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ON-SITE AMBULANCE CRASH INVESTIGATION

CASE NUMBER - IN16013
LOCATION - MISSOURI
VEHICLE - 2003 FORD ECONOLINE TYPE III AMBULANCE
CRASH DATE - October 2014

Contract Number: DTNH22-12-C-00270

Prepared for:

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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 in order 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 this report was published.

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INDIANA UNIVERSITY

TRANSPORTATION RESEARCH CENTER

ON-SITE AMBULANCE CRASH WITH FIRE INVESTIGATION

CASE NUMBER - IN16013

LOCATION - MISSOURI

VEHICLE - 2003 FORD ECONOLINE E-350TYPE III AMBULANCE

CRASH DATE - October 2014

BACKGROUND

The interest of this on-site investigation was the crash of a 2003 Ford Econoline E350 Type III ambulance (**Figure 1**) and the sources of the injuries to the occupants. This investigation was initiated by the National Highway Traffic Safety Administration (NHTSA) on October 29, 2014 through NHTSA's Emergency Medical Services (EMS) Office. The crash occurred in October, 2014, at 0845 hours in Missouri, and was investigated by a local police agency. Initial cooperation was established with the ambulance service on November 10, 2014. Because of ongoing litigation, authorization for inspection of the ambulance was not given until March 1, 2016. Final authorization and arrangements to inspect the ambulance were completed on April 26, 2016 and the investigation was then assigned on the same date. The crash involved the ambulance and a 2005 Peterbilt 335 with dump truck body. The crash scene was inspected on April 28, 2016 and the ambulance was inspected on April 29, 2016. A partial interview with the manager of the ambulance service was conducted on April 29, 2016. The driver of the ambulance could not be located for an interview. The Peterbilt had been repaired and was not inspected.

Figure 1: 2003 Ford E-350 ambulance

This crash occurred at the four-leg intersection of two, two-lane, undivided state highways. The ambulance was equipped with a Type III patient compartment and the cab was equipped with driver's and passenger's frontal air bags. It was occupied by a belted 21-year-old female driver and an unbelted 70-year-old male paramedic in the patient compartment. The paramedic was standing on the right side of the patient cot attending to a 77-year-old male patient, who was restrained on a Stryker Model 6500 POWER-PRO patient cot. The patient had terminal cancer and was being transported to a hospital for treatment of pain and the ambulance was operating without emergency lights or siren activated. The front plane of the ambulance impacted the right plane of the Peterbilt, which was turning left at an four-leg intersection. The driver and the paramedic sustained police reported "A" (incapacitating) injuries. Both were transported by ambulance to a hospital. The driver sustained moderate injuries and was hospitalized for four days. The paramedic sustained serious injuries and was hospitalized for 22 days. The patient sustained critical injuries and expired approximately 20 minutes after the crash. He was then taken to the county coroner's office where he was pronounced dead. The Peterbilt was a 6x4, rear wheel drive dump truck that was occupied by a belted 48-year-old male driver. He did not sustain any police reported injuries and was not transported for treatment. Both vehicles were towed from the crash scene due to damage.

Ambulance Service, Personnel, Driver Training: The ambulance service had been in operation since 1975. It provided predominantly emergency medical service but also provided non-emergency medical transport service to a 583 square kilometers (225 square miles) area with a population density of 12 people/km^2 (31/square mile). The ambulance service operated two ambulances and was a municipal operation. The service screened their drivers' records prior to employment and provided an open ended on-the-job driver training program, taught by current ambulance staff. No recertifications or defensive driving programs were required.

The driver was certified as an ambulance driver and Emergency Medical Technician (EMT) and had received driver training in EMT school as well as with this service's training program. She had been on this job for two years as a part time employee and worked on an "as needed" basis. She worked the day prior to the crash and began working at 0800 hours on the day of the crash. The paramedic also worked for the ambulance service on an "as needed" basis. He did not work the day prior to the crash and began working at 0750 hours on the day of the crash. The police crash report and reconstruction report did not indicate any driving citations issued as a result of this crash.

CRASH SUMMARY

Crash Site: This crash occurred during morning hours within the four-leg intersection of a two-lane, undivided state highway and a three-lane, undivided state highway. The weather conditions were dense fog with extremely limited visibility [0.3 km (0.2 miles)], according to local weather reports. There was no wind, the temperature was 12.8 °C (55 °F), and the dew point was 15 °C (59 °F), also according to local weather reports. Both vehicles were traveling on a portion of an undivided state highway that traversed in a general northeast-southwest direction. The ambulance's roadway curved to the right and had one through lane. The Peterbilt's roadway curved to the left and there was one through lane and a channelized right turn lane. The north leg of the intersection was a two-lane, undivided gravel road. The state highway lanes were was 3.5 m (11.5 ft) wide and were bordered by 3.0 m (9.8 ft) wide shoulders. The gravel roadway was 11.1 m (36.4 ft) wide. The roadway pavement markings consisted of a double yellow center line and solid white edge lines The northwest and southeast legs of the intersection also had one through lane in each direction. All surfaces were dry, level bituminous except the northwest leg of the intersection and the only traffic controls were stop signs on the northwest and southeast legs of the intersection. The ambulance and Peterbilt's roadway had a superelevation of -7% to the north and the speed limit was 88.5 km/h (55 mph). The Crash Diagram is included on page 16 of this report.

Figure 2: Ambulance's southwest approach to impact area

Pre-Crash: The ambulance was traveling southwest in the southwestbound lane (**Figure 2**) without the siren or flashing lights activated and the driver intended to continue southwest. At the intersection, a tractor semi-trailer (grain truck) was stopped in the southwestbound lane, and the driver was waiting for northeastbound traffic to clear so he could turn left. The Peterbilt was traveling

northeast in the northeastbound lane (**Figure 3**) and the driver intended to turn left at the intersection to proceed northwest. The Ambulance's driver steered to the right, onto the shoulder, and across the north leg of the intersection to proceed around the semi truck and resume westbound travel. Since the ambulance was operating without siren and flashing lights, this was not a legal maneuver, according to Missouri state traffic law. Based on the police crash diagram, the Ambulance driver steered to the right to avoid the crash. It is unknown if the Peterbilt driver attempted any avoidance maneuvers prior to the crash.

Figure 3: Intended travel path of Peterbilt

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Crash: The front plane of the Ambulance impacted the right plane of the Peterbilt. The force direction was within the 11 o'clock sector to the Ambulance and both frontal air bags deployed. The WinSMASH program could not be used to calculate Delta V for either vehicle since an impact with a heavy trucks is out of scope for the program. The Barrier Equivalent Speed calculated by WinSMASH was 18 km/h (11 mph) and this result was considered to be low, based on the damage to the Ambulance. The police reconstruction report calculated Delta V for the Ambulance as a range between 25.7 km/h (16 mph) and 30.6 km/h (19 mph). The patient cot remained fastened in the antler bracket and rail clamps, but the patient slid forward and out of the patient cot restraints as a result of the impact. The vehicles remained in contact after the impact and were redirected in a northwesterly direction, approximately 4 m (13.1 ft). The Ambulance rotated clockwise approximately 20 degrees coming to final rest heading northwest. The Peterbilt rotated counterclockwise approximately 25 degrees, coming to final rest heading northwest (**Figure 4**).

Figure 4: Ambulance and Peterbilt at final rest

Post-Crash: The police were notified of the crash at 0851 hours and arrived on scene at 0914 hours. Emergency medical and rescue services also responded. The driver of the Ambulance was pinned inside the vehicle and was extricated through the mechanically removed right front door. She sustained police reported "A" (incapacitating) injuries and was transported by ambulance to a hospital where she was admitted for four days for treatment of moderate injuries. The paramedic was lying against the right side door of the patient compartment and tumbled out when it was opened by emergency responders. He sustained police reported "A" injuries and was transported by ambulance to a hospital where he was admitted for 22 days for treatment of serious injuries. The patient was found on the floor in the fetal position, in the transition area between the cab and patient compartment. He sustained critical injuries and expired approximately 20 minutes post-crash and prior to the investigating officer's arrival. He was then taken to the county coroner's office where he was pronounced deceased.

DESCRIPTION

The Ambulance was an incomplete cutaway rear-wheel drive, two-passenger, two-door super duty cargo base van configured with an ambulance body, (VIN: 1FDWE35F93Hxxxxxx), manufactured in February, 2003. The Type III ambulance patient compartment was manufactured in June, 2003 by Wheeled Coach Industries. The vehicle was equipped with a 7.3-liter, V-8 diesel engine, five-speed automatic transmission, four-wheel anti-lock brakes, and driver's and passenger's frontal air bags. The patient compartment was configured with one right side entry door, double doors on the back plane for patient loading, and multiple storage cabinets along the right and left sides. An oxygen cylinder was normally located in a storage compartment under the right side bench seat but had been removed prior to SCI inspection. There were no issues with the oxygen cylinder, according to the ambulance service manager. The windshield glazing was AS1 laminated and the left front and right front glazings were AS2 tempered. The two right side glazing panels and four backlight glazing panels were AS3 tempered with original tinting. All of the glazing was either closed or fixed, prior to the crash. The specified wheelbase was 351 cm (138 in). The vehicle was not equipped with an Event Data Recorder (EDR).

The vehicle manufacturer's recommended tire size was LT225/75R16 for the front and rear tires and the vehicle was equipped with Firestone Transforce HT tires of the recommended size. The vehicle manufacturer's recommended cold tire pressure for the front and rear tires was 448 kPa (65 psi) and 414 kPa (60 psi), respectively. All tires were visually in good condition.

The front row was equipped with cloth covered bucket seats and integral head restraints. The patient compartment was configured with a vinyl covered, rear-facing, bucket seat located behind the driver and a three passenger padded bench seat on the right side. There were storage cabinets located along the left and front walls.

EXTERIOR DAMAGE

The Ambulance sustained front plane damage during the impact with the Peterbilt. The front bumper, grille, radiator, hood, left and right headlamp and turnlamp assemblies, and the left A-pillar were directly damaged (**Figure 5**). The direct damage began at the left end of the radiator support and extended 150 cm to the right. The undeformed end width was 176 cm (69.3 in) and the Field L was 140 cm (55.1 in). The crush measurements were taken on the lower radiator support and the front bumper and averaged where necessary, according to NASS vehicle crush measurement protocol. There was no crush to the front bumper. The maximum residual crush above the bumper was 64 cm (25.2 in), occurring at C_1. The averaged crush values were: C_1 = 32 cm (12.6

Figure 5: 2003 Ambulance E350 front end damage

in), C_2 = 32 cm (12.6 in), C_3 = 14 cm (5.5 in), C_4 = 8 cm (3.1 in), C_5 = 0, C_6 = 0. The vehicle's left side wheelbase was reduced 16 cm (6.3 in) and the right side wheelbase was extended 8 cm (3.1 in).

INTERIOR DAMAGE

Front Row: The interior of the Ambulance sustained severe damage from intrusion to the passenger compartment. The most severe intrusions to the driver's area involved the center instrument panel, toe pan, and steering wheel, which intruded longitudinally 41 cm (16.1 in), 34 cm (13.4 in), and 31 cm (5.9 in), respectively. Both front doors were jammed and mechanically opened by rescue personnel. The windshield glazing was cracked but in place and the left front glazing disintegrated impact forces. The remaining window glazing was undamaged.

Patient Compartment: Inspection of the patient compartment revealed no damage from intrusion. The right side door and rear doors were undamaged and operational. Scuffs from occupant contact and blood stains were noted on the cabinet door padding (**Figure 6**) above the rear facing seat and on the right cabinet wall, from the floor to the top of the cabinet. Blood drips were also noted on the right door.

Figure 6: Interior of patient compartment, forward wall/cabinets and rear facing seat

MANUAL RESTRAINT SYSTEMS

The front row was equipped with driver and front right passenger lap and shoulder safety belts with locking latch plates and fixed upper anchors.

The driver was restrained by the lap and shoulder safety belt as indicated by the condition of the safety belt and an injury the driver sustained as follows: Inspection of the driver's safety belt assembly revealed that the shoulder portion of the belt webbing was melted (**Figure 7**) and would not fully retract into the B-pillar. This damage was caused by contact to the driver's frontal air bag inflator as indicated by a burn hole in the back side of the air bag and a 3rd degree burn located above the driver's left breast that her medical records stated was caused by contact with hot metal.

Figure 7: Driver's safety belt burn damage from the driver's frontal air bag inflator

The patient compartment's rear facing seat was equipped with a lap and shoulder belt. There was no passenger in this seat at the time of the crash.

The patient compartment's right side bench seat was equipped with three lap belts that were secured to the right side wall. The paramedic was standing between the patient cot and this seat and was attending to the patient according to the ambulance service manager.

PATIENT COT

The cot that was used to transport the patient was a Stryker REF Model 6500 POWER-PRO (**Figure 8**), serial number 11114xxxx. It was an X-frame design, and could carry a maximum of 318 kg (700 lbs). It was 206 cm (81.1 in) in length and 58 cm (22.8 in) in width and had a height range of 36 cm (14.2 in) to 105 cm (41.3 in). The back rest could be adjusted from 0-73 degrees from horizontal. The cot was equipped with shoulder, torso, and thigh restraints. These restraints were nylon webbing straps, all of which were looped around the cot frame rail. They could slide along the frame rail to adjust for each patient.

Figure 8: Stryker 6500 Power Pro patient cot (padding removed)

The cot was secured by the antler bracket and rail clamp and remained secured throughout the crash. The antler bracket secured the head of the cot by restraining the undercarriage using the wheel frames as anchor points. The rail clamp was located at the back left of the patient compartment and secured the cot to the floor. SCI inspection discovered no abnormalities in the patient cot, its restraints, antler bracket ,or rail clamp and all components were in good working condition.

According to the driver's statement in the police reconstruction report, the patient was secured to the cot by the shoulder, torso, and thigh restraints when was loaded into the ambulance and the recline angle of the back rest was 30 degrees. The police reconstruction report also stated that the patient was found by emergency responders in the fetal position on the floor of the patient compartment, beside the rear facing seat suggesting that the shoulder restraints had been removed during transport and the patient slid under the torso and thigh restraints and came off the cot during the crash. The ambulance service manager stated during the SCI interview that it is standard procedure to secure the patient with all restraints and that removing the shoulder restraints is at the discretion of the paramedic, if he deems it necessary to treat the patient.

Figure 9: Back of driver's air bag burn damage from inflator

SUPPLEMENTAL RESTRAINT SYSTEMS

The ambulance was equipped with frontal air bags for the front row seating positions. Both air bags deployed as a result of the impact.

The back of the driver's frontal air bag had a 9 x 6 cm (3.5 x 2.4 in) burn hole (**Figure 9**) at the upper right side. This damage occurred when the air bag fabric was pressed between the driver and the inflator, due to the forward displacement of the driver and rearward displacement of the steering assembly during the crash. There was also a 0.5 cm (0.2 in) burn hole in the back left side or the air bag related to this occurrence.

The passenger's frontal air bag was removed along with the entire instrument panel assembly. The air bag was inspected and no abnormalities were noted.

2003 AMBULANCE ECONOLINE E-350TYPE III AMBULANCE OCCUPANTS

DRIVER DEMOGRAPHICS

Age/Sex:	21 years/Female
Height:	152 cm (60 in)
Weight:	86 kg (190 lb)
Eyewear:	Glasses
Seat Type:	Bucket seat
Seat Track Position:	Unknown
Manual Restraint Usage:	Lap and shoulder belt
Usage Source:	Vehicle inspection
Air Bags	Frontal, deployed
Alcohol/Drug Involvement:	Police reported none
Egress from Vehicle:	Extricated through driver's door
Transport from Scene:	Ambulance
Medical Treatment:	Hospitalized four days

DRIVER INJURIES

Injury Number	Injury	AIS 2005/08	Injury Source	Confidence Level
1	Fracture[1], bimalleolar[2], distal right tibia including a displaced medial malleolus, widening of tibiofibular space with fragments from posterior malleolus, not further specified	854361.2,1	Floor, foot controls	Certain

[1] Initially the driver had a closed reduction before being discharged but subsequently required an open reduction and internal fixation as an outpatient after the swelling had subsided.

[2] In this case the medial malleolus and posterior malleolus of the tibia were involved.

Injury Number	Injury	AIS 2005/08	Injury Source	Confi-dence Level
2	Fracture distal right fibula diaphyseal, moderately displaced and angulated, and probable distal fibula metaphysis (Weber C, stage IV[3]), not further specified	854471.2,1	Floor, foot controls	Certain
3	Dislocation/subluxation right tibiotalar joint (ankle), involving disruption of ankle mortise and shear injury to medial distal tibia and talus, not further specified	877130.2,1	Floor, foot controls	Certain
4	Fracture, open[4], cortical ulnar aspect left 4th metacarpal diaphysis with minimal displacement requiring surgical repair	752501.2,2	Left instrument panel	Certain
5	Laceration (torn), partial, extensor tendons in dorsum (top) of left hand (EDC[5]), requiring surgical repair, not further specified	740200.1,2	Left instrument panel	Certain
6	Laceration dorsal cutaneous branch left ulnar nerve, requiring surgical repair, not further specified	730804.2,2	Left instrument panel	Certain
7	Hematoma, small, left posterior-parietal scalp, not further specified	110402.1,2	A-pillar, left	Probable
8	Burn, 8.5 by 5 cm (3.3 x 2.0 in) left chest wall with the burn center, 3rd degree, 7 by 3.5 cm (2.8 x 1.4 in) on chest, above left breast; < 1% total body surface (TBS) area involved	912007.1,5	Air bag module[6] inflator	Probable
9	Contusion (bruising) over left scapular area, not further specified	710402.1,2	Seat back, driver's	Probable
10	Contusion (resolving hematoma) over right proximal medial lower leg, not further specified	810402.1,1	Left lower instrument panel (includes knee bolster), right of steering column	Probable
11	Laceration, 3 cm (1.2 in), superficial infra-patellar (below) anterior petella (knee), requiring surgical repair, not further specified	810602.1,1	Left lower instrument panel (includes knee bolster), right of steering column	Certain

Sources: Emergency Room Records, Hospitalization Records, and Interviewee Data–Friend. Injury

[3] See http://www.radiologyassistant.nl/en/p420a20ca7196b/ankle-fracture-weber-and-lauge-hansen-classification.html

[4] Laceration, large, dorsum (top) of left hand exposing tendon.

[5] See https://en.wikipedia.org/wiki/Extensor_digitorum_muscle

[6] The operative summary report indicated that the burn was cause by contact with hot metal.

*Numbers 7, 9, and 10 came only from **Emergency Room Records**. Injury Numbers 5 and 6 came only from **Hospitalization Records**. Injury Numbers 3, 4, and 11 came from a combination of **Emergency Room** and **Hospitalization Records**. Injury Numbers 1, 2, and 8 came from a combination of all sources.*

DRIVER KINEMATICS

The driver was restrained by the lap and safety shoulder belt. The front plane impact with the Peterbilt displaced the driver forward and slightly to the left, opposite the 11 o'clock direction of force, and she loaded the safety belt and frontal air bag. She sustained ~~a~~ tibial and fibial fractures in her lower right leg and a dislocation of her right ankle due to intrusion of the brake pedal. She sustained a 8.5 cm (3.3 in) burn on her left upper chest from contact with the air bag inflator as she was displaced forward and loaded through the frontal air bag and the steering assembly was displaced rearward. She sustained an open fracture of the left 4th metacarpal and lacerations to the extensor tendons and left ulnar nerve in her left hand from contacting the intruded left instrument panel. The driver's head contacted the left A-pillar resulting in a hematoma to the left posterior-parietal scalp. The driver's right lower leg and knee contacted the intruded left lower lower instrument panel, causing a contusion of the lower leg and laceration of the knee. The driver then rebounded and she sustained a contusion to the left scapular area from contact to the seat back.The driver was transported by ambulance to a trauma center where she was hospitalized for four days.

PARAMEDIC DEMOGRAPHICS

Age/Sex:	70 years/Male
Height:	191 cm (75 in)
Weight:	127 kg (280 lb)
Eyewear:	Glasses
Seat Type:	Not seated; standing/hovering and attending to the patient on the right side of the cot
Seat Track Position:	N/A
Manual Restraint Usage:	None
Usage Source:	Vehicle inspection/Ambulance manager interview
Air Bags	None available
Alcohol/Drug Involvement:	None reported
Egress from Vehicle:	Tumbled out of right door to patient compartment when opened by rescue personnel
Transport from Scene:	Ambulance
Medical Treatment:	Hospitalized 22 days

Injury Number	Injury	AIS 2005/08	Injury Source	Confidence Level
1	Fracture anterior squamous portion of right temporal bone, not further specified	150402.2,1	Other interior object: padded bulkhead above the rear-facing seat	Certain
2	Fracture right orbit, including greater wing of right sphenoid, septum of sphenoid sinus, and inferior (floor) and lateral orbital walls	251205.2,1	Other interior object: padded bulkhead above the rear-facing seat	Certain
3	Fracture maxillary sinus, anterior and lateral walls, not further specified	250800.2,1	Other interior object: padded bulkhead above the rear-facing seat	Certain
4	Fracture right zygomatic arch, not further specified	251806.1,1	Other interior object: padded bulkhead above the rear-facing seat	Certain
5	Fractured ribs: left 12th posteriorly, right 1st rib posteriorly and right 1st costosternal cartilage, right 5th through 9th ribs, right 4th through 6th, and 8th costosternal cartilage with displacement	450203.3,3	Other interior object: rear-facing seat	Certain
6	Fracture C_7 right transverse process, not further specified	650220.2,6	Other interior object: padded bulkhead above the rear-facing seat (indirect injury)	Certain
7	Dislocation[7] right glenohumeral joint with humeral head dislocated anterior-inferiorly	771030.2,1	Other interior object: left edge of right side cabinet	Probable
8	Fracture, comminuted, avulsed, right coracoid process of scapula with displacement	750971.2,1	Other interior object: left edge of right side cabinet	Probable
9	Fracture right scapula involving infraspinous fossa extending through scapular spine and supraspinous fossa	750951.2,1	Other interior object: left edge of right side cabinet	Probable
10	Fracture[8], comminuted, severely displaced left humeral neck with 2.5 cm (1 in) overriding and anterosuperior dislocation of humeral neck; head remained within glenoid fossa but is comminuted; fracture involves comminution to greater tuberosity	751171.2,2	Other interior object: left side cabinets	Probable

[7] The right shoulder was initially reduced in the emergency room but subsequently required open reduction and internal fixation.

[8] Treatment involved a left total shoulder reverse arthroplasty.

Injury Number	Injury	AIS 2005/08	Injury Source	Confidence Level
11	Fracture right 3rd middle phalanx with head/neck minimally displaced, not further specified	752653.1,1	Other interior object: rear-facing seat	Probable
12 13	Fracture[9], minimally displaced, right femoral neck; fracture, comminuted and slightly impacted, right femoral head–with head remaining within acetabulum	853161.3,1 853171.3,1	Other interior object: rear-facing seat	Certain
14	Fracture, non-displaced, right inferior pubic ramus, not further specified	856151.2,4	Other interior object: rear-facing seat	Certain
15	Laceration, 3 cm (1.2 in), small, intra-parenchymal posterior inferior[10] right lobe of liver, with	541822.2,1	Other interior object: rear-facing seat	Certain
16	Contusion (hematoma) intraparenchymal liver with small peri-hepatic hemoperitoneum, not further specified	541812.2,1	Other interior object: rear-facing seat	Certain
17	Contusion, small venous, right superior mesentery, posterior medial to hepatic flexure, not further specified	542010.2,8	Other interior object: rear-facing seat	Probable
18	Contusion (hematoma) right subconjunctival with lateral gaze palsy right eye, without visual changes, not further specified	240416.1,1	Other interior object: padded bulkhead above the rear-facing seat	Certain
19 20	Laceration, 2.5 cm (1 in) right upper eyelid[11] with contusion (ecchymoses to right upper and lower eyelids	210602.1,1 210402.1,1	Other interior object: padded bulkhead above the rear-facing seat	Certain
21 22	Abrasions and contusions (bruising) to face, not further specified	210202.1,9 210402.1,9	Other interior object: padded bulkhead above the rear-facing seat	Certain
23	Contusions (hematomas), bilaterally, supraclavicular/retropectoral (at level of shoulders), not further specified	410402.1,7	Other interior object: rear-facing seat	Probable
24	Abrasions bilateral upper extremities including left hand, not further specified	710202.1,3	Other interior object: rear-facing seat	Probable

[9] Treatment involved a total right hip arthroplasty.

[10] The location was also described as posterolateral dome of right lobe.

[11] Required surgical repair in the emergency room.

Injury Number	Injury	AIS 2005/08	Injury Source	Confidence Level
25	Contusions (bruising) about arms, not further specified	710402.1,3	Other interior object: rear-facing seat	Probable
26 27	Lacerations dorsum right hand and posterior left forearm, not further specified	710600.1,1 710600.1,2	Other interior object: rear-facing seat	Possible
28	Contusion (hematoma) right lateral thigh, not further specified	810402.1,1	Other interior object: left edge of right side cabinet	Probable
29	Contusions left leg, not further specified	810402.1,2	Other interior object: rear-facing seat	Probable

*Sources: Emergency Room Records, Hospitalization Records, and Interviewee Data–Friend. Injury Number 25 came only from **Interviewee Data**. Injury Numbers 24, 26, 27, and 29 came only from **Emergency Room Records**. Injury Numbers 16, 17, 19, and 20 came only from **Hospitalization Records**. Injury Number 11 came from a combination of **Interviewee Data** and **Hospitalization Records**. Injury Numbers 1 through 7, 14, 18, 21, 22, and 28 came from a combination of **Emergency Room** and **Hospitalization Records**. Injury Numbers 8 through 10, 12, 13, 15, and 23 came from a combination of all three sources.*

PARAMEDIC KINEMATICS

According to medical documents, the paramedic was standing/hovering and attending to the patient at Model Minimum Uniform Crash Criteria (MMUCC) position 5, to the right of the cot. The impact with the Peterbilt displaced the paramedic forward and slightly to the left, opposite the 11 o'clock direction of force. He sustained fractures to the right temporal bone, right orbital bone, and zygomatic arch, the anterior and lateral walls of the maxillary sinus, and the C_7 transverse process, from contact to the padded bulkhead above the rear-facing seat. The impact with the bulkhead also resulted in a hematoma of the right subconjunctival, a 2.5 cm (1 in) long laceration of the right upper eyelid with contusion to the right upper and lower eyelids, as well as abrasions and contusions to the face. The paramedic also contacted the left edge of the right side equipment cabinet. This resulted in a dislocation of the right glenohumeral joint, and a comminuted and avulsed fracture of the right scapula. The paramedic also contacted the rear facing seat and sustained multiple bilateral fractures to the rib cage, fractures to the 3rd middle phalanx, the right femoral neck, and the right pubic ramus. This contact also resulted in a laceration and hematoma to the liver, contusions to right and left legs, and a contusion to the right superior mesentery. He also sustained contusions to the back of both shoulders as well as contusions, lacerations, and abrasions to both upper extremities. He also contacted the left side cabinets and sustained a comminuted fracture and dislocation to the left humeral head.

According to the police reconstruction report, the paramedic came to final rest in an supine position near the right door and tumbled out of the door and onto the ground as the door was opened by rescue personnel. He was transported by ambulance and was hospitalized for 22 days.

Age/Sex:	77 years/Male
Height:	188 cm (74 in)
Weight:	86 kg (190 lbs)
Eyewear:	None
Seat Type:	Supine on ambulance cot with head of cot angled at 30 degrees
Seat Track Position:	N/A
Restraint Usage:	Initially secured by shoulder, torso, and thigh cot restraints; Shoulder restraints likely removed prior to impact
Manual Usage Source:	Ambulance service owner interview
Air Bags	None available
Alcohol/Drug Involvement:	None reported
Egress from Vehicle:	Fatal before removal
Transport from Scene:	Medical Examiner
Medical Treatment:	Expired approximately 20 minutes after crash

PATIENT INJURIES

Injury Number	Injury	AIS 2005/08	Injury Source	Confidence Level
1	Herniation, cerebellar tonsillar, with flattening of gyri, narrowing sulci, and uncal grooving[12]	140202.5,8	Other interior object: rear-facing seat cushion or seat back	Certain
2	Hemorrhage, subarachnoid at base of brain, not further specified	140694.2,9	Other interior object: rear-facing seat cushion or seat back	Certain
3	Fractured ribs: **right** 1st through 4th anteriorly, right 1st and 2nd laterally, and right 1st through 9th posteriorly; **left** 1st through 4th anteriorly and 1st through 5th posteriorly	450203.3,3	Other interior object: rear-facing seat cushion or seat back	Certain
4	Hemothoraces, bilateral, 600 cm left pleural and 400 cm right pleural cavities, not further specified	442200.3,3	Other interior object: rear-facing seat cushion or seat back	Certain
5	Lacerations[13], multiple, thoracic spinal cord with multiple fractures and cord distortion specifically at T_6	640464.5,7	Other interior object: rear-facing seat cushion or seat back	Certain

[12] There were no skull fractures, epidural or subdural hemorrhages, or scalp contusions.

[13] According to the Forensic Pathologist: ... obvious that multiple thoracic vertebra (5, 6 and 7) were multiply fractured. The cord was multiply lacerated. We do not open the back on cases where injuries are documented anteriorly but the spinal cord is angled forward at the level of 6 therefore the force was from the back most likely and spinous processes were most likely fractured. Due to the extensive nature of the fractures the lateral processes were involved also.

Injury Number	Injury	AIS 2005/08	Injury Source	Confidence Level
6 7	Fractures, multiple, at T_5 and T_7 involving the body and processes, spinous and transverse, not further specified	650417.2,7 650417.2,7	Other interior object: rear-facing seat cushion or seat back	Certain
8	Laceration, curve, diagonal, 5.8 cm (2.3 in), on posterior scalp, not fur-ther specified	110602.1,6	Other interior object: rear-facing seat cushion or seat back	Certain
9	Abrasions, patterned, 18.3 by 12 cm (7.2 x 4.7 in) upper right back and 1.5 cm (0.6 in) right upper back, not further specified	410202.1,6	Other interior object: rear-facing seat cushion or seat back	Certain
10	Abrasion, 8 by 7 cm (3.1 x 2.75 in) over right upper lateral hip, not further specified	510202.1,8	Other interior object: ambulance cot, patient belt(s)	Probable
11	Contusion, 3.5 by 5 cm (1.4 x 2.0 in) on left anterior shin, not further specified	810402.1,2	Other interior object: left side cabinets	Probable

*Sources: Autopsy Records, Medical Examiner Records, and Interviewee Data–Other: ambulance service manager. Injury Numbers 2 through 11 came only from **Autopsy Records**. Injury Number 1 came from **Autopsy Records**.*

PATIENT KINEMATICS

The patient was situated supine on the cot (MMUCC position 8), with the cot's head reclined 30 degrees from horizontal. He was secured by the torso, thigh, and shoulder restraints as he was loaded into the ambulance, according to the statement given by the driver. The cot was secured to the floor by the antler bracket and rail clamp. At some point after the patient was loaded, the shoulder straps were removed from the patient, most likely for the paramedic to facilitate treatment. The front plane impact displaced the patient forward and slightly to the left opposite the 11 o'clock direction of force and slid under the torso and thigh restraints, and out of the cot. He contacted the rear facing seat and sustained a herniation of the cerebellar tonsillar, a subarachnoid hemorrhage at the base of the brain, bilateral fractures of the anterior and posterior ribs, hemothoraces of the left and right pleural cavities, and multiple lacerations of the thoracic spinal cord with multiple fractures and cord distortion at T_6. He also sustained multiple fractures at T_5 and T_7, a 5.8 cm (2.3 in) laceration to the posterior scalp, and abrasions to the right upper back. He sustained critical injuries and expired 20 minutes post-crash. He was then taken to the county coroner's office where he was pronounced dead.

DESCRIPTION

The Peterbilt incomplete vehicle was a 6x4 rear wheel, three-occupant, two-door truck-tractor with dump truck body (VIN: 2NPLLZ9X75Mxxxxxx), equipped with a 7.3-liter I-6 engine, a dual air brake system and four-channel anti-lock brakes.

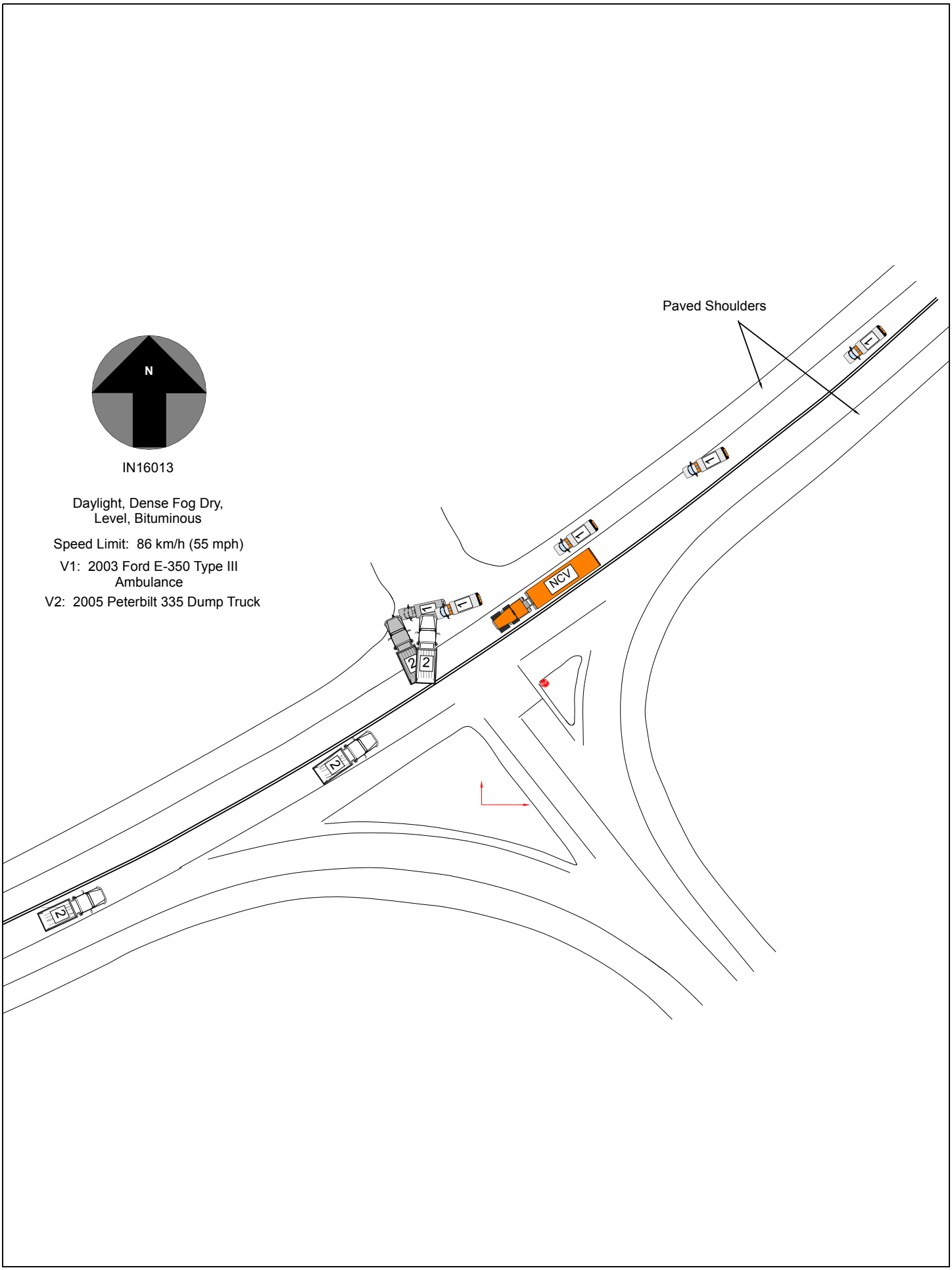
Figure 10: 2005 Peterbilt 335 dump truck

EXTERIOR DAMAGE

The Peterbilt sustained right and front plane damage, based on police on-scene images. The front bumper, engine cowl, and right front wheel were directly damaged.

OCCUPANT DATA

The driver of the Peterbilt (48-year-old male) was restrained by the lap-and-shoulder safety belt, according to the police crash report. He did not sustain any police reported injuries and was not transported for medical treatment.


N
IN16013
Daylight, Dense Fog Dry,
Level, Bituminous
Speed Limit: 86 km/h (55 mph)
V1: 2003 Ford E-350 Type III
Ambulance
V2: 2005 Peterbilt 335 Dump Truck
Paved Shoulders
NCV
1
2
2
1
1
1
1