulance that struck a 2020 Volvo VNR 640 tractor truck and a 2019 Walker tanker trailer. The Ford was traveling southbound and the Volvo was traveling northbound on a divided interstate highway. The ambulance occupants were a belted 22-year-old male EMT driver and an unbelted 29-year-old female EMT front passenger. No occupants were in the patient compartment. The ambulance driver fell asleep and the vehicle departed the roadway on the right edge, where it struck two delineator posts. The driver woke up, steered left, and returned the vehicle to the roadway. He overcorrected his steering, crossing over the southbound lanes and center median before entering the northbound lanes, where the front of the ambulance struck the left side of the Volvo. A second impact occurred when the right side of the ambulance struck the left side of the tanker. The right side door of the ambulance opened; the front passenger was fully ejected. She struck the tanker and sustained fatal injuries. The Volvo and tanker then tripped and rolled one quarter-turn onto their right planes and came to rest on the roadside. The ambulance driver complained of pain and was transported by ambulance to a hospital where he was treated and released. The driver of the Volvo was not injured or transported. The Ford, Volvo, and tanker were towed due to damage.			
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Special Crash Investigations
On-Site Ambulance Crash Investigation
Case Number: DS20011
Vehicle: 2008 Ford Econoline E350 Super Duty Type III Ambulance
Location: South Dakota
Crash Date: August 2020

Background

This report documents the investigation of a crash involving a 2008 Ford Econoline E350 Super Duty Type III Ambulance (Figure 1) that struck a 2020 Volvo VNR 640 tractor truck and 2019 Walker tanker trailer. The front passenger of the ambulance was an unbelted 29-year-old female emergency medical technician. During the crash she was fully ejected through the open right side door. She struck the tanker and sustained fatal injuries. The ambulance was not responding to an emergency call or transporting a patient at the time of the crash, and there were no occupants in the patient compartment. The Special Crash Investigations (SCI) group of the National Highway Traffic Safety Administration initiated this investigation in September 2020 in response to a notification received by the Office of Emergency Medical Services. The SCI team obtained permission to inspect the ambulance from the ambulance company. The field inspections were completed in September 2020 with the ambulance company's safety and risk manager in attendance. The ambulance's air bag control module was not supported by the Bosch CDR system and the vehicle's event data recorder was not imaged. The ambulance company provided the SCI team with on-board forward and rearward camera video files taken from the ambulance cab, a GPS-based accident position report log, vehicle service records, and a completed occupant interview questionnaire, with permission to use the material in the investigation. SCI obtained a copy of the police crash report in September 2020 and the police investigative report and photos in July 2022. SCI obtained photos of the Volvo and Walker tanker from the insurance company and they were used to conduct partial exterior inspections.



Figure 1. The 2008 Ford E350 Type III ambulance

The crash occurred at night in August 2020 on a north/south interstate highway in South Dakota. The ambulance was traveling southbound and the Volvo was traveling northbound. The

ambulance driver was a belted 22-year-old male EMT and the front passenger was the unbelted 29-year-old female EMT. Based on the on-board video footage, both occupants appeared to be asleep. The ambulance departed the roadway on the right edge, where it struck two delineator posts. The driver woke up, steered left, and returned the vehicle to the roadway. He overcorrected his steering, crossing over the southbound lanes and center median before entering the northbound lanes where the front of the ambulance struck the left side of the Volvo. A second impact occurred when the right side of the ambulance struck the left side of the tanker. The right side door of the ambulance opened and the female EMT was fully ejected. She struck the tanker, sustaining fatal injuries, and came to rest in the center median. Continuing northbound, the Volvo and tanker tripped and rolled one quarter-turn onto their right planes, coming to rest on the right shoulder. The ambulance driver complained of pain and was transported by ambulance to a hospital where he was treated and released. The driver of the Volvo was not injured or transported. The Ford, Volvo, and tanker were towed due to damage.

Summary

Crash Site

The crash site was a divided north/south interstate highway in rural South Dakota. The highway was separated by a depressed grass median measuring 14.6 m (48.0 ft) wide. The travel lanes were paved grooved concrete and the shoulders were paved with milled-in rumble strips. The roadway was straight and level in both directions. The southbound roadway had a right shoulder 3.5 m (11.4 ft) wide, a right lane 3.6 m (11.9 ft) wide, a left lane 3.4 m (11.2 ft) wide and a left shoulder 1.9 m (6.1 ft) wide. The lanes were separated by a dashed white painted stripe and bordered by a white painted fog line on the right and a yellow painted fog line on the left. The right roadside had reflectorized delineator posts set approximately 30.0 (100.0 ft) apart.

The northbound roadway had a right shoulder 3.2 m (10.7 ft) wide, a right lane 3.7 m (12.2 ft) wide, a left lane 3.4 m (11.1 ft) wide and a left shoulder 1.6 m (5.3 ft) wide. The lanes were separated by a dashed white painted stripe and bordered by a white painted fog line on the right and a yellow painted fog line on the left. The posted speed limit was 129 km/h (80 mph).

Conditions at the time of the crash were dark without artificial illumination, clear and dry. A crash diagram is included at the end of this report.

Pre-Crash

The Volvo was driven northbound in the first lane from the right by the belted 62-year-old male at a driver-estimated speed of 111 km/h (69 mph). It was unknown if the Volvo driver attempted any evasive maneuvers prior to impact with the ambulance.



Figure 2. Area of departure, the 2008 Ford E350 Type III ambulance, looking north



Figure 3. Area of departure, the 2008 Ford E350 Type III ambulance, looking south (screen shot taken from on-board video camera)

The ambulance was being driven southbound in the first lane from the right by the belted 22-year-old male. In the vehicle's on-board video, the driver and unbelted female EMT passenger appear to be asleep. The driver appears to close his eyes for approximately 12 seconds before the ambulance departs the road on the right edge. The nearest section of rumble strip was located approximately 30 m (100 ft) north of the area of departure. During the departure the vehicle traveled from grooved concrete to asphalt shoulder to downward sloping grass roadside (Figures 2 and 3). The ambulance departed the roadway at a speed of 130 km/h (81 mph). According to the GPS log, the vehicle speed was 129 km/h (80 mph) just prior to a GPS deceleration and large "G" Event. It traveled southbound along a grass roadside and drainage ditch parallel to the roadway. The table below includes the final minutes of data taken from the GPS log on the night of the crash.

Time h:m:s	Reason Code	Speed km/h (mph)	Distance km (mi)	Heading
x:20:37 AM	Periodic	128 (80)	2.15 (1.34)	134 SE
x:21:37 AM	Periodic	129 (80)	2.17 (1.35)	137 SE
x:22:37 AM	Periodic	129 (80)	2.16 (1.34)	138 SE
x:22:39 AM	GPS Decel	117 (73)	0.1 (0.06)	134 SE
x:22:40 AM	Large G Event	117 (73)	0 (0)	134 SE
x:22:40 AM	Harsh Cornering	107 (66)	0 (0)	131 SE
x:22:43 AM	Large G Event	107 (66)	0 (0)	131 SE
x:22:44 AM	Large G Event	107 (66)	0 (0)	131 SE
x:22:46 AM	GPS Decel	60 (37)	0 (0)	139 SE
x:22:50 AM	Heading	31 (19)	0.05 (0.03)	155 SE
x:23:05 AM	Power Disconnected	2 (1)	0 (0)	359 N
x:23:25 AM	Begin Stop	1 (1)	0.05 (0.03)	359 N
x:23:25 AM	Ignition Off	1 (1)	0 (0)	359 N
x:27:26 AM	Park Timer	0 (0)	0 (0)	0

Crash

After departing the roadway on the right edge, the ambulance traveled southbound parallel to the roadway for approximately 34 m (110 ft) and struck the first of two reflectorized delineator posts with its front plane (Event 1). The post yielded and this was a low delta V event. The vehicle traveled another 30 m (100 ft) and struck the second delineator post with its front plane (Event 2). The ambulance driver awoke and steered left, returning the vehicle to the roadway approximately 129 m (423 ft) south of where it departed (Figure 4). The ambulance returned to the roadway at a speed of 114 km/h (71 mph). The driver overcorrected his steering to the left, the vehicle crossed the southbound lanes, and entered the center median at a speed of 100 km/h (62 mph). The video shows the driver actively steering and the front passenger appears to be bracing her right arm and hand on her seat back and cushion. The ambulance crossed over the center median and entered the northbound lanes where its front plane struck the left plane of the Volvo (Event 3) (Figure 5). The last frame of video before impact indicated a vehicle speed of 76 km/h (47 mph). Impact forces caused the ambulance to rotate counterclockwise and its right plane struck the left plane of the tanker (Event 4). During Event 4, it appears the right side door of the ambulance came open when the latch disengaged from the striker. The unbelted EMT was fully ejected through the open door and her head struck the tanker, causing a critical severity avulsive head injury, according to the police report. She came to rest in the center median. The ambulance came to rest facing east on the right shoulder of the northbound lanes approximately 20 m (66 ft) north of the area of impact.



Figure 4. Tire marks at point of return to roadway, looking south, the 2008 Ford E350 Type III ambulance



Figure 5. Tire marks at area of impact, looking north, the 2020 Volvo VNR 640 perspective

The Volvo and tanker continued northbound while initiating a counterclockwise rotation until its right side tires tripped, causing a right-side-leading one quarter-turn rollover (Event 5). It came to rest facing west on its right plane on the right shoulder approximately 70 m (230 ft) north of the initial impacts.

The Ford and Volvo were out of scope of the WinSMASH program, precluding a reconstruction. WinSMASH calculations for the vehicle-to-vehicle impacts were run for informational purposes. For the ambulance in Event 3, the barrier algorithm of WinSMASH calculated a barrier equivalent speed (BES) of 41 km/h (26 mph), which appears reasonable. For the ambulance in Event 4, WinSMASH calculated a BES of 7 km/h (4 mph), which appears low.

Post-Crash

The ambulance driver exited the vehicle without assistance and noticed his passenger was missing from the vehicle. He called 911 and while reporting the crash stated that he found the passenger with a serious head injury on the center median. The front passenger was declared deceased on-scene. The driver complained of pain to the abdomen and was transported by ambulance to a hospital where he was treated and released. The driver of the Volvo was not injured or transported. Both vehicles and the tanker were towed due to damage and the ambulance company later took possession of the ambulance.

2008 Ford Econoline E350 Super Duty Type III Ambulance

Description

The 2008 Ford Econoline E350 Super Duty was manufactured as an incomplete cutaway cab/chassis in November 2007 and completed by Osage Industries as a Type III ambulance in May 2008. The Vehicle Identification Number (VIN) was 1FDWE35P58Dxxxxxx. A vehicle inspection form¹ completed by the EMS team at the beginning of its shift 2 days prior to the crash indicated the odometer reading at that time was 580,188 km (360,512 mi). The Ford chassis certification placard indicated a gross vehicle weight rating (GVWR) of 5,216 kg (11,500 lb). The vehicle had a payload capacity of 1,157 kg (2,550 lb) and a stated optional equipment weight of 347 kg (765 lb). The chassis was rear-wheel drive with dual rear wheels powered by a 6.0-liter, 8-cylinder, turbocharged diesel engine. The vehicle had automatic transmission, power steering and brakes, hydraulic brakes, antilock brakes, tilt steering functionality and power windows. The vehicle manufacturer recommended size LT225/75R16 tires for the front and rear with a cold pressure of 448 kPa (65 psi) for the front and 414 kPa (60 psi) for the rear. The ambulance had Firestone Transforce HT tires of the recommended size manufactured in 2018. Tread depth for the tires measured from a minimum of 7 mm (9/32 in) to a maximum of 11 mm (14/32 in).

As a Type III certified ambulance, the vehicle had a forward cab and rear patient compartment equipped for treatment of medical emergencies in a mobile environment. The cab had seating for two front-row occupants with forward-facing box-mounted seats and integral head restraints. At the time of the vehicle inspection both seats were in the full-rearward track positions. The front row seats had three-point lap and shoulder seat belts. The patient compartment had an inward-facing, three-occupant squad bench seat, a rear-facing captain's chair, and a single-occupant inward-facing seat. All patient compartment seats had manual seat belts.

Service History

The ambulance company provided service records to the SCI team. Recent service was summarized as follows. In January 2017 four of six tires were replaced and balanced.² In July 2017 a crash sensor was replaced and an illuminated air bag warning lamp was cleared. In July 2020, an inverter circuit breaker, headlamp wiring harness, headlamp switch, and headlamps were replaced. In March 2019 the exhaust system was service and the convertor and muffler were replaced.

Unit Inspection Reports

The Ford underwent a 26-point unit inspection at the beginning of each shift beginning at 0800 hours. The inspection included a check of safety systems, emergency equipment, tire pressure, fluid levels and various other components. A copy of the unit inspection report taken one day prior to this crash is included in the Appendix of this report. The inspection report for the day of the crash was not available.

¹ See Appendix A.

² The TINs documented during the vehicle inspection suggest tires were replaced again during or after 2018.

Exterior Damage

The ambulance struck two roadside reflectorized delineator posts with its front plane (Events 1 and 2). These were lightweight posts that yielded, and damage to the ambulance from the impacts was minor or masked by later events. The ambulance sustained severe crush damage to the front plane during the Event 3 impact with the Volvo. Direct damage at bumper level was distributed from bumper corner to bumper corner and the field L measured 150 cm (59.1 in). Twenty measurements were taken at bumper level using the Nikon total station and the AutoCrush tool calculated six crush measurements as follows: C1=33 cm (13.0 in), C2=40 cm (15.7 in), C3=50 cm (19.7 in), C4=37 cm (14.6 in), C5=30 cm (11.8 in), C6=27 cm (10.6 in). Maximum crush was 52 cm (20.5 in) at 90 cm (35.4 in) right of the front left bumper corner and the truck deformation classification (TDC) for the ambulance in Event 3 was 01FDEW3 (Figure 6).



Figure 6. Front plane damage, the 2008 Ford E350 Type III ambulance



Figure 7. Right plane damage, the 2008 Ford E350 Type III ambulance

The ambulance sustained moderate severity crush including direct and induced damage to the right plane caused during the Event 4 side plane to side plane impact with the tanker. Direct damage at mid-door level began at 228 cm (89.8 in) forward of the right rear axle extending forward to 373 cm (146.9 in) forward of the right rear axle. Direct damage extended vertically to the right roof rail. The field L measured 150 cm ((59.1 in). A string line was used to measure six

crush measurements as follows: C1=15 cm (5.9 in), C2=0 cm, C3=5 cm (2.0 in), C4=0 cm, C4=8 cm (3.1 in), C6=0 cm. Maximum crush was located 318 cm (125.2 in) forward of the right rear axle and the TDC for the ambulance in Event 4 was 05RDAW3 (Figure 7).

The left front wheel and tire were displaced rearward in a restricted position reducing the left wheelbase by 13 cm (5.1 in). The right front wheel and tire were displaced forward in a restricted position increasing the wheelbase by 14 cm (5.5 in). Both front tires were de-beaded. The right front tire outer sidewall had a tear measuring 40 cm (15.7 in) long.

Interior Damage

The occupant compartment was damaged by impact forces, integrity loss, air bag deployments, and occupant contacts. The windshield was fractured and out of place and the passenger side window glass was disintegrated. The front right door appeared to have opened during the crash due to damage and separation of the latch (Figure 8) from the striker (Figure 9). The striker plate and upper and lower hinges were unremarkable. Both frontal air bags deployed. The driver's seat belt exhibited scuff and stretch marks caused by occupant loading. The front row was reduced by vertical intrusion of the left roof (16 cm [6.3 in]), middle roof (24 cm [9.4 in]), right roof (10 cm [3.9 in]), left windshield header (21 cm [8.3 in]), center windshield header (28 cm [11.0 in]) and right windshield header (15 cm [5.9 in]); it was reduced by lateral intrusion of the right A-pillar (20 cm [7.8 in]) and left seat back (25 cm [9.8 in]); and it was reduced by longitudinal intrusion of the center instrument panel (15 cm [5.9 in]) and right instrument panel (15 cm [5.9 in]). The right door panel trim was fractured in all four quadrants and the right window frame was bent at the forward, upper, and rearward aspects.



Figure 8. Right side door latch, the 2008 Ford E350 Type III ambulance



*Figure 9. Right side door striker, the 2008 Ford E350
Type III ambulance*

Manual Restraint Systems

The ambulance had manual three-point continuous loop seat belts for the front row seats. The driver was belted at the time of the crash, confirmed by on-board video, the vehicle inspection, and police report. The driver's belt had light scuffing present on the latch plate and stretch marks on the webbing. The belts had retractor pretensioners. The driver's belt was not locked in place. The retractor was operational and it was not known if the pretensioner actuated during the crash.

The front passenger EMT was not belted, confirmed by on-board video, the vehicle inspection, and police report. The belt revealed evidence of historical usage but no sign of occupant loading. The retractor was non-operational and the belt was fixed in place in the stowed position. Some slack in the webbing was present. At the time of the SCI vehicle inspection, it was unknown if the pretensioner actuated, if the belt was fixed in place due to damage, or if other causes prevented it from unspooling.

The police investigation revealed the front passenger's seat belt began to malfunction the day before the crash. The ambulance was equipped with a rear-facing camera that recorded activities in the cab. Police viewed video footage captured on the day of the crash as well as the two preceding days. According to the police report, two days before the crash a female EMT is seen seated in the front passenger's seat "with the seat belt working properly." The day before the crash, the 29-year-old female involved in this crash is seen attempting "to use the seat belt and it didn't work. The seat belt was stuck in the up position and would not release." Apparently, the retractor would not release the belt and the EMT could not use it. Presumably, the EMT was unbelted during her shift that day. On the day of the crash (approximately 1 hour before the crash), the driver is seen entering the cab and fastening his seat belt. The front passenger is seen entering the cab and sitting in the front passenger seat. According to the police report, "she did not attempt to reach or put on a seat belt." Police conducted a vehicle inspection of the ambulance during their investigation. The police officer conducting the inspection tried a number of times to get the front passenger's seat belt to release, and was unsuccessful. The cause of the malfunction was not determined.

Supplemental Restraint System

The ambulance had driver and passenger frontal air bags. Both air bags deployed at impact with the Volvo. The passenger's frontal air bag exhibited slight blood splatter. Both air bags were

original equipment. Service records indicated that in July 2017 a crash sensor was replaced and an illuminated air bag warning lamp was cleared.

Patient Compartment

The patient compartment was a walk-through design. Double rear doors served for the loading and unloading of the patient cot, as well as entry for the crew. The patient compartment had a single door and window located on the forward aspect of the right wall. The interior had an inward-facing squad bench seat on the right wall, a rear-facing captain's chair on the forward wall and a single inward-facing seat on the left wall. All seats had manual seat belts. The compartment had a patient cot fastening system with a Stryker rail clamp (serial number 0804xxxxx) and an antler style stabilizer. According to the ambulance company, a Stryker patient cot was on-board at the time of the crash. It remained clamped in place during the crash and did not sustain any visible damage. Due to the age of the patient cot, it could not be recertified and was retired from service. It had been removed from the ambulance and was not available at the time of the vehicle inspection.

NHTSA Recalls and Investigations

VIN-based searches for NHTSA recalls were queried in September 2020 and October 2022, and no open recalls were found.

2008 Ford Econoline E350 Super Duty Type III Ambulance Occupants

Driver Demographics

Age/sex:	22 years/male
Height:	178 cm (70 in)
Weight:	82 kg (180 lb)
Eyewear:	Contact lenses
Seat type:	Box mounted with integral head restraint
Seat track position:	Full rearward track
Manual restraint usage:	Lap and shoulder seat belt used
Usage source:	Vehicle inspection, video, police report
Air bags:	Frontal air bag deployed
Alcohol/drug data:	None reported
Egress from vehicle:	Exited without assistance through left side door
Transport from scene:	Ambulance to hospital
Type of medical treatment:	Treated and released

The 22-year-old male driver had 3 months of experience as an EMT and 2 months of full-time employment with the ambulance company. His certifications included EMT training from a State-approved school, EMT certification through the National Registry of Emergency Medical Technicians, and Basic Life Support Provider through the American Heart Association. His specialized driver training included completion of a safe ambulance operations course administered by the ambulance company. He was enrolled in paramedic school at the time of the crash.

On the day of the crash the driver was working a 24-hour “on call” shift that began the day before and was scheduled to end at 0800 hours. This schedule was typical. During the shift and prior to the trip, the driver had several hours of time away from his job responsibilities. His activities during the time off were unknown. At the time of the crash, the EMT crew was returning from a non-emergency transport of a patient from one city to another. The patient had been transferred and the patient compartment had no occupants. The departure trip distance was 135 km (84 mi) and began at 1252 hours. The return trip distance was 134 km (83 mi) and began at 0230 hours. The crash occurred approximately 111 km (69 mi) into the return trip and 23 km (14 mi) from the final destination.

Driver Injuries

Following the crash, the ambulance driver complained of stomach pain and was transported to a hospital where he was treated and released. The hospital refused to release his medical records to SCI and no further injury data was available.

Driver Kinematics

The belted 22-year-old male ambulance driver was seated in a normal posture and was actively steering the vehicle and accelerating with his foot on the accelerator pedal. On-board video footage showed he was asleep. His eyes appeared to be closed for approximately 12 seconds while the vehicle traveled off the right edge of the roadway. He appeared to wake up and return his attention ahead while traveling off-road. In response, the driver oversteered left and lost control of the vehicle. The ambulance returned to the roadway, crossed the southbound lanes and

center median, and entered the northbound lanes. The ambulance company reported that he was braking prior to impact, which was supported by GPS log data.

At impact with the Volvo the driver was displaced to the right, loading the seat belt. His frontal air bag deployed and he likely loaded it with his face, head, and chest. Due to impact forces, the ambulance rotated counterclockwise and the driver remained in his seated position. The vehicle's right plane struck the tanker in a secondary impact and the driver was displaced to the right. The ambulance traveled a short distance in a post-impact, northbound trajectory and came to rest facing east on the right shoulder and ditch. The driver exited the ambulance without assistance and was ambulatory at the scene. Following the arrival of emergency responders, he was transported to a local hospital, treated for unspecified minor injuries, and released. The driver was subsequently placed on leave of an unknown duration from his job with the ambulance company.

Front Right Passenger Demographics

Age/sex:	29 years/female
Height:	163 cm (64 in)
Weight:	68 kg (150 lb)
Eyewear:	None
Seat type:	Box mounted with integral head restraint
Seat track position:	Full rearward track
Manual restraint usage:	Lap and shoulder seat belt not used
Usage source:	Vehicle inspection, video, police report
Air bags:	Frontal air bag deployed
Alcohol/drug data:	Positive for citalopram 400 ng/mL, caffeine
Egress from vehicle:	Fully ejected through right side door
Transport from scene:	Ambulance to unknown destination
Type of medical treatment:	None, declared deceased on-scene

The 29-year-old female was an EMT with 9 month's experience while employed full-time by the ambulance company and 2 years of prior experience as a certified nursing assistant (CNA). Her certifications included EMT training from a State-approved school, EMT certification through the National Registry of Emergency Medical Technicians, Basic Life Support Provider through the American Heart Association, and CNA through a State-approved school. Her specialized driver training included completion of an emergency vehicle operator course administered by the ambulance company during her employment orientation. She was enrolled in paramedic school at the time of the crash. On the day of the crash, she was working a 24-hour "on call" shift, which began the day before and was scheduled to end at 0800 hours. This schedule was typical.

Front Right Passenger Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Avulsive injury, head (crown of skull, brain, left eye)	113002.6	Exterior of other vehicle	Certain

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
2	Fractures, posterior, right ribs R1-R5, R9, R10	450203.3	Exterior of other vehicle	Probable
3	Laceration, parenchymal (9 cm/3.5 in) liver, right lobe	541824.3	Exterior of other vehicle	Probable
4	Contusion, parenchymal, right lung, upper lobe	441407.2	Exterior of other vehicle	Probable
5	Fracture NFS, sternum	450804.2	Exterior of other vehicle	Probable
6	Fracture NFS, right tibia	854000.2	Exterior of other vehicle	Probable
7	Fracture NFS, right fibula	854441.2	Exterior of other vehicle	Probable
8	Lacerations, minor, right ear and chin	210602.1	Exterior of other vehicle	Probable
9	Abrasions, right ear, right cheek	210202.1	Exterior of other vehicle	Probable
10	Laceration, minor, right neck	310602.1	Exterior of other vehicle	Probable
11	Abrasion, right chest	410602.1	Exterior of other vehicle	Probable
12	Hemorrhages, left adrenal gland	540210.1	Exterior of other vehicle	Probable
13	Contusion, right upper arm	710402.1	Exterior of other vehicle	Probable
14	Abrasion and contusion, left upper arm	710202.1	Ground	Probable
15	Contusions, right upper leg and knee	810202.1	Ground	Probable
16	Multiple contusions, left upper leg, knee and lower leg	810202.1	Ground	Probable
17	Abrasion, right foot	810202.1	Ground	Probable

Source: autopsy report

Front Right Passenger Kinematics

Prior to impact, the occupant was seated in a normal posture and leaning slightly right with her head facing right. On-board video footage showed she was unbelted and asleep. The right side window was closed. According to the ambulance company's safety and risk manager, traveling in the ambulance cab unbelted and while asleep are inconsistent with company training and policies. The occupant appeared to wake up when the ambulance departed the roadway. In response, she braced herself with her right arm and hand which held onto the right aspect of her seat cushion. The occupant remained in her seated position until the front plane of the ambulance

struck the Volvo. At impact, her frontal air bag deployed and she was displaced to the right where she likely contacted the left side door and possibly contacted the side glass. At impact, the glass disintegrated and the door opened as a result of the latch separating from the striker. The occupant was fully ejected through the doorway and her head contacted the left plane of the tanker near the ladder, causing an avulsive injury involving the skull, brain, and left eye, and a basilar skull fracture. Her torso and extremities contacted the tanker causing fractures to the ribs, sternum, right tibia and fibula. She sustained lacerations to the face, neck and liver; abrasions to the right lung; and abrasions to the face and chest. Following her ejection, impact forces with the tanker displaced the occupant toward the center median, where she struck the ground and came to rest. Ground contact caused abrasions and contusions to the arms, legs, and right foot. The avulsive head injury was of critical severity and she was declared deceased on-scene. The occupant's body was taken to the county coroner's facility.

2020 Volvo VNR 640 Tractor and 2019 Bulk Tank International/Walker Tanker

Description

The 2020 Volvo VNR 640 was identified by police using VIN 4V4WC9EH9LNxxxxxx. The Volvo was a tractor truck with a long conventional cab, a 12.8-liter, 6-cylinder, diesel engine, rear-wheel drive, tandem real axles, and air brakes. It had a Class 8 GVWR of 22,838 kg (50,350 lb). The Volvo was pulling a 2019 Bulk Tank International stainless steel tanker trailer manufactured by Walker Stainless Equipment Company. It was identified by police using VIN 5WSABB236KNxxxxxx. It had a GVWR of 29,484 kg (65,000 lb). The weight and length of the tanker were unknown. It contained a non-hazardous cargo at the time of the crash.

Exterior Damage

The Volvo tractor was damaged on the left plane in Event 3 and on the right plane during the rollover. The Walker tanker was damaged on the left plane in Event 4 and on the right plane during the rollover. It was unknown if post-crash damage occurred. A partial exterior inspection was completed by SCI using insurance and police photos. The second and third axle left tires of the Volvo were flat and de-beaded (Figure 10). The left side metal fuel tank was dented and the windshield was fractured and in place. The right plane including the side door and rear-view mirror showed scrape marks and minor deformation caused by ground contact. The left plane of the stainless steel tank was dented and a metal seam was split open (Figure 11). The rear aspect of the tank's right plane was dented and scraped. An access ladder mounted to the tank's right plane was bent. The left front rim of the tanker was bent and the tire was flattened. The metal fenders above the left and right side tires were deformed. The TDC for the Volvo in Event 3 was 10LKEWA. The TDC for the tanker in Event 4 was 11LTFWA. The TDC for the Volvo and tanker for the Event 5 rollover was 33RDAOA.



Figure 10. The 2020 Volvo VNR 640 (insurance photo)

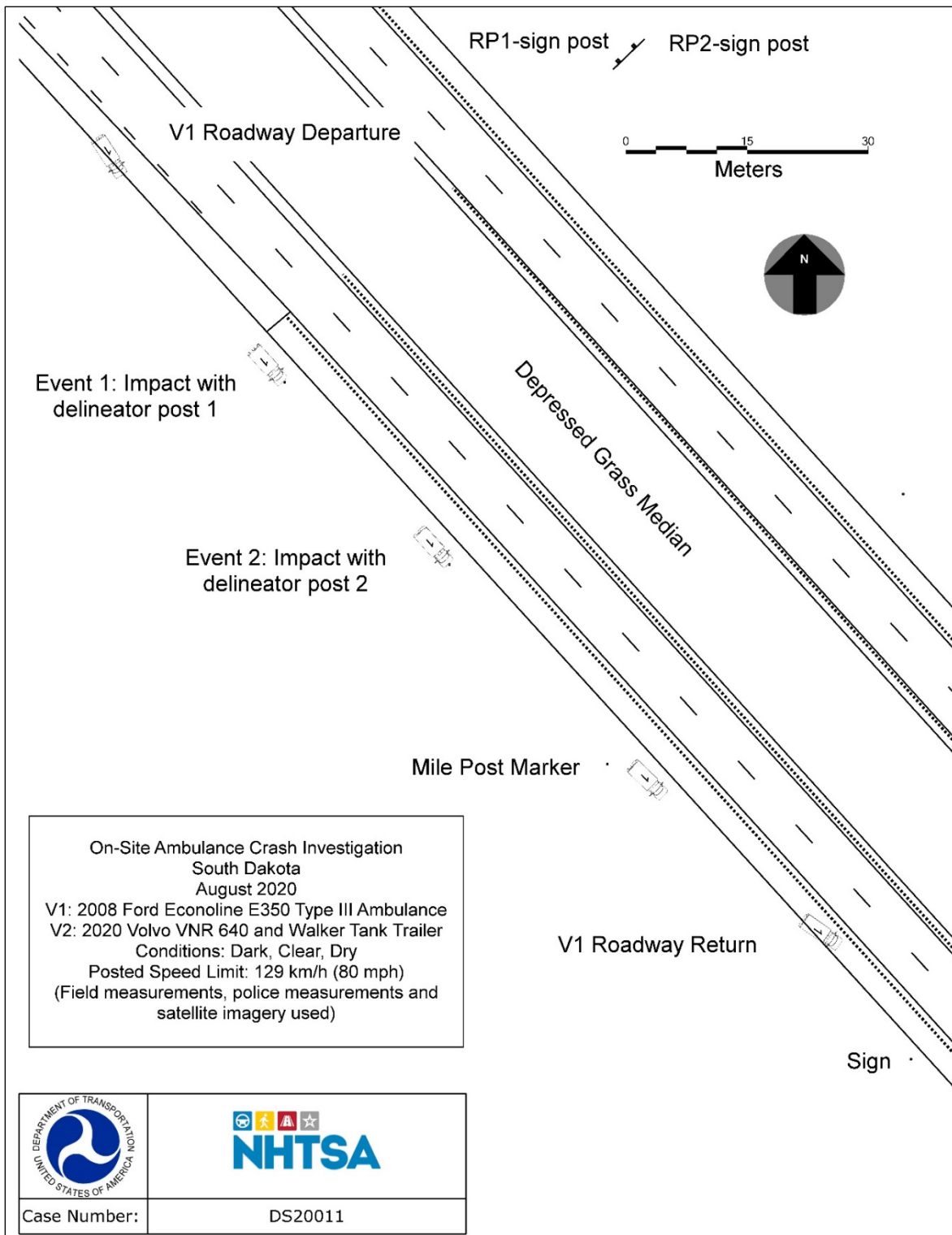


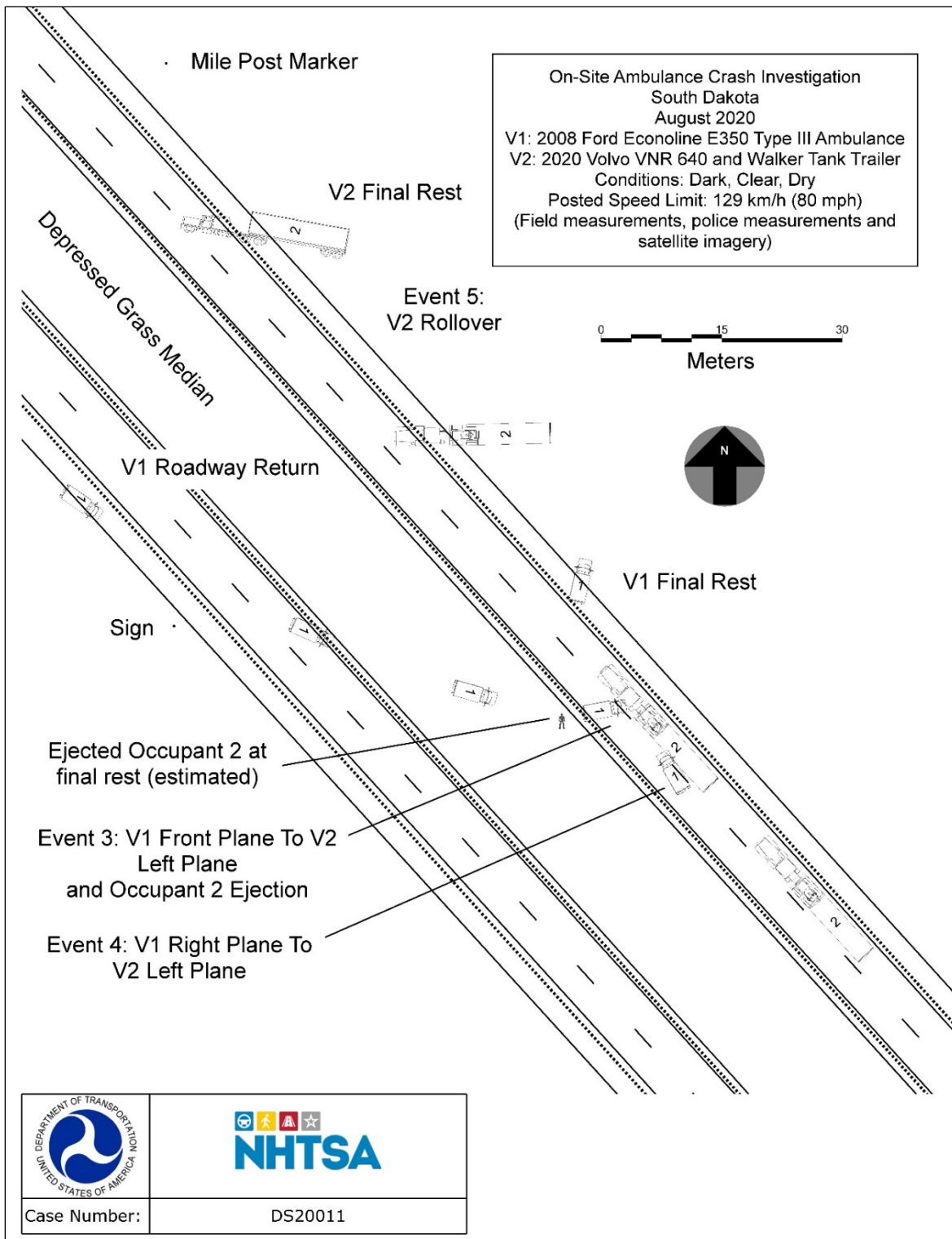
Figure 11. The 2019 Bulk Tank International/Walker tanker trailer (insurance photo)

Occupant Data

According to the police report, the Volvo driver was a belted 62-year-old male who was not injured or transported.

Crash Diagram





Appendix A: Unit Inspection Report – 2008 Ford Econoline E350 Type III Ambulance³

³ The inspection report was provided by the ambulance company. The inspection was conducted by the EMS crew at the start of their shift one day prior to the crash.

xxxx, xxxxxxxx, August xx, 2020 7:50:15 AM, xxxxx, xxxx

Question	Answer
Mileage	360512
Vehicle Registration / Insurance Info	Present / Valid
Fuel Card Present	Yes
Fuel Level	Full
Horn / Siren Operational	Yes
Emergency / Scene Lights Operational	Yes
Headlights & High Beams Operational	Yes
Hazard Lights / Indicators Operational	Yes
Oil Level	Full
Transmission Fluid Level	Full
Condition Check/ Front Driver PSI?	65
Condition Check/ Rear Passenger Inside PSI?	60
Condition Check/ Rear Driver Inside PSI?	60
Condition Check/ Rear Passenger Outside PSI?	60
Condition Check/ Rear Driver Outside PSI?	60
Condition Check/ Front Passenger PSI?	65
Shoreline Connection Operational	Yes
Paint / Body Damage	No
Seat Belts Operational	Yes
Rear Camera Operational	Not Applicable
Front / Rear Air Conditioner Operational	Yes
Other notable items not listed above	
Does Def tank need filled?	No
Main O2 Level?	800 2000
Is the truck Clean Inside and Out?	Yes
Is clipboard full of paperwork	Yes

4882, Monday, August 17, 2020 7:53:02 AM, Mohr, Donnie

Question	Answer
Mileage	358429
Vehicle Registration / Insurance Info	Present / Valid
Fuel Card Present	Yes
Fuel Level	Full
Horn / Siren Operational	Yes
Emergency / Scene Lights Operational	Yes
Headlights & High Beams Operational	Yes
Hazard Lights / Indicators Operational	Yes
Oil Level	Full
Transmission Fluid Level	Full
Condition Check/ Front Passenger PSI?	64
Condition Check/ Rear Driver Outside PSI?	60
Condition Check/ Front Driver PSI?	66
Condition Check/ Rear Passenger Outside PSI?	58
Condition Check/ Rear Driver Inside PSI?	58
Condition Check/ Rear Passenger Inside PSI?	60
Shoreline Connection Operational	Yes
Paint / Body Damage	No
Seat Belts Operational	Yes
Rear Camera Operational	Not Applicable
Front / Rear Air Conditioner Operational	Yes
Other notable items not listed above	
Does Def tank need filled?	No (Fill Tank); Yes
Main O2 Level?	2000/ 1100
Is the truck Clean Inside and Out?	Yes
Is clipboard full of paperwork	Yes

4882, Sunday, August 23, 2020 8:02:38 AM, Mohr, Donnie

Question	Answer
Mileage	359620

DOT HS 813 412
February 2023



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



15851-020723-v3a