ACCIDENT RECONSTRUCTION GROUP
FORENSIC DOCUMENTATION
CHAIRMAN'S FACTUAL REPORT

Fatal Grade Crossing Accident
Midland, TX; 11/15/2012

HWY-13-MH-003
(23 Pages)

NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF HIGHWAY SAFETY
WASHINGTON, D.C. 20594

A. ACCIDENT

LOCATION:	At the intersection of South Garfield Street and the Union Pacific Railroad (UPRR), Mile Post 554.74, DOT grade crossing inventory #796-331L, Midland, Midland County, Texas
VEHICLE 1:	2006 Peterbilt truck-tractor in combination with a 2005 Transcraft D-Eagle Drop-Deck Flatbed Semitrailer
OPERATOR:	Smith Industries of Midland, Texas
VEHICLE 2:	Union Pacific Freight Train ZLCAI-14, consisting of 4 locomotives and 84 loaded cars
OPERATOR:	Union Pacific Railroad (UPRR)
VEHICLE 3:	2008 Ford Crown Victoria Police Interceptor
OPERATOR:	Midland County Sheriff Office
DATE:	November 15, 2012
TIME:	Approximately 4:35 p.m. CST
NTSB #:	**HWY-13-MH-003**

B. ACCIDENT RECONSTRUCTION FACTORS GROUP

Robert Squire — Accident Investigator — Group Chairperson
Office of Highway Safety
National Transportation Safety Board
Washington, DC 20594

Steven Prouty — Vehicle Factors Investigator
Office of Highway Safety
National Transportation Safety Board
Arlington, TX 76011

Dan Walsh — Highway Factors Investigator
Office of Highway Safety
National Transportation Safety Board
Arlington, TX 76011

Sergeant Jim Crouse — Law Enforcement Representative
Midland Police Department
Midland, TX 79701

C. FORENSIC DOCUMENTATION

1. Introduction

On Thursday, November 15, 2012, the National Transportation Safety Board initiated an investigation of a highway-railroad grade crossing[1] (rail crossing) collision that occurred on South Garfield Street between West Front Avenue and West Industrial Avenue in Midland, Texas. A 2006 Peterbilt truck-tractor in combination with a 2005 Transcraft D-Eagle drop-deck flatbed semitrailer (Peterbilt combination) was traveling southbound on Garfield Street in a slow-moving procession that was under law enforcement escort.

Immediately preceding the rail crossing South Garfield Street intersects with West Front Avenue. The intersection is controlled by traffic signals that are also interconnected with the rail crossing warning system. The rail crossing warning system was comprised of flashing lights, audible bell and automatic gates. As the Peterbilt combination approached West Front Avenue it faced a red signal but was permitted to cross the intersection by law enforcement. Before the Peterbilt combination reached the rail crossing approach, the crossing warning lights and bell had activated.

As the Peterbilt combination entered the rail crossing, Union Pacific Freight Train ZLCAI-14, consisting of 4 locomotives and 84 loaded cars was approaching from the west. The locomotive engineer sounded the locomotive horn and placed the train into emergency braking. As both units occupied the crossing the right front corner of the lead locomotive struck the semitrailer at the passenger side (right) rear.

The impact propelled the semi-trailer into a clockwise rotation around the unit's coupling with the truck tractor. The tail end of the trailer collided with another motor vehicle near the end of its rotation. This second motor vehicle was a 2008 Ford Crown Victoria occupied by personnel from the Midland County (Texas) Sheriff's Office.

The collision events resulted in eighteen persons sustaining injury, four of which were fatalities.

Primary forensic documentation involved photographs, measurements and laser scanning of the truck tractor, semitrailer, lead locomotive, rail crossing and rail crossing approach. Investigators also photographed and measured the damage to the Midland County Sheriff Department vehicle. This report provides descriptions of significant observations and

[1] The grade crossing is owned and operated by the Union Pacific Railroad (UPRR) and is identified by DOT grade crossing inventory #796-331L, at UPRR Mile Post 554.74.

information regarding the documentation process. Factual reports prepared by other investigative groups should be consulted for additional details.

All photographs were taken in digital format using an SLR camera. Laser scanning was accomplished using the FARO Focus 3D[2] scanner that yielded multiple linked scans of the locomotive, commercial motor vehicle and grade crossing. The scans were preprocessed and converted to select three-dimensional images to depict various perspectives of the subject material. Additional processing permitted the data to be exported for use in various CAD software applications to acquire additional dimensional data and create two-dimensional renderings of the highway environment.

2. Locomotive Documentation

Upon the arrival of NTSB investigators, the lead locomotive, identified as UPRR unit 7877, had been decoupled from the remainder of the train and parked along a siding approximately 2.9 miles east of the accident location. The locomotive was initially examined and scanned on November 16, 2012, the day following the collision with additional examination taking place two days later on November 18, 2012, at a secured rail facility in Odessa, TX.

The locomotive was identified as a General Electric Evolution Series model ES44AC (UPRR model designation C45ACCTE) having an overall length of 73.16 feet, a maximum width of 10.25 feet and a nominal weight in excess of 400,000 pounds. In addition to photographs, a total of five stations were established for the scanner effectively covering all exterior vertical surfaces of the locomotive (top of the unit was not captured). Figures 1 and 2 depict the lead locomotive by way of photography and a screen capture of the colorized three-dimensional linked scans.

Figure 1: Photograph of subject locomotive taken during follow up examination

[2] The FARO Focus3D is a high-speed Terrestrial Laser Scanner for 3D measurement and image documentation. The scanner produces dense point cloud scans that can be combined or linked with multiple positions to create a cohesive three-dimensional point cloud rendering an exact measureable copy of the target.

Figure 2: Depiction of linked 3D scans for subject locomotive.

Impact to the locomotive occurred at the right front with evidence of direct contact extending inboard a maximum distance of 37 inches. The majority of material transfer and structural deformation was confined to within about 30 inches from the outboard edge of the locomotive's front-mounted plow. The plow was positioned forward of the locomotive end plate[3] and extended across most of the lateral width of the locomotive's front end. While the end plate was a vertical structure (that extended downward from the side step landing to within a few inches of the rail), the plow exhibited an aftward taper from the locomotive's centerline. Outboard of the coupler the plow extended vertically to a maximum height of approximately 43 inches above the rails and exhibited an increasing curved surface such that the top edge arcs further forward than the bottom. At a minimum, the back side of the plow on the undamaged side was about five inches forward of the end plate.

Evidence of material transfer at the right front of the locomotive exhibited black, red and blue coloring. The color and location of the material transfer was consistent with the tire and decorative banner material that had been in place on the trailer. The plow also exhibited scrapes and gouges to the paint and steel structure that included an arced pattern consistent with the rim and tire from the semitrailer. The arced pattern was most pronounced within an area about 21 inches inboard of the plow edge and 19 inches above the rail. Blue colored material transfer was observed on the hand rail at the top of the plow as well as further aftward on the end plate. The end plate also exhibited surface gouging and additional material transfer (blue and red color) that extended inboard from the right edge at a vertical height of 43 to 44½ inches. Red and blue material transfer was also observed on protruding fasteners and hardware and both side step hand rails on the right side of the locomotive. A wood fragment consistent with the semitrailer's deck surface was located within an end plate cutout just inboard of the right edge and about 46 inches above the rail.

[3] Forward most steel structure extending across the width of the rails that also serves to position the unit's frame.

The plow, end plate, side steps and side step mounting plate on the right side all exhibited rearward displacement. The displacement ranged from approximately one foot at the bottom edge of the side step mounting plate, to 1.2 feet at the end plate to 1.6 feet at the plow. The top edge of the plow was displaced downward approximately seven inches at the outboard edge. Some tearing of the approximately $^{5}/_{16}$-inch thick steel near the lower corners of a cutout in the plow was observed within the area that made contact with the semitrailer wheel. Figure 3 depicts a screen capture of linked three-dimensional scans of the damaged area on the locomotive. Figures 4 and 5 are photographs that depict elements of the impact damage.

Figure 3: Depiction of linked 3D scans with focus on frontal impact area.

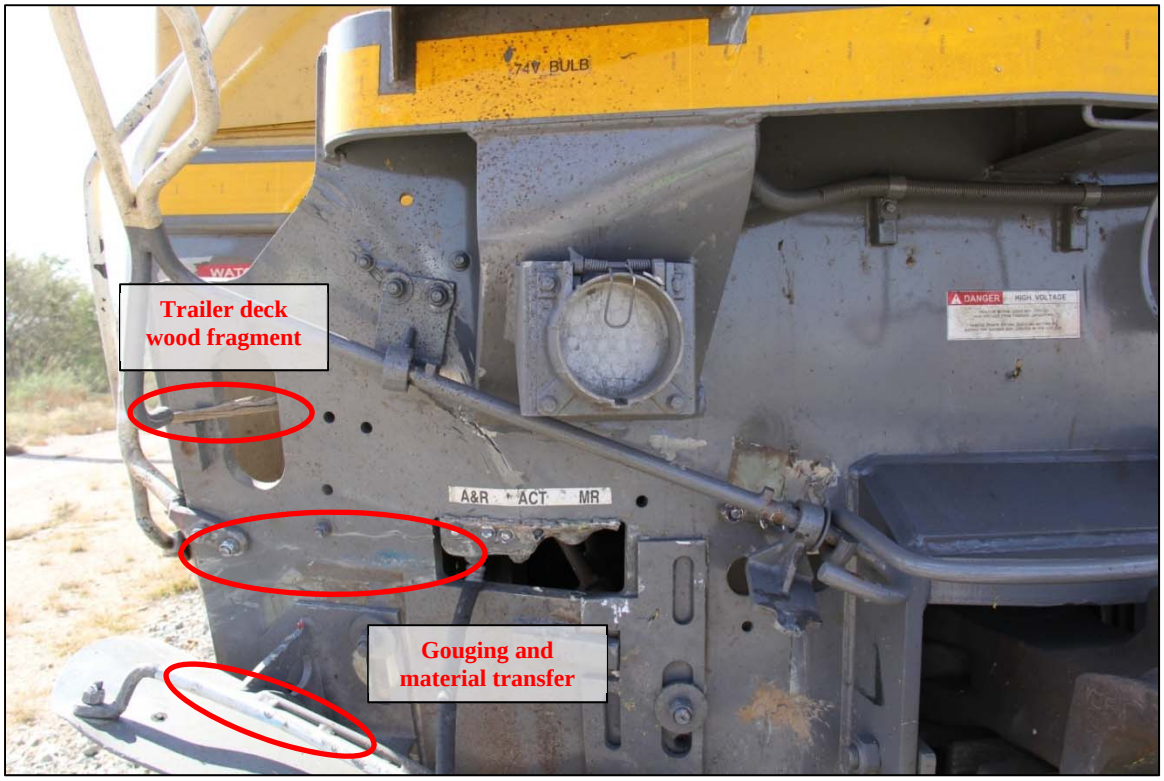


Figure 4: Photograph of impact damage to subject locomotive exhibiting semitrailer override of plow.

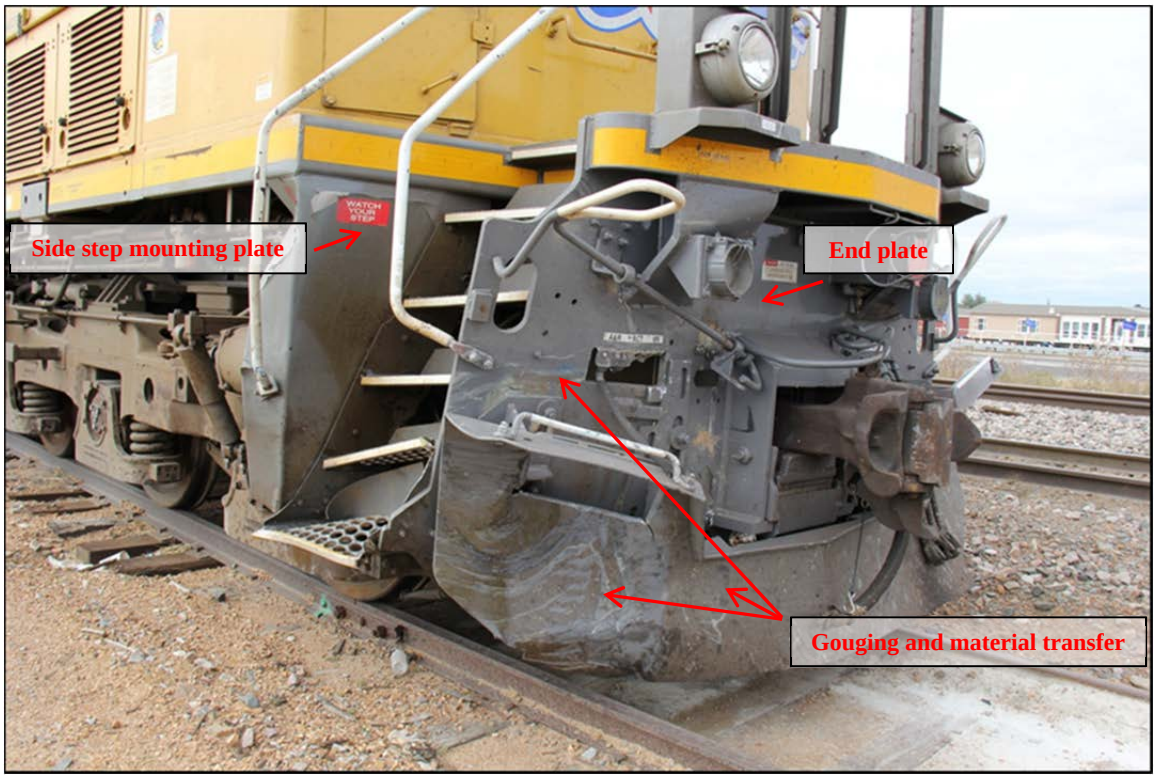


Figure 5: Photograph of subject locomotive depicting impact damage and subsequent component deformation.

3. Commercial Vehicle Documentation

The involved commercial motor vehicle was identified as a 2006 Peterbilt model 379 truck tractor in combination with a 2005 Transcraft D-Eagle drop-deck flatbed semitrailer. Following the collision, law enforcement left the vehicle at its post-collision position of rest and secured the location until arrival of NTSB investigators. The vehicle was photographed and scanned (FARO laser scanner) while at the post-collision position rest and again after removal to a storage facility. Multiple stations were established for the scanner to effectively capture the entire vehicle combination and semitrailer individually such that all exterior vertical surfaces as well as the horizontal deck of the trailer were scanned (top of the power unit was not captured). When coupled, the overall length of the combination was approximately 70 feet.

Figure 6 depicts a photograph of the tractor-semitrailer combination following its removal from the scene. Screen captures of colorized three-dimensional linked scans of the tractor-semitrailer combination at the collision scene and the trailer after it had been uncoupled are depicted in figures 7 and 8 respectively. Some additional vehicle components displaced during the collision had been recovered and were placed atop the trailer and subsequently appear in the photographs and scanned images.

Figure 6: Subject combination vehicle as viewed forward from the impact area.

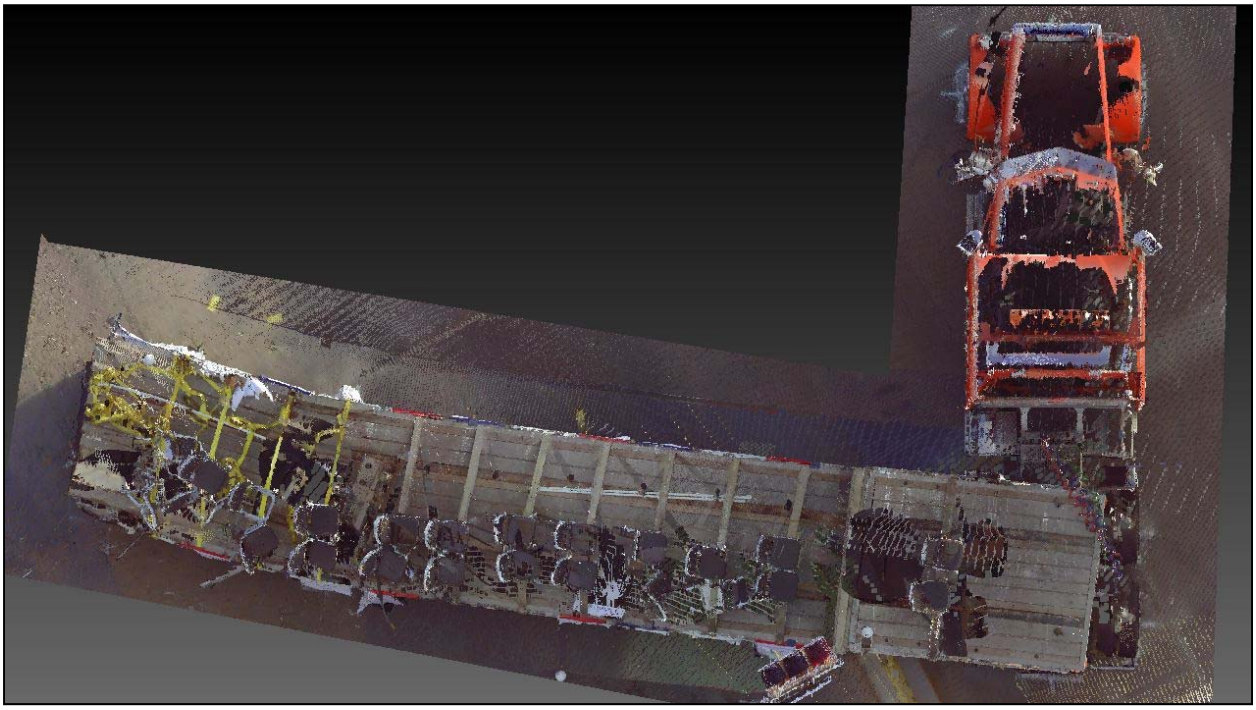


Figure 7: Depiction of linked 3D scans of subject commercial vehicle in its post-collision orientation.

Figure 8: Depiction of linked 3D scans of subject semitrailer after being uncoupled from power unit.

As depicted in the preceding figures, individual chairs had been arranged into multiple rows of two with each row secured by a single synthetic webbing cargo strap to the deck of the semitrailer. Beginning at the front of the trailer, rows one through eight were secured by a single four-inch wide strap while rows nine through twelve were secured by a two-inch wide strap (marked with WLL of 3,335 pounds). The trailer had been outfitted with a 13th row of chairs positioned toward the aft end of the vehicle, but these chairs were displaced from the vehicle as a result of the collision with the locomotive.

The four-inch straps used at rows one through eight were secured to the trailer by way of trailer-mounted strap winches on the left side of the trailer and flat hooks anchored along the right side rail. The two-inch straps at rows nine through twelve were secured by way of ratchet straps along the left side and flat hooks along the right side with both having been attached to the trailer side rail. Post-collision the remaining straps were found to be tightly secured to the trailer although the chairs exhibited displacement toward the passenger side of the vehicle with many also exhibiting deformations to their support legs. The average distance between the rows of chairs was fairly consistent at approximately 2.9 feet.

As a result of the impact the aft end of the trailer was displaced laterally toward the driver's (left) side resulting in a skew of the trailer deck measuring approximately 1.9 to 2.0 feet at the aft end (see Figure 9). Onset of the lateral displacement was observed approximately 10.9 feet forward of the tail end of the trailer[4] or just behind the leading trailer axle. At this location a two-inch wide gap was observed at the right side rail while there was a corresponding compression of the left side rail. Additional side rail separation was observed on both sides of the trailer approximately three feet further forward, just forward of the leading axle. The trailer deck was buckled and fractured between these locations.

Despite the lateral displacement of the trailer deck and associated lateral offset of the trailing axle, the axle wheelbase on both sides were essentially unaltered measuring 10.11 and 10.08 feet on the right and left sides respectively (nominal wheelbase is 10.08 feet).

Figure 9: Depiction of linked scans illustrating post-collision skew of trailer.

[4] Equates to approximately 37.1 feet rearward of the trailer front.

Contact damage about the area of the locomotive impact was observed at the passenger side rear of the trailer. Damage was observed to the rearmost wheel assembly[5], side rail, deck and end plate[6]. The deck sidewall exhibited evidence of direct contact that extended from the aft end of the trailer forward for a distance of approximately 32 inches (2.69 feet). Induced damage adjacent the area of contact included additional tearing of the side rail and extended another 3.5 inches forward of the contact area. Other than the bowing of the semitrailer and related structural disfigurement, induced damage adjacent the area of contact extended forward from the aft end of the trailer approximately 46 inches. In addition to the contact damage exhibited at the side rail and deck, the trailing axle outer wheel rim and tire sustained contact damage. The rim was deformed and torn. The outer tire was punctured, deflated and entrapped by deformation of the side rail. The end plate, which also comprised approximately 10 inches of the aft end of the side rail, had been torn from its securement hardware and displaced from the vehicle. Adjacent the area of direct contact, aluminum sections of the deck were buckled upward while wooden sections were fractured and splintered. Vertical height of the trailer deck was measured at 39 to 40 inches when coupled to the truck tractor. Figure 10 depicts the damage about the area of direct contact. Figure 11 depicts linked scans with certain dimensional measurements.

Figure 10: Photograph of area of contact to subject semitrailer.

[5] Rear-most trailer axle is also identified as axle 5 when the semitrailer is in combination with the three axle power unit.

[6] Trailer end plate is an aluminum structure that abuts the aft end of the deck and extends across the full width of trailer. The end plate houses the trailer's rear lighting fixtures.

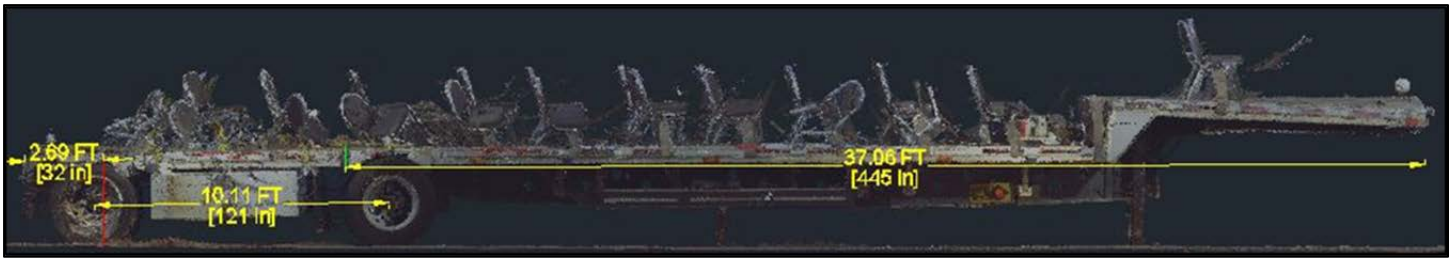


Figure 11: Depiction of linked 3D scans with dimensional measurements.

Evidence of subsequent contact that resulted in minor damage was observed at the trailing axle on the left (driver's) side. Concentric circular impressions were visible on the tire sidewall and rim flange. The rim flange exhibited minor indentations in conjunction with the tire sidewall impressions. The impressions were consistent with the impact to the rear wheel of the Midland County Sheriff Department patrol vehicle that was also struck by the trailer. Figure 12 below depicts the outer wheel assembly on left side trailing axle.

Figure 12: Photograph of left side trailing axle tire and rim contact evidence.

Evidence of biological material (blood) was observed on the left side rail and deck approximately 10.4 feet forward of aft end of the trailer (26.6 feet aft of drop deck). The material deposits exhibited an expanding pattern across and aftward on the deck from the outboard face of the side rail.

While the truck tractor exhibited no collision damage, lateral scuff marks were observed about the circumference of tread area on both steer axle tires and are depicted in Figure 13.

Figure 13: Photograph depicting scuff marks to steer axle tires (right side tire illustrated).

4. Passenger Vehicle Documentation – Midland County Sheriff Department Patrol Vehicle

An unmarked patrol vehicle operated by the Midland County Sheriff Department was involved in a secondary collision with the semitrailer. The patrol vehicle was identified as a 2008 Ford Crown Victoria Police Interceptor and had been in a stationary position at the time of impact. As noted in the NTSB On-Board Image Factual Report in addition to subsequent review of video images taken from the tractor-semitrailer combination operating ahead of the Peterbilt combination, the patrol vehicle was oriented at an approximate westerly heading within the intersection of South Garfield Street and West Industrial Avenue. The vehicle appeared to occupy the westbound through lane of West Industrial Avenue and the right northbound lane of South Garfield in close proximity to the roadway curb.

The vehicle exhibited evidence of impact damage to the passenger (right) side with the more significant area of damage about the rear fender and wheel. The area of damage included the fender, rear passenger door, wheel and tire and rear window. Direct contact, which was consistent with contact from the trailing end of the trailer's left side rail, initiated approximately six inches aft of the rear axle and within a vertical height of 35 to 41 inches (adjusting for tire deflation). Induced damage extended within an area between approximately 28 inches aft of the axle and the rear passenger door opening at the C-pillar. The lower portion of the C-pillar and lower right corner of the rear window frame were distorted and the rear window fractured and displaced from the frame. The interior body panel at the C-pillar exhibited some intrusion into the occupant compartment such that the rear seat back was slightly compressed. About midway along the passenger rear door, just below the window sill, a group of vertical scrape marks superimposed an indentation in the sheet metal. The vertical height of this damage was consistent with the side rail height of the semitrailer.

Additional contact damage was observed at lower trailing edge of the rear passenger side door. This area of contact was characterized by an arced indentation and paint gouging of the door sheet metal that extended approximately 21 inches forward of the rear axle. A reverse impression of the arced indentation was likewise observed on portions of the tire sidewall, wheel rim flange and hub cap. At points of contact the rim flange and hub cap exhibited minor deformation. The circular indentations were indicative of contact from the left side trailing outboard wheel assembly on the trailer.

The second area of contact was observed about the right front fender, side marker lamp housing and outboard corner of the bumper cover. Minor indentations, black colored material transfer and paint scuffing were located on the fender beginning about 3-4 inches forward of the axle, but at a vertical height less than 31 inches. The tire sidewall exhibited scuffing. Further forward, arced scuff marks were observed across the side marker lamp/reflector housing and corner of the bumper cover. Measurements taken forward from the rear axle placed this damage at slightly more than 120 inches forward of the rear contact damage. Additional damage exhibited on the Ford included the fracturing of the front passenger side window.

Characteristics of the damage and the pre-collision position of the vehicle indicate that as the semitrailer rotated following the locomotive impact it struck the rear of the Ford inducing it into a clockwise rotation until the passenger side front made contact with the trailer. Impact induced rotation and lateral movement of the Ford is also depicted in video footage viewed by investigators.

Figures 14 and 15 depict the damage observed on the Ford patrol vehicle.

Figure 14: Photograph depicting Midland County Sheriff patrol vehicle damage.

Figure 15: Photograph depicting damage to passenger side front of sheriff patrol vehicle.

5. Scene Documentation

The scene was documented photographically and by laser scanner. A portion of the scene that included the Peterbilt combination in its post-collision orientation was also scanned upon arrival of NTSB investigators on November 16, 2012. The entire rail grade crossing was subsequently documented by laser scanner during the on-scene investigation. The Peterbilt combination in its post-collision orientation at the rail crossing is depicted by photograph and linked three-dimensional scans in figures 16 and 17 respectively. Figures 18 and 19 depict screen captures of linked three-dimensional scans of rail grade crossing and the highway approaches.

South Garfield Street was oriented north-northwest to south-southeast with the rail line intersecting at a right angle.

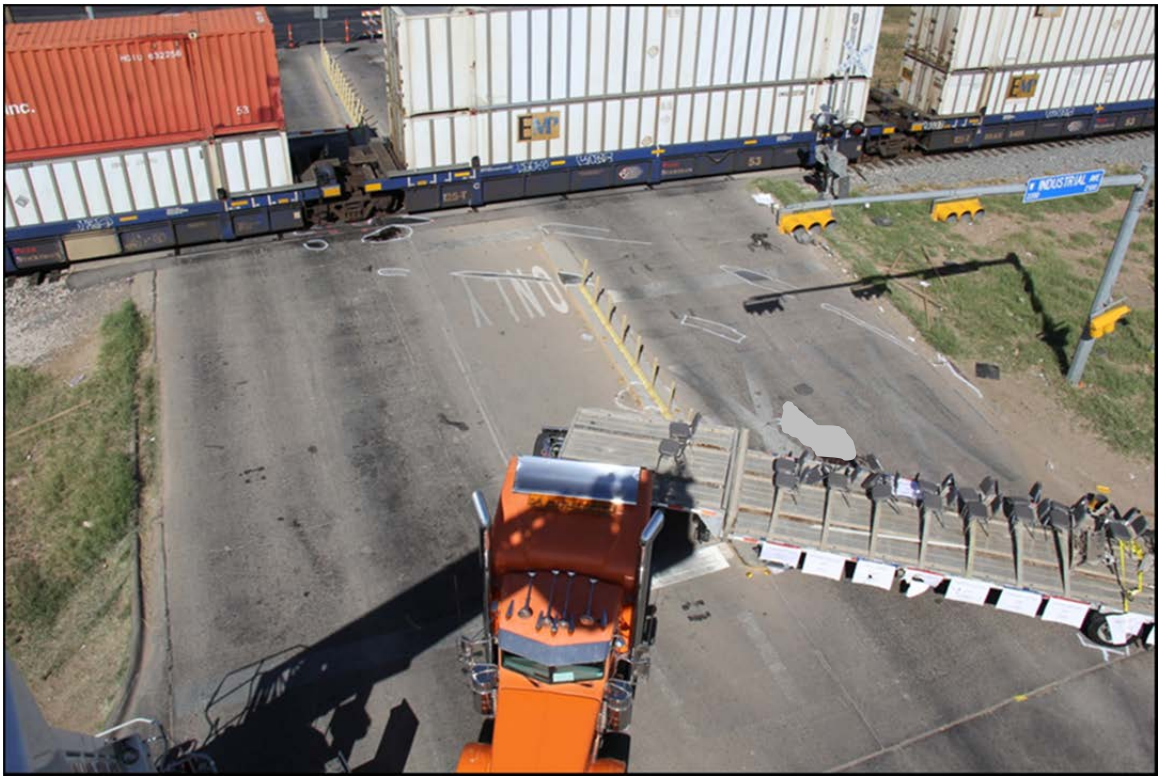


Figure 16: Photograph depicting overhead view of commercial vehicle in its post-collision position of rest. Roadway evidence was outlined by law enforcement personnel. (Note – Light gray color area on opposite side of trailer was inserted to obscure a large deposit of biological material on the road surface.)

Figure 17: Depiction of linked scans illustrating commercial vehicle at post-collision position of rest.

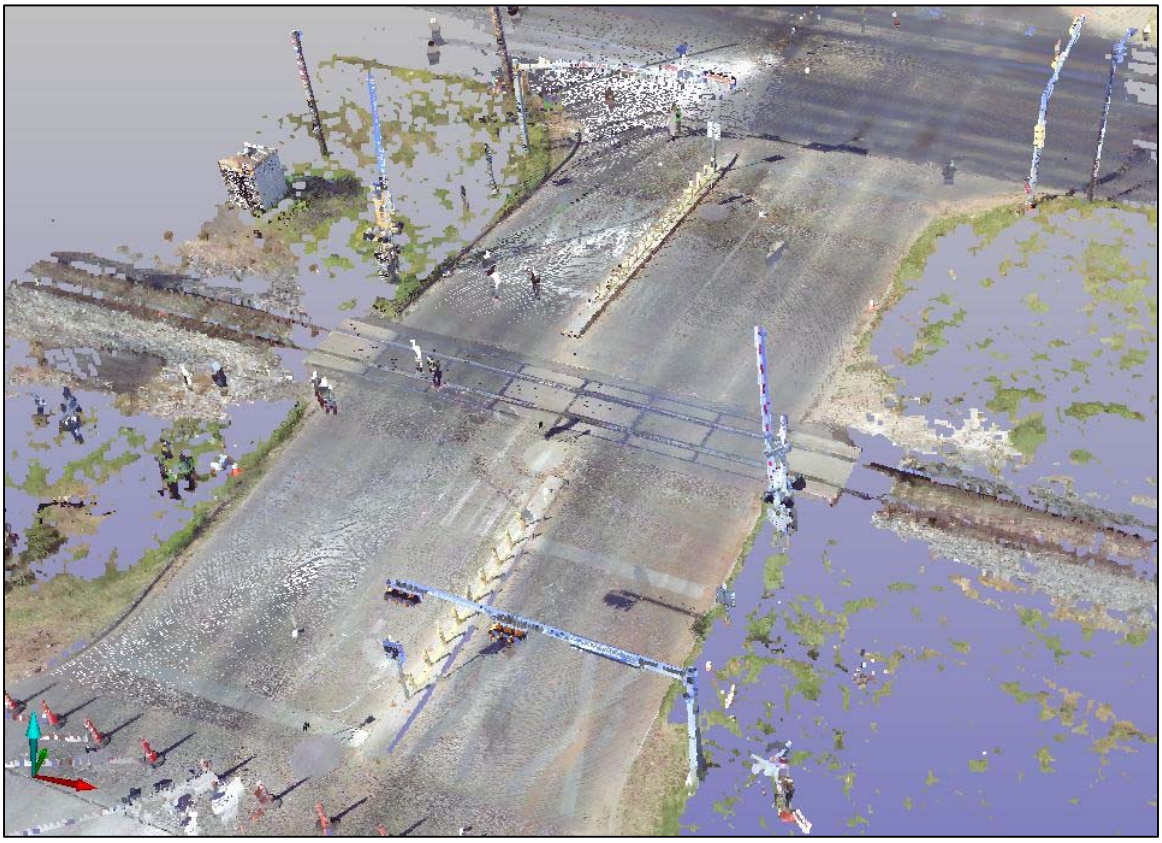


Figure 18: Depiction of linked 3D scans illustrating entire rail grade crossing.

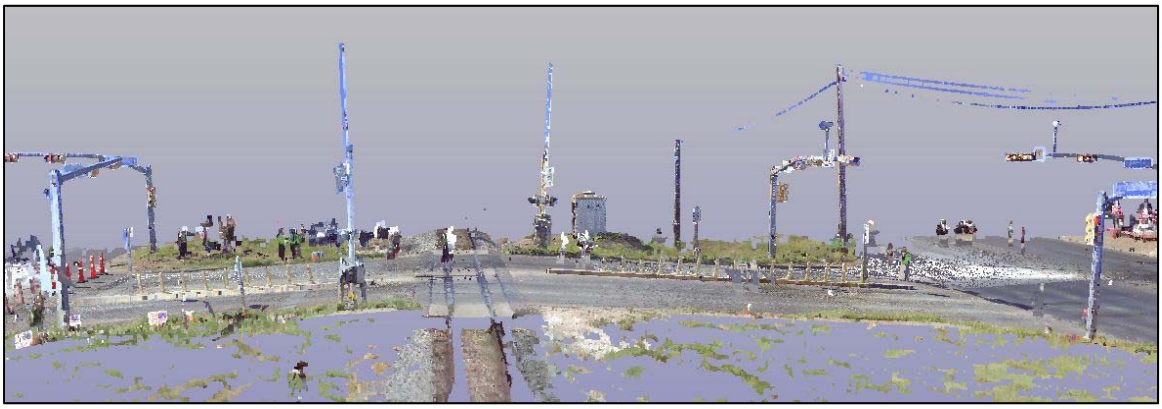


Figure 19: Depiction of linked 3D scans depicting grade crossing profile.

The majority of roadway evidence consisted of tire friction marks, debris displaced from the trailer and some deposits of biological material (blood) on the roadway surface south of rail line. All physical evidence from the collision was confined to the south side of the rail line and extended from the rails to the south side of W. Industrial Avenue.

In its position of final rest, the truck tractor exhibited a clockwise rotation of about 28º relative to its original direction of travel. The front of the tractor occupied the left through lane of southbound S. Garfield Street while the drive axles occupied the southbound left turn lane. The front of the truck tractor was approximately 68 feet south of the southern rail. The semitrailer was angled at about 90º relative to the tractor and at rest was straddling the raised median and occupied both through lanes of northbound S. Garfield Street. At final rest the trailer exhibited a clockwise rotation of about 122º relative to its original direction of travel. As the aft end of the trailer progressed through its post-impact rotation the arc radius increased from about 47 to 53 feet and covered an average distance of approximately 105 feet. The tractor's fifth wheel coupler exhibited a lateral movement of approximately 10.6 feet during the collision.

The onset of roadway evidence consisted of tire friction marks created by the passenger (right) and driver (left) side dual tires on the trailing axle of the semitrailer. The marks initiated about one foot south of the southern rail and 14.9 and 22.3 feet east of the western curb line for the right and left side tires respectively. From the onset of these marks, additional intermittent tire friction marks exhibiting an arced path of travel continued in southeasterly direction. The final mark created by the trailing axle was observed atop the east side curb approximately 37.6 feet south of the southern rail. The trailing axle wheels then traveled atop the roadside soil and returned to the paved road surface. At final rest the right side wheels were about 2.6 feet into the roadway.

Approximately 10.6 feet further south from the trailing axle tire marks and 6.4 feet further east, pavement scuff marks from the right side leading tires were observed. The road surface scuffing transitioned to intermittent black friction marks that surmounted the raised median about 18.2 feet south of the southern rail.

Deposits of biological material, characteristic of blood, were observed at several locations on the road surface. Areas of deposits were located near the rail line on the southbound roadway, atop the median, within the northbound roadway and across the eastbound lane of W. Industrial Avenue. Nearest the rail were two areas both of which were about 4.2 feet south of the southern rail. One area was about 1.5 feet east of the onset of the right side trailing axle tire mark and the other about seven feet east of the first. About 35 feet south of the rail another deposit area was observed atop the raised median. That material exhibited characteristics of having been deposited as the material was in motion toward the south-southeast. Approximately 41.6 feet south of the rail and seven feet east of the median, within the northbound roadway, another deposit area was documented. The final area of deposit was observed extending across the eastbound lane of W. Industrial Avenue from the about the center line to the curb. The deposit at the curb was approximately 28 feet east of curb line for S. Garfield Street.

Damage to highway infrastructure as a result of the collision was minimal. During the post-impact rotation of the trailer it struck the northbound automatic gate arm and overrode median delineator posts and two signs. The gate arm was displaced from the gate mechanism and fractured into at least three segments. The delineator posts were flexible and appeared to sustain no permanent damage. The two signs that were struck included a "keep right" sign located at the

southern end of the median and a “do not stop on tracks” sign located on the east roadside south of the crossing warning device.

A single traffic signal head located on a utility pole and positioned about nine feet above the ground was also displaced from its mounting by an unknown projectile. The signal head was found hanging by its wiring with one of the lens hoods missing. The pole on which the signal was mounted was positioned about seven feet off the roadway and 45 feet south of the southern rail.

At impact, approximately 48 inches of the aft end of the semitrailer overlapped the locomotive right-of-way. Figure 20 is a photograph depicting the relative positions of the train and Peterbilt combination at impact using an exemplar semitrailer and locomotive.

D. FULL-SCALE COLLISION SEQUENCE EVALUATION

On November 20, 2012, a full scale simulation of the pre-collision movement of the Peterbilt combination and locomotive was conducted at the subject grade crossing. The exercise involved an exemplar locomotive coupled to ten rail cars and an exemplar truck tractor and drop-deck semitrailer combination. The relative positions of the locomotive and Peterbilt combination were established to approximate ½ second intervals over a time period of 25 seconds leading up to contact. The relative distance intervals were based on an approximate speed of 5 mph (7.3 fps) for the truck and 62 mph (90.9 fps) for the locomotive. The locomotive and truck were positioned at static locations representing ½ second intervals and photographed from three perspectives. The photographic perspectives included:

- Forward view from inside the locomotive cab;
- Forward view from inside the truck tractor followed by an appropriate rightward rotation to face the approaching train;
- Downward view from an elevated position above grade crossing.

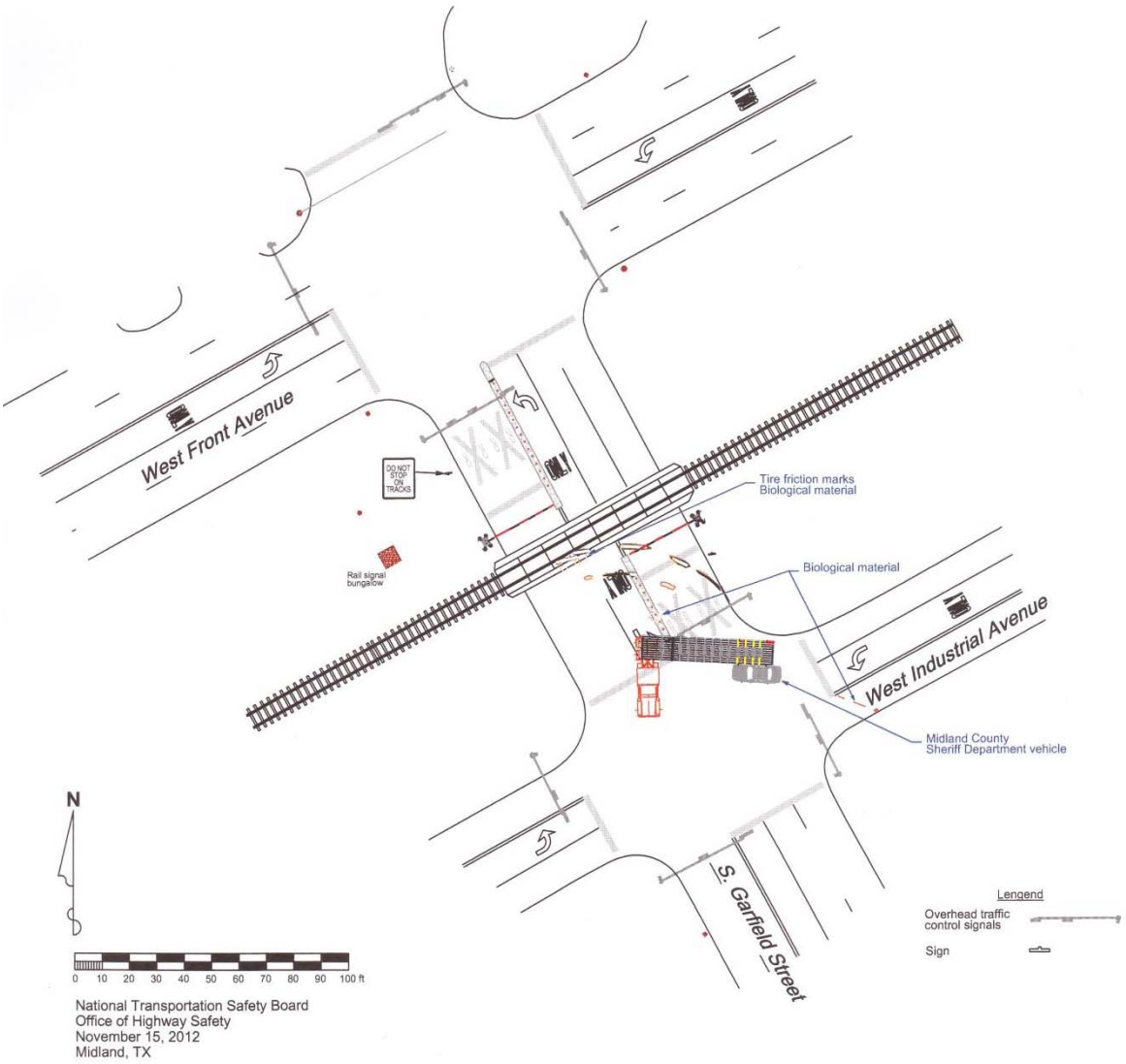
Figure 20 depicts the overhead perspective of the approximate position of the exemplar locomotive and tractor-semitrailer combination at contact (as defined by physical evidence).

Figure 20: Photograph depicting relative position of locomotive and semitrailer at impact (using exemplar equipment).

Appendix A provides a two-dimensional scaled diagram of the railroad grade crossing and post-collision position of the Peterbilt combination. The Sheriff Department vehicle had already been removed from the scene when initially scanned and its placement is based on physical evidence. Appendix B conveys the data applied to placement of the exemplar locomotive and combination vehicle for the full scale simulation.

END OF REPORT

Appendix A: Scale diagram of collision location and post-impact position of involved motor vehicles.



Appendix B: Full-scale investigative timeline and vehicle position calculations.

Time (s)	Train Speed (mph)	Train Velocity (ft/s)	Train Distance to Impact (ft)	Tractor Trailer Speed (mph)	Tractor Trailer Velocity (ft/s)	Time Segment Distance (ft)	Tractor Trailer Distance to Impact (ft)	Front of Tractor Past North Rail (ft)
0.0	62.0	90.9	0.0	5.0	7.3	0.0	0.0	73.3
-0.5	62.0	90.9	46.0	5.0	7.3	-3.7	-3.7	69.6
-1.0	62.0	90.9	92.0	5.0	7.3	-3.7	-7.3	65.9
-1.5	62.0	90.9	138.0	5.0	7.3	-3.7	-11.0	62.3
-2.0	62.0	90.9	184.0	5.0	7.3	-3.7	-14.7	58.6
-2.5	62.0	90.9	229.5	5.0	7.3	-3.7	-18.3	54.9
-3.0	62.0	90.9	275.0	5.0	7.3	-3.7	-22.0	51.3
-3.5	62.0	90.9	321.0	5.0	7.3	-3.7	-25.7	47.6
-4.0	62.0	90.9	367.0	5.0	7.3	-3.7	-29.3	43.9
-4.5	62.0	90.9	413.0	5.0	7.3	-3.7	-33.0	40.3
-5.0	62.0	90.9	459.0	5.0	7.3	-3.7	-36.7	36.6
-5.5	62.0	90.9	504.5	5.0	7.3	-3.7	-40.3	32.9
-6.0	62.0	90.9	550.0	5.0	7.3	-3.7	-44.0	29.3
-6.5	62.0	90.9	595.5	5.0	7.3	-3.7	-47.7	25.6
-7.0	62.0	90.9	641.0	5.0	7.3	-3.7	-51.3	21.9
-7.5	62.0	90.9	687.0	5.0	7.3	-3.7	-55.0	18.3
-8.0	62.0	90.9	733.0	5.0	7.3	-3.7	-58.7	14.6
-8.5	62.0	90.9	779.0	5.0	7.3	-3.7	-62.3	10.9
-9.0	62.0	90.9	825.0	5.0	7.3	-3.7	-66.0	7.3
-9.5	62.0	90.9	871.0	5.0	7.3	-3.7	-69.7	3.6
-10.0	62.0	90.9	917.0	5.0	7.3	-3.7	-73.3	-0.1
-10.5	62.0	90.9	962.5	5.0	7.3	-3.7	-77.0	-3.8
-11.0	62.0	90.9	1,008.0	5.0	7.3	-3.7	-80.7	-7.4
-11.5	62.0	90.9	1,054.0	5.0	7.3	-3.7	-84.3	-11.1
-12.0	62.0	90.9	1,100.0	5.0	7.3	-3.7	-88.0	-14.8
-12.5	62.0	90.9	1,146.0	5.0	7.3	-3.7	-91.7	-18.4
-13.0	62.0	90.9	1,192.0	5.0	7.3	-3.7	-95.3	-22.1
-13.5	62.0	90.9	1,238.0	5.0	7.3	-3.7	-99.0	-25.8
-14.0	62.0	90.9	1,284.0	5.0	7.3	-3.7	-102.7	-29.4
-14.5	62.0	90.9	1,329.5	5.0	7.3	-3.7	-106.3	-33.1
-15.0	62.0	90.9	1,375.0	5.0	7.3	-3.7	-110.0	-36.8
-15.5	62.0	90.9	1,421.0	5.0	7.3	-3.7	-113.7	-40.4
-16.0	62.0	90.9	1,467.0	5.0	7.3	-3.7	-117.3	-44.1
-16.5	62.0	90.9	1,513.0	5.0	7.3	-3.7	-121.0	-47.8
-17.0	62.0	90.9	1,559.0	5.0	7.3	-3.7	-124.7	-51.4
-17.5	62.0	90.9	1,605.0	5.0	7.3	-3.7	-128.3	-55.1
-18.0	62.0	90.9	1,651.0	5.0	7.3	-3.7	-132.0	-58.8
-18.5	62.0	90.9	1,696.5	5.0	7.3	-3.7	-135.7	-62.4
-19.0	62.0	90.9	1,742.0	5.0	7.3	-3.7	-139.3	-66.1
-19.5	62.0	90.9	1,788.0	5.0	7.3	-3.7	-143.0	-69.8
-20.0	62.0	90.9	1,834.0	5.0	7.3	-3.7	-146.7	-73.4
-20.5	62.0	90.9	1,880.0	5.0	7.3	-3.7	-150.3	-77.1
-21.0	62.0	90.9	1,926.0	5.0	7.3	-3.7	-154.0	-80.8
-21.5	62.0	90.9	1,971.5	5.0	7.3	-3.7	-157.7	-84.4
-22.0	62.0	90.9	2,017.0	5.0	7.3	-3.7	-161.3	-88.1
-22.5	62.0	90.9	2,063.0	5.0	7.3	-3.7	-165.0	-91.8
-23.0	62.0	90.9	2,109.0	5.0	7.3	-3.7	-168.7	-95.4
-23.5	62.0	90.9	2,155.0	5.0	7.3	-3.7	-172.3	-99.1
-24.0	62.0	90.9	2,201.0	5.0	7.3	-3.7	-176.0	-102.8
-24.5	62.0	90.9	2,247.0	5.0	7.3	-3.7	-179.7	-106.4
-25.0	62.0	90.9	2,293.0	5.0	7.3	-3.7	-183.3	-110.1