VEHICLE FACTORS GROUP CHAIRMAN'S FACTUAL REPORT

Penwell, TX

HWY15MH004

(9 pages)

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

VEHICLE FACTORS GROUP CHAIRMAN'S FACTUAL REPORT

A. CRASH INFORMATION

Location:	Interstate 20 (I-20) Ector County near Penwell, Texas
Vehicle #1:	2015 Blue Bird Vision bus modified for prison transport
Operator #1:	Texas Department of Criminal Justice
Date:	January 14, 2015
Time:	Approximately 7:50 a.m. Central Daylight Time (CDT)
NTSB #:	**HWY15MH004**

B. VEHICLE FACTORS GROUP

Jennifer Morrison, Vehicle Factors Group Chairman
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C. CRASH SUMMARY

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

D. DETAILS OF THE VEHICLE FACTORS INVESTIGATION

The Vehicle Factors Group Chairman's Factual Report is a collection of factual information regarding the 2015 Blue Bird Vision bus modified for prison transport involved in this crash (therein referred to as the bus, or accident bus). After the collision the bus was found in several separate pieces which included: 1) the main portion of the bus body, 2) the chassis frame rails and rear axle, 3) the front axle, and 4) a large section from the front of the bus which included the driver seat and boarding door steps. In addition, multiple parts from the bus such as the engine, suspension components, drive shaft sections, and exhaust systems components, were located through the postcrash debris. A full mechanical inspection of the bus and its pneumatic

braking system could not be conducted due to the extent of the damage and separation of the bus. However, all major mechanical components were located and documented.

The bus was inspected at Crash Master's auxiliary tow lot on West 83rd Street in Odessa, TX and H&T Auger Company's indoor storage building on North County Road in Odessa, TX. The inspection was completed between January 15 and 19, 2015. Trooper James Jones of the Texas Department of Public Safety also completed a postcrash vehicle inspection during this time.

1. Vehicle #1: 2015 Blue Bird Vision bus modified for prison transport

1.1. General Information[1]

VIN:[2] 1BAKJCPA4FFxxxxxx
Body Number: F447979
Company Unit #: 153094

Date of Manufacture:	March 2014
GVWR:[3]	33,000 lbs
GAWR (front axle):[4]	10,000 lbs
GAWR (rear axles):	23,000 lbs
Engine:	Cummins ISB13 diesel
Transmission:	Allison 5-speed automatic

1.2. Damage Description

As noted in Section D above, the bus was located in several separate pieces after the collision. The largest piece consisted of the main portion of the bus body aft of the driver seat area. This main portion of the bus body sustained multiple side and roof impacts and was deformed in all directions. No major mechanical components remained attached to this main portion of the bus body.[5]

The next largest piece of the bus was the wreckage of the chassis frame rails, which included the rear axle and fuel tank. The right frame rail (right refers to the boarding door side, left refers to the driver side) was bent to the left, twisted downward, and then back upward, creating a loop in the frame rail forward of the rear axle. The left frame rail was bent to the left and twisted upward, redirecting it nearly 180-degrees from its original configuration.[6]

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[1] Additional equipment and specifications are included in *Vehicle Attachment 1 – Accident Bus Build Record and Technical Specifications*, which can be found in the docket for this investigation.
[2] Vehicle Identification Number (VIN).
[3] Gross Vehicle Weight Rating (GVWR) is the total maximum weight that a vehicle is designed to carry when loaded, including the weight of the vehicle itself plus fuel, passengers, and cargo
[4] Gross Axle Weight Rating (GAWR) is the maximum distributed weight that a given axle is designed to support
[5] Refer to *Vehicle Photograph 1 – Left side view of bus body, and Vehicle Photograph 2 – Right side view of bus body*, which can be found in the docket for this investigation
[6] Refer to *Vehicle Photograph 3 – Front view of twisted frame rails and Vehicle Photograph 4- Rear view of twisted frame rails*, which can be found in the docket for this investigation.

Much of the front end of the bus and front axle suspension was completely destroyed. No large sections of the hood or front bumper were located. The Cummins engine was located in the crash debris. The engine was damaged and separated from the bus, but remained attached to the transmission. The front axle and lower steering linkage was also separated from the bus. A large section from the front of the bus which included the driver seat, the steering wheel, some of the dash area, and boarding door steps was torn from the main portion of the bus body. [7]

1.3. Weight and Measurements

On June 16, 2014 the Texas Department of Criminal Justice supplied an exemplar bus, VIN: 1BAKJCXXXXXX, three digits off and ordered from Bluebird in the same batch of 20 buses as the accident bus. This exemplar bus was examined, photographed, and weighed by the Texas Department of Public Safety using digital Intercomp certified portable scales. **Table 1** contains the axle weights that were measured.

Table 1: Exemplar Bus Axle Weights

Axle	Weight (lbs)	
	Left	Right
1	3,950	3,850
2	7,450	7,450
Total		22,700 lbs

The precrash dimensions listed in the technical specifications for the accident bus are listed in in **Table 2**.[8]

Table 2: Accident Bus Precrash Dimensions

Dimension	Inches
Overall Length	498.29
Overall Width	94.50
Wheelbase	280.0
Rear Overhang	147.4

Center of gravity calculations for an exemplar Blue Bird prison transport bus were obtained from Blue Bird and are listed in **Table 3**.[9]

The NTSB Evidence Documentation Team mapped an exemplar Blue Bird Vision bus using a FARO laser scanner, which generated a 3-dimensional model of the bus (see **Figure 1**.)

[7] Refer to *Vehicle Photograph 5 - Left side view of the driver seat area*, which can be found in the docket for this investigation

[8] Refer to Attachment 1.

[9] Additional information is contained in *Vehicle Attachment 2 – Center of Gravity Calculations for an Exemplar Blue Bird Vision Bus*, which can be found in the docket for this investigation

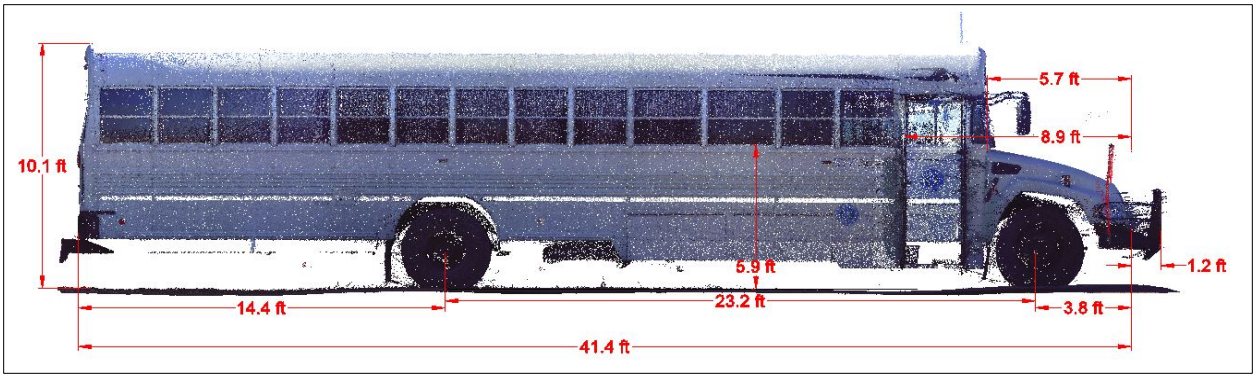

Figure 1. Passenger (right) side profile from the 3-dimensional model of an exemplar Blue Bird Vision Bus.

Table 3: Calculated Center of Gravity of an Exemplar Bus

Estimated Weights	Front (lbs.)	Rear (lbs.)	Total (lbs.)
Vehicle curb weight	7,800	14,900	22,700
Payload weight (15 passengers)	750	1,500	2,250
Total gross vehicle weight	8,550	16,400	24,950
Calculated center of gravity height above ground: **48 inches**			

1.4. Tires and Wheels

According to the VIN plate on the inside of the boarding door area of the bus was specified to be equipped with 11R22.5 tires mounted on 22.5X8.25 rims. The tires were specified to be inflated to 120 psi for both the front and rear axles. At the time of the inspection all of the tires were flat, damaged, and no longer seated on the wheels. **Table 4** includes the tire and wheel information documented at the time of inspection.

The front left tire was shipped to NTSB, Office of Research and Engineering, Materials Laboratory Division in Washington DC for further examination.[10]

Table 4: Accident Bus Tire Information

Front Axle	**Left**		**Right**	
Tire Make	Hankook AH12		Hankook AH12	
Tire Size	11R22.5		11R22.5	
Pressure	- flat -		- flat -	
Tread Depth	17/32 inch		17/32 inch	
Rear Axle	**Left**		**Right**	
	Outside	Inside	Inside	Outside
Tire Make	Hankook AH12	Hankook AH12	Hankook AH12	Hankook AH12
Tire Size	11R22.5	11R22.5	11R22.5	11R22.5
Pressure	- flat -	- flat -	- flat -	- flat -
Tread Depth	17/32 inch	17/32 inch	17/32 inch	17/32 inch

[10] Refer to *Materials laboratory Factual Report*, which can be found in the docket for this investigation

1.5. Steering and Suspension

The front area of the bus where the steering wheel was located was crushed and detached from the remainder of the bus body. The steering wheel was crushed and deformed such that it measured 22 inches wide (left to right) and 14 inches high (up to down). The steering wheel remained attached to the steering column through two universal joints and linkage shafts into the driver floor pan area. Aft of the floor pan area the steering input shaft was destroyed and detached from the TRW steering gear box.

The steering gear box remained attached to the left side frame rail of the bus.[11] The output shaft from the steering gear box was found sheared off at the pitman arm connection. The pitman arm remained attached to the drag link, and the drag link remained attached to the left front axle steering knuckle, however all ball joint connections were either deformed or damaged.[12] The steering arm connecting the left side of the front axle to the right side steering knuckle also remained attached with some damage and deformation noted at the ball join connections. The steering gear box was removed from the bus frame rail and shipped to TRW in Lafayette, Indiana on January 19, 2015 for further disassembly and internal examination and possible identification of any impact related steering angle witness marks. It was determined that no further examination was required and the steering gear was returned to the Texas Department of Criminal Justice on August 19, 2015.

1.6. Braking

The accident bus was equipped with pneumatic drum brake system on both axles. The brake system consisted of size 24 long stroke service brake chambers (Type 24L) with 5 ½ inch automatic slack adjusters on the front axle and size 30 long stroke service and parking brake chambers (Type 30/30L) with 6 inch automatic slack adjusters on the rear axle.

Brake pushrod stroke measurements and air systems tests could not be performed due to the extent of damage to the air brake system. All air hoses were severed and the air tanks that were located were detached and punctured. The left front slack adjuster was broken away at the S-cam connection and mostly missing, with only a portion of the slack adjuster still attached to the pushrod. The right front slack adjuster was bent and pinned against its attachment bracket. The left rear brake components sustained the least amount of damage, all remaining intact and connected, however the brake chamber and slack adjuster were no longer in alignment with the axle such that the slack adjuster was nearly in contact with the rear axle. The right rear slack adjuster was twisted 90 degrees and detached from the pushrod.

The brake drums and brake pads on both axles were visually inspected. All brake pads were found to be in excess of the minimum thickness requirement of 1/4 inch.[13] The front brake

[11] Refer to *Vehicle Photograph 6 – Steering gear box at left side frame rail*, which can be found in the docket for this investigation

[12] Refer to *Vehicle Photograph 7– Front drive axle with steering linkage*, which can be found in the docket for this investigation

[13] 49 CFR Part 393.47(d) states 1/4 inch minimum for air-braked non-steering axles, or 3/16 inch minimum for air-braked front steering axle brakes

pads were measured to be 13/16 inch thick, and the rear brake pads were measured to be 3/4 inch thick. No brake pad or brake drum cracks or defects were observed.

2. Anti-lock Braking Systems (ABS)

All commercial vehicles (such as buses) manufactured after March 1998, are required to be equipped with anti-lock braking systems (ABS).[14] The bus was equipped with Bendix ABS sensors at all four wheels locations. All of the sensors remained intact in the wheel ends. The sensor wires on the front axle and right side of the rear axle were severed. The sensor wire on the left rear side of the axle was the only location where the wire remained connected from the sensor to the modulator.

2.1. Vehicle Recorded Event Data

The bus was equipped with an electronically controlled Cummins ISB engine. The engine control module (ECM) has the capability to record events which often include vehicle speed, engine rpm, brake circuit status, throttle percentage, and other associated data in the event of a sudden decelerations or hard braking. However the ECM was torn away from the left side of the engine and only small pieces from that area of the engine were located in the wreckage. The engine ECM wiring harnesses were located, but the ECM was not.[15]

The bus's Bendix ABS system was also electronically controlled. Previous downloads of ABS control modules have included data related to crash event braking, steering, and throttle input. The Bendix control module was located in the front portion of the bus to the right of the driver seat and was intact. Only minor damage noted to the right side of its wiring harness. Just below the Bendix control module there was a "Commercial Vehicle Controls" unit. According to Blue Bird, this was just a part of the electrical system multiplex and did not have any recording capabilities.

On the other side of the firewall from these control modules, at the right rear corner of the engine compartment, an Allison transmission control unit was also located. Previous downloads of transmission control modules have also been known to include crash related information. The Bendix control module and the Allison transmission control module were removed from the bus and shipped to the NTSB Recorders Specialist in Washington, DC. The Bendix ABS control module was imaged by Bendix engineers under observation of NTSB staff. No accident related data was recorded by the module. Engineers at Allison Transmission were consulted and it was determined the Allison transmission control module contained no time-stamped data relevant to the investigation. [16]

When inspection the damage dash section of the bus staff also noted that speedometer needle was stopped just below 60 mph.[17] The instrument cluster containing the speedometer was

[14] 49 CFR Part 393.55 (c)

[15] Refer to *Vehicle Photograph 8 – View of detached bus engine showing area of missing engine control module*, which can be found in the docket for this investigation

[16] Refer to *Vehicle Recorder Division Factual Report*, which can be found in the docket for this investigation

[17] Refer to *Vehicle Photograph 9 – Instrument cluster containing speedometer*, which can be found in the docket for this investigation

removed and shipped to NTSB Headquarters in Washington, DC, it was determined that no further examination was required.

2.2. Maintenance History

The Texas Department of Criminal Justice purchase order summary #ESA13287 documented that the bus was delivered to the Texas Department of Criminal Justice on June 27, 2014, as one of 20 in a new fleet of prison transport buses.[18]

Maintenance records for the bus were obtained from the Texas Department of Criminal Justice. The bus had been in service for less than six months. The records documented one as needed repair and one regularly scheduled preventative maintenance. The two maintenance actions were logged under work order #61249, dated December 18, 2014 to replace a broken fog lamp and work order #612494 dated, December 22, 2014 for an engine oil service, chassis lube, and fuel filter change.[19]

E. DOCKET MATERIAL

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

LIST OF ATTACHMENTS

Vehicle Attachment 1 - Accident Bus Build Record and Technical Specifications

Vehicle Attachment 2 - Center of Gravity Calculations for an Exemplar Blue Bird Vision Bus

Vehicle Attachment 3 - Accident Bus Purchase Order Summary

Vehicle Attachment 4 - Accident Bus Maintenance Records

LIST OF PHOTOGRAPHS

Vehicle Photo 1 - Left side view of bus body

Vehicle Photo 2 - Right side view of bus body

Vehicle Photo 3 - Front view of twisted frame rails

Vehicle Photo 4 - Rear view of twisted frame rails

[18] Additional information is contained in *Vehicle Attachment 3 - Accident Bus Purchase Order Summary.* which can be found in the docket for this investigation

[19] Additional information is contained in *Vehicle Attachment 4 - Accident Bus Maintenance Records,* which can be found in the docket for this investigation.

Vehicle Photo 5 -	Left side view of driver seat area
Vehicle Photo 6 -	Steering gear box at left side frame rail
Vehicle Photo 7 -	Front drive axle with steering linkage
Vehicle Photo 8 -	View of detached bus engine showing area of missing engine control module
Vehicle Photo 9 -	Instrument cluster containing speedometer

END OF REPORT

Jennifer Morrison