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

# VEHICLE FACTORS GROUP CHAIRMAN'S FACTUAL REPORT

## A. CRASH INFORMATION

| | |
|---|---|
| Location: | Lanetown Road and Buckingham Branch Railroad Grade Crossing (22470), near Crozet, Albemarle County, Virginia |
| Vehicle 1: | 2018 Freightliner Refuse Truck |
| Operator 1: | Time Disposal, Inc., of Ruckersville, Virginia |
| Vehicle 2: | Amtrak "Congressional Special Amtrak Train 923, consisting of 2 locomotives, 10 cars |
| Operator 2: | National Railroad Passenger Corporation dba Amtrak |
| Date: | January 31, 2018 |
| Time: | Approximately 11:16 a.m. EST |
| NTSB #: | **HWY18MH005** |

## B. VEHICLE FACTORS GROUP

Brian Bragonier, Vehicle Factors Investigator, Group Chairman
NTSB Office of Highway Safety
490 L'Enfant Plaza East, S.W., Washington, DC 20594

Trooper Scott Parsons, Virginia State Police
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## C. CRASH SUMMARY

For a summary of the crash, refer to the *Crash Summary Report*, which can be found in the docket for this investigation.

## D. DETAILS OF THE VEHICLE FACTORS INVESTIGATION

The Vehicle Factors Group Chairman's Report is a collection of factual information obtained during the detailed inspection of the involved vehicle. The 2018 Freightliner Refuse Truck was inspected on February 2, 2018 at a Stoney Creek Auto Center facility, located at 1355 Beach Grove Road, Nellysford, Virginia. All major mechanical systems on the refuse truck were examined, including the steering, braking, and suspension systems. Overall accident damage, along with any damage or anomalies within major vehicle mechanical systems were documented. Some areas of the vehicle could not be reliably documented due to extensive collision damage. Supporting photographs, vehicle specifications, maintenance records, and prior inspection reports were collected.

## 1. Vehicle Inspection

### 1.1. Vehicle #1: 2018 Freightliner Refuse Truck

#### 1.1.1. General Information

This vehicle was manufactured in two stages. The first build stage of the Freightliner truck cab and chassis, known in the industry as an incomplete vehicle, or commercial cutaway, was completed in April 2017. The second build stage consisted of configuring the truck with a rear load trash hopper was completed in August 2017, by McNeilus Truck & Manufacturing.

**Daimler Freightliner Chassis**

| | |
|---|---|
| VIN : | IFVHCYFE2JHJP0802 |
| Manufacturer: | Daimler Freightliner Trucks North America |
| Model: | M2 106 – Originally Manufactured as a Chassis only |
| Manufactured: | April 1, 2017 |
| Mileage : | Approximately 11,500 |
| GVWR : | 60,000 lbs. |
| GAWR #1: | 14,600 lbs. |
| GAWR #2: | 23,000 lbs. |
| GAWR #3: | 23,000 lbs. |
| Engine: | Cummins L9 300HP |
| Transmission: | Allison, 3500RDS, Automatic |
| Steering Gear: | TRW Ross Power Steering |
| Brake System: | Wabco, Pneumatic Drum Brakes w/ABS All Axles |

**Refuse Hopper Equipment:**

| | |
|---|---|
| Manufacturer: | McNeilus Truck & Manufacturing |
| Model: | 28 Yard Model 2813 Heavy Duty Rear Hopper Refuse Truck |
| Manufactured: | August 2017 |
| Serial Number: | 83170X281349339 |

#### 1.1.2. Damage Description

The entire vehicle sustained severe damage affecting all major mechanical systems. Damage specific to many of the vehicle components will be described in greater detail later in the appropriate sections of this document.

The vehicle chassis was separated from the refuse hopper at impact. The top of the hood was torn from the front of the chassis and the bottom of the hood was only partially connected to a hinge near the front bumper. The windshield was shattered from contact damage but remained in place. The driver's side mirror frame was intact, but the mirror was missing. The passenger side mirror was intact.

Both doors were in place, but the passenger door would not function normally due to damage to the door frame. A portion of the sheet metal near the door had been deformed and several rivets had pulled through the outer layer of metal. The sheet metal on the rear of the cab had been torn into two pieces, both deformed and still partially attached. The foam liner attached to the rear of the inside cab was exposed, but intact. There was contact damage to the top right rear of the cab. The right-side fuel tank was damaged, but still in place held by two mounting straps. The exhaust pipe was missing from its mount near the right rear corner of the cab.

The frame of truck was twisted the entire length, from the rear most part of the frame to the back of the cab. The supporting crossmembers between the two frame rails were all deformed and buckled. Both frame rails were bent at an approximate 45-degree angle from their original position. Starting approximately 37-inches forward of the rear, the right frame rail was displaced approximately 14-inches to the right. Deformation of the left frame rail began approximately 31-inches forward of the rear and it was displaced approximately 20-inches to the right. The rear of the cab was separated from the frame and lifted on the right side away from its normal mounting position and canted to the left at approximately a 15-degree angle.

The radiator was displaced rearward approximately 2-inches and the right-side mounting brackets were deformed. The hydraulic system for the refuse hopper on the right side of the chassis was damaged with a valve control lever torn from its mount and displaced downward.

### 1.1.3. Driver's Controls

The driver's seat was intact and in place in the truck. The driver's lap/shoulder seatbelt was found unbuckled, retracted, and hanging from the upper attachment point to the left of the driver's seat location. Located immediately in front of the driver's seat was an 18-inch diameter steering wheel. The steering wheel was mounted on a steering column that was adjustable for both height and angle. The steering wheel contained a large button at its center to activate the standard electric horn. The turn signal stalk was located on the left side of the steering column, and included accessory functions such as high and low beam headlight selection. The turn signal stalk was found in the centered position at the time of the examination. Under the steering column was a lever allowing for the adjustment of steering wheel tilt and elevation. The vehicle's keyed ignition switch was located on the left side of the steering column.

The dash in front of the driver's seat contained several gauges, indicator lights, and a digital information display. The gauges included: electrical system voltage, exhaust temperature, coolant temperature, engine oil pressure, engine oil temperature, engine speed (RPMs), vehicle speed (mph & km/h), air pressure (primary and secondary), fuel level, and transmission temperature. The fuel gauge showed approximately half full. The secondary air pressure gauge showed approximately 100psi. The engine RPM gauge showed 1000. The oil pressure gauge indicated 30psi. The

transmission temperature gauge showed approximated 210 degrees. All other gauge indicators were in their zero or "home" positions.

Numerous switches were located to the left and right of the gauge panel. The switches and their positions at the time of the inspection include the following:

- Headlights (Off/Parking/Headlights) – Headlights On
- Speed Control (Off/On) – Off
- Speed Control (Set-Decel/Neutral/Resume-Accel – Self Centering) – Neutral
- Engine Brake (Off/Low/High) – Off
- Inter-axle Power Divider Lockout (Off/On) – Off
- Mirror Heat (Off/On) – Off
- Pump (Off/On) – On
- Hopper Light (Off/On) – Off
- Strobe Light (Off/On) – On
- Side Light (Off/On) – On
- Throttle (Off/On) – On

The floorboard of the cab below the driver's seat was buckled and deformed upward toward the seat bottom. The floorboard was touching the bottom of the brake treadle valve. The accelerator pedal cover was detached and located next to the pedal against the firewall.

### 1.1.4. Steering and Suspension

The truck's steering system was inspected including, gear box, pitman arms, drag links, and steering knuckles. Damage was noted to the steering shaft firewall flange bearing, which was fractured and partially torn away from its mounts. The steering linkage components, including the steering column, and the intermediate shaft were connected with U-joints which were undamaged. Full rotation of the steering wheel was not possible due to the damaged flange bearing causing the system to bind. The front axle of the truck was lifted off the ground and with assistance turning the tires, the steering was rotated to the far left position with no component rubbing. Investigators were unable to turn the steering to the far right position due to binding.

Each side of the steer axle was equipped with a set of leaf springs and a conventional shock absorber. The suspension on each side consisted of three full length leaf springs. All of the leaf springs were free of any visible cracks, damage, or apparent defects. The shock absorbers were securely attached, and free of wear or excessive play.

The truck's drive axles (axles #2 and #3) were supported by Hendrickson Haulmaax rubber suspensions. The rubber bolster spring between axles #2 and #3 on the left side was fractured. All four of the axle positioning bars on the rear were deformed and the rear axles were shifted from their original position.

### 1.1.5. Tires and Wheels

According to the VIN plate located on the frame of the driver's door, the truck was specified to be equipped with 12R22.5 tires mounted on 22.5 x 8.25 rims on the front axle and

11R22.5 tires mounted on 22.5 x 8.25 rims on axle 2 and 3. The tires were specified to be inflated to 120 psi for axle 1, and 105 psi for axle 2 and 3.

Tire pressure measurements were taken using a commercial grade tire pressure gauge. All tires were found to be inflated to pressures near what was recommended. Tread depth measurements were taken in 2 locations within the major tread grooves of a given tire, the lowest of which is entered in Table 1 and represents the minimum tread depth. All tread depths measured were within the minimum tread depth regulation for commercial vehicle tires, which is 4/32 of an inch for the steer axle and 2/32 of an inch for all other axles. **Table 1** includes the tire and wheel information documented at the time of inspection.

**Table 1:** Tire Information

| **Axle 1** | **Left** | | **Right** | |
|---|---|---|---|---|
| Tire Make | Michelin XZE | | Michelin XZE | |
| Tire Size | 12R22.5 | | 12R22.5 | |
| Pressure | 102PSI | | 102PSI | |
| Tread Depth | 4/32” | | 6/32” | |
| DOT # | 2CBTGWU2815 | | 2CBTGWU2815 | |
| **Axle 2** | **Left** | | **Right** | |
| | **Outside** | **Inside** | **Outside** | **Inside** |
| Tire Make | Michelin XDE M&S | Michelin XDE M&S | Michelin XDE M&S | Michelin XDE M&S |
| Tire Size | 11R22.5 | 11R22.5 | 11R22.5 | 11R22.5 |
| Pressure | 94PSI | 90PSI | 98PSI | 96PSI |
| Tread Depth | 10/32” | 12/32” | 11/32” | 7/32” |
| DOT # | Y7BT3X43115 | Y7BT3X43115 | Y7BT3X43115 | Y7BT3X43115 |
| **Axle 3** | **Left** | | **Right** | |
| | **Outside** | **Inside** | **Outside** | **Inside** |
| Tire Make | Sailun S753 | Sailun S753 | Sailun S753 | Sailun S753 |
| Tire Size | 11R22.5 | 11R22.5 | 11R22.5 | 11R22.5 |
| Pressure | 104PSI | 100PSI | Flat | Flat |
| Tread Depth | 10/32” | 6/32” | 7/32” | 7/32” |
| DOT # | Y7BT3X43115 | Y7BT3X43115 | Y7BT3X43115 | Y7BT3X43115 |

All fasteners were intact and tight. The rims were inspected for cracks, welds, and elongated lug nut holes. No non-collision related defects were found on any of the rims. For all sets of dual tires on the truck, the tire surfaces to the inside of each dual pair were checked for visible signs of rubbing and/or chaffing. None of these signs were present. The left steer axle tire showed signs of past rubbing on the pitman arm, but inspectors were unable to make the tire touch the arm during the post-crash examination. The tire and rim damage observed during the inspection included the following:

- Axle 1 Left
  - No damage to rim or tire
- Axle 1 Right
  - No damage to rim or tire
- Axle 2 Left Outboard and Inboard Tires
  - No damage to rims or tires
- Axle 2 Right Outboard and Inboard Tires
  - No damage to rims or tires
  - Debris pinched between rim and tire bead on outside tire
- Axle 3 Right Outboard Tire
  - 20-inch cut in tread at 06:00[1]
- Axle 3 Right Inboard Tire
  - 14-inch cut in sidewall at 12:00
  - 6-inch cut in sidewall near the tread at 03:00
- Axle 3 Left Outboard Tire
  - Minor damage/small portions of tread gouged out
- Axle 3 Left Inboard Tire
  - Minor damage/small portions of tread gouged out

### 1.1.6. Brakes

The accident truck was equipped with pneumatic drum brake system on all axles. The front axle was equipped with size 24 long stroke service brake chambers (Type 24). Axles 2 and 3 were equipped with size 30 long stroke service and parking brake chambers (Type 30/30). All axles were equipped with automatic slack adjusters. There were no brake adjustment indicators located on the pushrods of any brakes, which is a violation of §393.53(c)[2].

[1] Tire and wheel damage is referenced using a clock reference with the valve stem being 12:00

[2] §393.53(c) states that each commercial motor vehicle manufactured on or after October 20,1994, and equipped with an air brake system which contains an external automatic adjustment mechanism and an exposed pushrod, the condition of service brake under-adjustment must be displayed by a brake adjustment indicator.

As part of the post-crash inspection, the brake drums and brake pads were visually inspected and measured. All brake pads were found to be in excess of the minimum thickness limit of ¼-inch. No pre-crash brake pad or brake drum cracks or defects were observed.

All air braked truck tractors manufactured after March 1997, and all other commercial vehicles (such as trailers) manufactured after March 1998, are required to be equipped with anti-lock braking systems (ABS). The accident truck tractor was equipped with ABS and sensors were in place.

Due to extensive damage, a performance check of the intact braking system was not possible. Both left and right brake chambers on axle #3 were damaged in the collision and parts of the chambers were missing, rendering them inoperable. Each remaining brake chamber was individually checked by supplying it with shop air at approximately 100 psi. Each brake chamber's push rod stroke length was then measured. **Table 2** shows the brake measurements.

**Table 2:** Brake Information and Measurements

| Position | Brake Chamber Type | Brake Chamber Manufacturer | Slack Adjuster Length (inches) | Push Rod Stoke (inches) | Adjustment Limit (inches) |
|---|---|---|---|---|---|
| L Steer Axle | 24-L (2.5" RS) | Wabco | 5 1/2 | 1 1/2 | 2 |
| R Steer Axle | 24-L (2.5" RS) | Wabco | 5 1/2 | 1 1/2 | 2 |
| L 2nd Axle | 30/30-L | Wabco | 6 | 1 | 2.5 |
| R 2nd Axle | 30/30-L | Wabco | 6 | 1 1/8 | 2.5 |
| L 3rd Axle | 30/30-L | Wabco | 6 | Damaged | 2.5 |
| R 3rd Axle | 30/30-L | Wabco | 6 | Damaged | 2.5 |

The low air pressure warning sensors for both the primary and secondary systems and the ABS light were unable to be checked due to faults in the electrical system of the truck and damage to the braking system.

### 1.1.7. Transmission

The bell housing of the Allision Automatic Transmission was fractured near the engine mount on the right side of the engine compartment. The driveshaft was twisted at the point the center bearing brackets were attached to the frame crossmembers. The universal joint between axle #2 and #3 was fractured allowing the driveshaft to hang loose. The bracket holding the hydraulic pump had been displaced rearward, separating the power take off (PTO) shaft from the pump and allowing the shaft to fall and make contact with the ground.

### 1.1.8. Electrical

Due to the extent of damage, the trucks electrical system was compromised. It was not possible to check the function or integrity of the entire electrical system. The interior cab lights

worked, but there was no power to the dashboard. The headlights and taillights were missing from the vehicle at the time of the inspection. The cab lamps were not operational.

### 1.1.9. Event Data

This vehicle is equipped with modules capable of recording event data. Attempts were made by investigators to download these modules while still installed on the truck, but due to electrical system damage, no data could be recovered. These modules, the Engine Control Module (ECM) and the Anti-Lock Brake System (ABS) module, were removed and transferred to the NTSB recorders laboratory for downloading and analysis.

### 1.1.10. Maintenance and Inspection History

Maintenance records for the accident truck and trailer were obtained from the carrier and indicate two warranty claims and routine maintenance. The vehicle was new with low mileage with little need for repairs.

### 1.1.11. Documented Recalls and Warranty Claims

Recall and warranty claim information was obtained from the manufacturer. Records indicate that warranty work was completed to remedy a leaking rear main seal and a leaking transmission. No recalls were in effect for the vehicle.

## E. DOCKET MATERIAL

The following attachments and photographs are included in the docket for this investigation:

*LIST OF ATTACHMENTS*

| | |
|---|---|
| Vehicle Attachment - | Virginia State Police Post Crash Inspection |
| Vehicle Attachment - | 2018 Freightliner Refuse Truck Maintenance Record |
| Vehicle Attachment - | 2018 Freightliner Refuse Truck Virginia Registration |
| Vehicle Attachment- | 2018 Freightliner Refuse Truck Build Sheet |

*LIST OF PHOTOGRAPHS*

| | |
|---|---|
| Vehicle Photo 1 - | 2018 Freightliner Refuse Truck damage left front corner view |
| Vehicle Photo 2 - | 2018 Freightliner Refuse Truck damage right side view |
| Vehicle Photo 3 - | 2018 Freightliner Refuse Truck damage right rear corner view |
| Vehicle Photo 4 - | Refuse hopper damage right side view |

Vehicle Photo 5 - Refuse hopper damage right rear corner view

END OF REPORT

Brian Bragonier
Senior Vehicle Factors Investigator