VEHICLE FACTORS GROUP CHAIRMAN'S FACTUAL REPORT

Chattanooga, Tennessee

HWY17MH009

(11 pages)

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

VEHICLE FACTORS GROUP CHAIRMAN'S FACTUAL REPORT

A. CRASH INFORMATION

Location:	300 block of Talley Road, Chattanooga, Hamilton County, Tennessee.
Vehicle:	2008, Thomas Built Buses, INC. School Bus
Operator:	Durham School Services LP of Warrenville, Illinois
Date:	November 21, 2016
Time:	Approximately 03:20 p.m. (EST)
Fatalities:	6 school bus passengers
Injuries:	32 school bus passengers; minor to serious injuries, driver; minor injury
NTSB #:	**HWY17MH009**

B. VEHICLE FACTORS GROUP

Jerome Cantrell, Vehicle Factors Investigator, Group Chairman
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Trooper Wade Clepper, Vehicle Factors Group Member
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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 information obtained during the detailed inspection of the accident bus and subsequent review of maintenance records. The 2008 Thomas Built school bus (the bus) was inspected at Yates Wrecker Service, in Chattanooga, Tennessee, on November 22, 2016.

All major vehicle operation systems were examined, which included the steering, braking, suspension, and electrical systems. Overall crash damage, along with any damage or anomalies within major vehicle mechanical and electrical systems were documented. Supporting photographs, vehicle specifications, maintenance records, and prior Tennessee Highway Patrol (THP) state inspections were collected and reviewed. Information was downloaded from the bus engine, which was equipped with an Electronic Control Unit (ECU) module, as well as MeritorWABCO anti-lock brake system (ABS) module.

The inspection was conducted in conjunction with the Tennessee Highway Patrol (THP), who was tasked with the inspections of all buses in Tennessee.[1]

E. VEHICLE INSPECTION

1. 2008 Thomas Built School Bus / 1418S / 84 Passenger

1.1. General Information:

Make/Model:	2008 Thomas Built Bus / MVP-EF 1418S
VIN:[2]	1T88U4E2681XXXXXX
Company Unit #:	16760-366
Date of Manufacture:	6/01/2007
GVWR:[3]	33,350 lbs.
GAWR (front axle):[4]	12,850 lbs.
GAWR (rear axle):	21,000 lbs.
Engine:	Cummins ISB-240, Six-Cylinder, 240 horsepower, Diesel
Transmission:	Allison 3000 Automatic

Additional equipment and specifications are included in Thomas Built Final Vehicle Record.[5]

[1] See Vehicle Attachment #1 – Tennessee Highway Patrol Commercial Vehicle Post-Crash Investigation Report
[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] See vehicle attachment #2 – Thomas Built Bus Final Vehicle Record

1.2. Damage Description

The bus sustained extensive damage, but the most of the damage was concentrated to the right side of the bus and the roof. The impact with the utility pole crushed the right-front corner of the bus rearward which caused the entrance doors to be displaced rearward, blocking the entrance stairwell. The utility pole was in contact with the bus from the bottom of the right-side "A" pillar and between the top, right-side amber warning lamp and extreme right amber identification lamp.

The front of the bus sustained damage that broke out both windshield panels and the front portion of the roof was displaced rearward. The damage to the front of the bus was concentrated from the bottom of the windshield panel mounting locations towards the roof. **Figure 1** is the front of the bus and the red, oblong circle indicates the approximate location of the impact between the bus and the utility pole.

Figure 1: The Front of the Bus

Figure 2 shows the right-front corner of the bus and displacement of the entrance doors.

Figure 2: Right-Front of Bus

The window frames on both the right and left sides were displaced rearward from the front of the bus to the rear of axle 2. All the glass from the passenger windows, except for the last three, were missing from the right side and all the glass for the passenger windows, except for the last four, were missing from the left side.

The roof was collapsed down almost to the tops of the seat backs and bottom of the window frames. The roof escape hatch covers were missing. The contact between the tree and the bus started rear of the second passenger window on the right side and stopped at the rear axle (axle 2). The top of the bus to the bottom of the side window line, was significantly displaced rearward. The exterior skin on the bus body and the roof top were stretched rearward and collected into wrinkles above axle 2. The rear body-to-frame mounting plates were bent and broken. The rear of the bus body was separated from the rear frame assembly and arched upward. The rear emergency exit door was still operational. **Figure 3** shows the right side of the bus with the red arrows indicating where the contact between the tree and the bus started and stopped.

Figure 3: The Right Side of the Bus

1.3. Weight and Measurements

The bus was weighed by the THP using certified portable scales on November 22nd, 2016. The measured axle weights are shown in **Table 1**. The weights shown do not include the weight of the passengers at the time of the crash.

Table 1: Bus Axle Weights

Position	Weight (lbs)	
	Left	Right
Steer Axle (Axle 1)	4,200	4,500
Drive Axle (Axle 2)	5,900	4,700
Total	**19,300**	

Per the manufacturer, Thomas Built Buses, INC, a MVP-EF 1418S model bus has a dry weight (without fuel and oil) of approximately 19,842 lbs. at the time it was built.[6] Pre-crash dimensional specifications per the manufacturer are listed in **Table 2**. Post-crash measurements, taken by the THP, are listed in **Table 3.**

Table 2: Pre-crash Bus Measurements (inches)

Overall	481.5
Wheelbase	231
Front Overhang	81.328
Rear Overhang	165.3
Overall Width	96
Overall Height	126

[6] See Vehicle Attachment #1 – Final Record and Technical Specifications for the Accident Bus.

Table 3: Post-crash Hand Measurements (inches)

Overall	540
Front Overhang	82
Front Bumper to Axle 2	317

In addition to the hand measurements, the bus that crashed and an exemplar bus were scanned by Technical Reconstruction group chairman.

1.4. Steering System

The steering system consisted of hydraulic power assisted gear, a drag link, steering knuckles, a tie rod, and outboard tie rod ball joints. The steering system was capable of being operated from stop-to-stop by rotating the steering wheel from left-to-right. No defects or collision damage was noted.

1.5. Suspension

The suspension consisted of spring packs, shock absorbers, and solid axles. No defects or collision damage was noted to the suspension.

1.6. Tires and Wheels

The VIN sticker was located on the bulkhead, above the driver's seat. The motorcoach was specified to be equipped with 11R22.5 "G" rated tires, mounted on 22.5X8.25 rims[7]. The tires were specified to be inflated to a maximum of 105 psi for both axles.

Except for the outside tire mounted on the right side of axle 2, all other tires and wheels were without damage other than normal wear and tear. The entire circumference of the outboard wheel flange, of the wheel mounted on the right side of axle 2, was abraded. There was debris lodged between the outboard wheel flange and the outboard tire bead. The circumference of the outboard tire sidewall was scuffed. **Table 4** includes the tire and wheel information documented at the time of inspection.

[7] Hereafter referred to as wheel

Table 4: Bus Tire Information

Axle 1	**Left**		**Right**	
Make/Model	BRIDGESTONE R268		BRIDGESTONE R268	
Tire Size	11R22.5 (LRG)		11R22.5 (LRG)	
Pressure	95 psi		110 psi	
Tread Depth[8]	11/32, 10/32, 9/32, 9/32 inch		6/32, 7/32, 9/32, 10/32 inch	
DOT #	2C3T 3B2 4614		2C3T 3B2 4614	
Maximum Load Rating[9]	6,610 lbs @ 120 psi (single)		6,610 lbs @ 120 psi (single)	
Tire Plies	Tread 5-Steel Sidewall 1-Steel		Tread 5-Steel Sidewall 1-Steel	
Rolling Radius	19 3/8		20	
Axle 2	**Left**		**Right**	
	Outside	Inside	Inside	Outside
Make/Model	BRIDGESTONE R268	GOODYEAR C149	BRIDGESTONE R260	MICHELIN XZE
Tire Size	11R22.5 (G)	11R22.5 (G)	11R22.5 (G)	11R22.5 (G)
Pressure	94 psi	76 psi	80 psi	58 psi
Tread Depth	23/32, 21/32, 22/32 inch	20/32, 20/32, 21/32 inch	8/32, 5/32, 7/32 inch	19/32, 18/32, 19/32 inch
DOT # RECAP#[10]	2C3T 3B2 2814 RANR3716	MC3T 6XBW 1308 UNKNOWN	323T 3DB 1013 RANR0515	M53T A7MX 1507 UNKNOWN
Maximum Load Rating[11]	5,840 lbs @ 105 psi (dual)	5,840 lbs @ 105 psi (dual)	5,840 lbs @ 105 psi (dual)	5,840 lbs @ 105 psi (dual)
Tire Plies	Tread 5-Steel Sidewall 1-Steel	Tread 5-Steel Sidewall 1-Steel	Tread 5-Steel Sidewall 1-Steel	Tread 5-Steel Sidewall 1-Steel
Rolling Radius	20		20	

1.7. Braking

The school bus was equipped with a dual pneumatic system with drum brakes. Axle 1 had 5 ½-inch automatic slack adjusters and axle 2 had 6-inch automatic slack adjusters. The school bus was equipped with size 20 inch, long stroke, clamp style, service brake chambers (Type L20) on axle 1 and standard size 30 inch, clamp style, service/parking brake chambers on axle 2 (type 30/30).

[8] Tire tread depth measurements were taken in the major tread grooves, starting from the outboard side of the tire
[9] This is the maximum weight this size tire can carry in a single tire configuration
[10] When new tread is applied (recapped) to an old casing, the sidewall must be stamped with the recap date
[11] This is the maximum weight each tire can carry when mounted in a dual tire configuration

Brake pushrod stroke measurements, for axles 1 and 2, were taken on the school bus by utilizing the shop air compressor at the inspection site. The shop air hose was connected to the air compressor service hose on the school bus and the brake air reservoirs on the bus were pressurized 100 psi. The air pressure gauge, located on the instrument panel of the school bus was utilized to monitor the air pressure. Brake applications were completed by depressing releasing the bus brake pedal. No defects or discrepancies were noted to the brake system. Pushrod travel during the brake applications was recorded as "Pushrod Stroke" in **Table 5**.

Table 5. Bus Brake Measurements

Brake Location	Axle I		Axle II	
	Left	Right	Left	Right
Brake Type	Bendix L20/Drum[12]	Bendix L20/Drum	Bendix 30/30 Drum[13]	Bendix 30/30 Drum
Pushrod Stroke (inches)	1 3/8	1/2	1 7/8	1 7/8

1.7.1. Anti-lock Braking System (ABS)

All air-braked motorcoaches manufactured after March 1998, are required to be equipped with anti-lock braking systems (ABS).[14] There were no defects noted to the ABS. All wheel sensors were in place and no broken wires were discovered during the vehicle inspection. The ABS module was manufactured by MeritorWABCO. NTSB's Research and Engineering personnel retrieved the data.

1.8. Vehicle Recorded Data

The motorcoach was equipped with an electronically controlled Cummins engine. The electronic control module (ECM) on this year engine had the capability to capture or record events which often included vehicle speed, engine rpm, brake circuit status, throttle percentage, and other associated data in the event of a sudden decelerations or hard braking. The ECM for this engine had been removed under the direction of the THP and was placed into evidence with the Chattanooga Police Department. The ECM was mounted on an exemplar bus by Durham Bus Services LP mechanics and then the data was downloaded by NTSB Research and Engineering personnel.

1.9. Instrument Panel Switch Settings

Cruise Control	N/A
Wipers	Off
Engine Brake	N/A
Lights	Off
Interior Lights	Off

[12] Maximum pushrod stroke for size 20 long-stroke brake chambers is 2 inches, per Commercial Vehicle Safety Alliance Out-of-Service criteria (CVSA)
[13] Maximum pushrod stroke for size 30 brake chambers is 2 inches, per CVSA
[14] 49 CFR Part 393.55 (c)

Heater	Off
Fresh Air Lever	Off
Strobe Light	Off

F. MAINTENANCE HISTORY

Maintenance and inspection records for the bus were obtained from Durham School Services, LP. by the NTSB Motor Carrier Factors Group Chairman and were reviewed along with the prior bus inspections conducted by the THP. There were 11 inspections conducted on the bus by the THP between 7-30-2007 and 8-3-2016, and there were no violations noted. The maintenance records for the bus were maintained and no defects with the major mechanical systems of the bus were noted in the DVIRs provided. The maintenance records were reviewed in detail and contained a variety of regularly scheduled maintenance and as-needed repairs made to the bus.

G. RECALLS AND WARRANTY CLAIMS

Per the bus manufacturer, there were two recalls issued for this bus, two Vehicle Owner Notification letters, and three warranty claims.[15]

1. Recalls

- Recall # 08V-622; Dual Power Switch

  This recall, dated June 26, 2009, involved MVP-EF model buses manufactured between February 2002 and October 2008. The defect involved the solid-state circuit breakers. These breakers may have tripped unnecessarily potentially resulting in the loss of power to the bus chassis and body electrical causing an unexpected loss of engine power and exterior lighting.

- Recall # 09V-462: TBB EF Accelerator Pedal

  This recall, dated March 10, 2010, involved MVP-EF model buses manufactured between February 15, 2005 and November 23, 2009. The defect involved the accelerator pedal. The accelerator could have become stuck in the full throttle position. NTSB investigators inspected the throttle pedal assembly and verified the accelerator pedal mounting bracket had been replaced.

2. Vehicle Owner Notification Letters

- The first Vehicle Owner Notification letter, dated June 30, 2008, was to inform the owners that Thomas had determined that the internal oil transmission cooler in the radiator was not sufficient with the PTS 3000 transmission.

[15] See Vehicle Attachment #3 – Recalls, Vehicle Owners Letters, and Warranty Claims

- The second Vehicle Owner Notification letter, dated January 31, 2013, was to inform the owners that Thomas had determined that the fuse for the heater/defroster was the incorrect size and the correct fuse size was a 1 amp.

3. Warranty Claims

- The first warranty claim, dated January 27, 2012, was for an oil leak. The cause of the oil leak was determined to be the air compressor mounting gasket. Problem was repaired.

- The second warranty claim, dated March 30, 2012, was for oil leaks and noise. The cause of the oil leak was determined to be the air compressor mounting gasket and the engine noise was determined to be an exhaust leak at the #5 exhaust port. Both problems were repaired.

- The third warranty claim, dated July 2, 2012, was for a fuel leak. The cause of the fuel leak was determined to be coming from the bottom of the fuel pump. The fuel pump was removed and replaced with a new one.

H. DOCKET MATERIAL

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

LIST OF ATTACHMENTS

Vehicle Attachment #1 -	Tennessee Highway Patrol Commercial Vehicle Post-Crash Investigation Report
Vehicle Attachment #2 -	Thomas Built Bus Final Vehicle Record
Vehicle Attachment #3 -	Recalls, Vehicle Owners Letters, and Warranty Claims

END OF REPORT

Jerome F. Cantrell
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