VEHICLE FACTORS GROUP CHAIRMAN'S FACTUAL REPORT

PALM SPRINGS, CALIFORNIA

HWY17MH005

(24 pages)

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

VEHICLE FACTORS GROUP CHAIRMAN'S FACTUAL REPORT

A. CRASH INFORMATION

Location:	Westbound Interstate 10 (I-10) in the vicinity of post mile marker 32.5, near Desert Hot Springs, Riverside County, California
Vehicle #1:	1996 MCI, 47 Passenger, Motorcoach
Operator #1:	USA Holiday
Vehicle #2:	2015 International Prostar Truck Tractor in combination with a 2013 3000R Utility VS2RA Refrigerated Semitrailer
Operator #2:	TSC, Tri-State Collision, LLC
Date:	October 23, 2016
Time:	5:16 a.m. Pacific Daylight Time (PDT)
Transported:	30 Bus Passengers, 1 Truck Driver
Fatalities:	12 Bus Passengers, 1 Bus Driver

NTSB #: **HWY17MH005**

B. VEHICLE FACTORS GROUP

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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 regarding the vehicles involved in this crash and the subsequent review of maintenance records. This report details the mechanical condition of the 1996 Motor Coach Industries (MCI) motorcoach. A Federal Motor Carrier, Commercial Vehicle Safety Alliance (CVSA) level 1 post-crash inspection was conducted on the 2015 International truck tractor and 2012 Utility Trailer MFG. CO. semitrailer combination (truck tractor combination).

The motorcoach and truck tractor combination were inspected between October 24 and 31, 2016, at Mohica Towing, located in Desert Hot Springs, California. Inspections of the motorcoach and truck tractor combination were also completed by M.A.I.T Investigator S. Turner of the California Highway Patrol Multidisciplinary Accident Investigation Team (M.A.I.T).

All major mechanical systems were examined, which included the steering, braking, and suspension systems. Overall crash damage, along with any damage or anomalies within major vehicle mechanical and electrical systems was documented. Supporting photographs, vehicle specifications, and maintenance records were collected and reviewed.

E. VEHICLE INSPECTIONS

1. VEHICLE #1: 1996 MCI MOTORCOACH PRODUCTION NUMBER [redacted]

1.1. General information

MOTORCOACH:	
Make/Model:	1996 MCI 102D3 47 Passenger
VIN:[1]	1M8SDMPA5TPXXXXXX
Date of Manufacture:	May 1996
Mileage:[2]	144,408
GVWR:[3]	44,400 lbs
GAWR (steering axle):[4]	14,400 lbs
GAWR (drive axle):	22,400 lbs
GAWR (tag axle):[5]	12,000 lbs
Engine:	Detroit, Series 60, Six-Cylinder, 470 hp, Diesel
Transmission:	Allison B500 Automatic

Additional equipment and specifications are included in MCI Vehicle Records[6]

1.2. Damage Description

[1] Vehicle Identification Number (VIN)
[2] Mileage was taken from the hubodometer which was mounted to the right side of axle #2
[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] The tag axle consisted of two independent swing arm axles, each rated at 6,000 lbs.
[6] See vehicle attachment – MCI Vehicle Records

The motorcoach sustained extensive front-end damage. The upper glass (front destination sign windscreen) above the windshields was missing. The left and right windshields were missing. The right side of the front bumper cover was missing. The right-side rear-view mirror was missing. The right-front headlamp and turn signal assemblies were missing. The left side high beam headlamp case was broken and found separated from its mounting location. The filament for the high beam headlamp was slightly distorted. The left side low beam headlamp was found still attached at its proper mounting location. The low beam headlamp was removed and transferred to the NTSB Research and Engineering staff on scene, for further analysis. The left side turn signal assembly was missing. The front motorcoach body panels were missing. The steering wheel, steering wheel column, instrument panel, and the passenger loading door, were found separated from the motorcoach and were found in the debris pile. The electrical wiring for the driver controls and instrument panel were found hanging down the outside of the motorcoach by the left side low beam headlamp. The passenger entrance stepwell was crushed rearward. The right side of Axle 1 had been crushed rearward trapping the tire and wheel inside the right-side wheel well. The roof of the passenger compartment was separated from the left side panels for approximately 12 feet from the leading edge of the bus. Numerous side panels had been cut and removed from both sides of the motorcoach. **See Figure 1**

Figure 1: The Front of the 1996 MCI Motorcoach

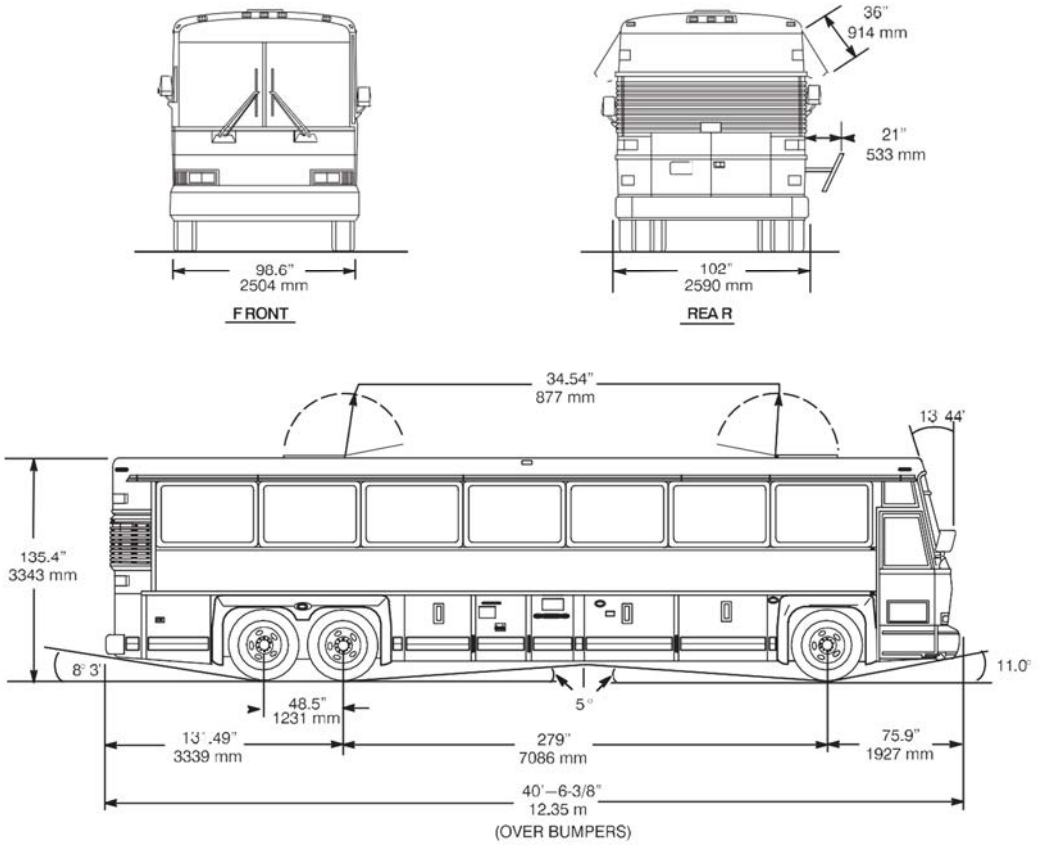
1.3. Weights and Measurements

No axle weights were taken of the motorcoach after the crash. The information provided in Table 1 and Figure 2 was obtained from the 102D Series Maintenance Manual: Coach Specifications.[7]

Table 1: Motorcoach Weights

GVWR	44,400 lbs
Approximate Payload Capacity	11,500 lbs
Fuel Capacity	192 Gal.

Figure 1: Measurements of Motorcoach



[7] This information was provided courtesy of MCI

1.4. Headlamp Inspection

The motorcoach was equipped with two head lamp mounting assemblies, one on the left-front of the motorcoach and one on the right-front of the motorcoach. Each headlamp mounting assembly contained two individual sealed beam halogen lamps. The two outboard lamps were for low beam operation and the two inboard lamps were for high beam operation.

The right-side head lamp mounting assembly along with the two lamps were destroyed in the crash. The left side headlamp mounting assembly was broken at the inboard lamp location and most of the lamp reflector and all of the lamp lens were missing. The halogen bulb was still intact. A visual inspection of the left inboard halogen bulb was conducted at the tow yard. The tungsten coil filament appeared to have a shiny appearance with a rough texture. The filament was fractured within the third coil from one of the filament supports. No deformation of the filament was observed. The left outboard halogen lamp was intact still mounted in the headlamp mounting assembly. The lamp was removed and transferred to the NTSB materials laboratory for a closer inspection.

The NTSB Material Laboratory conducted an inspection on the left-outboard halogen lamp on June 13, 2017. The lamp was examined in a non-evasive way by using an x-ray machine to view the lamp filament through the outer lens. The headlamp contained a single, dual-filament halogen light bulb. Both filaments were intact and showed no evidence of hot coil stretching.

1.5. Steering System

The damage to the steering was isolated to the steering column and steering wheel, which were recovered from the debris pile.[8] The tie rod and steering knuckles were capable of being rotated from stop to stop by pushing and pulling on the steering knuckles by hand. The steering gear box was removed and sent to the manufacturer, ZF Friedrichshafen AG, for further inspection and analysis.

On Thursday, February 23, 2017, a detailed external and internal examination and component teardown of the steering gear was conducted at ZF TRW Commercial Steering facilities in Lafayette, Indiana. This examination was conducted under the direction and presence of NTSB investigators. The examination found the steering gear to be mechanically functional and able to translate movement over its entire range.[9] The input shaft splines sustained damage from the u-joint pinch bolt having been pulled against them during the crash.[10] The splines on the output shaft were undamaged and in good condition. There was a fluid leak from the seal around the input shaft, but the steering gear box was full of fluid at time of inspection. There were no impact marks on the helical worm gear from the recirculating ball bearing making the angle of the steering wheel at the time of the crash indeterminant.

1.6. Suspension

[8] See Vehicle photograph – MCI Steering Wheel and Instrument Panel
[9] See Vehicle Attachment – Steering Gear Examination Report from ZF-TRW Commercial Steering
[10] See Vehicle Photograph – MCI Steering Gear Input Shaft

The suspension on each side of axle 1 of the motorcoach consisted of an air spring, a forward and rear shock absorber, a torque arm and a stabilizer bar mounted to the solid axle.

The suspension on each side of axle 2 of the motorcoach consisted of forward and rear air springs and shock absorbers, a torque arm, and a trunnion assembly mounted to a solid axle. Stabilizer bars, located above the axle, connected the trunnion assemblies.

The suspension on each side of axle 3 of the motorcoach consisted of a shock absorber, an air spring, and a swing arm.

No damage was noted to the motorcoach suspension.

1.7. Tires and Wheels

The VIN plate had been torn away from its original mounting location. The motorcoach was specified to be equipped with 315/80R22.5 tires, mounted on 22.5X8.25 rims[11]. The tires were specified to be inflated to 105 psi for axle 1 (steer axle), 90 psi for axle 2 (drive axle), and 80 psi for axle 3 (tag axle).[12]

Both axle 1, right-side and left-side tires were worn below the minimum tread depth limits set for steer axle tires.[13] Axle 1 right-side tire sustained roadway abrasions in the tread area. Axle 2 left inside tire, axle 2 right outside tire, and axle 3 right tire were all worn below the minimum tread depth limits set for other tires.[14] The minimum tread depth regulation for commercial vehicle tires is 4/32 of an inch for the steer axle and 2/32 of an inch for all other axles.[15] The tire tread depth measurements on axle #1 were out-of-service conditions for the motorcoach.[16]

Tire tread measurements were taken across the tread area from the outboard side of the tires to the inboard side of the tires, in four separate locations, at approximately the 12, 3, 6, and 9 clock positions when possible. The lowest measurement for each major tread groove was documented.

Table 2 includes the tire and wheel information documented at the time of inspection.

Table 2: Motorcoach Tire Information

Axle 1	Left	Right
Make/Model	FIRESTONE FS 400	FIRESTONE FS 400
Tire Size	315/80R22.5 (LRL)	315/80R22.5 (LRL)

[11] Hereafter referred to as wheel
[12] A tag axle is a trailing axle or a third axle positioned behind the rear drive axle to assist in distribution of weight, stabilization, and braking.
[13] Minimum tread depth for steer axle tires is 4/32 inch (Title 49 CFR 393.75 (b)
[14] Minimum tread depth for tires other than steer axle is 2/32 inch (Title 49 CFR 393.75 (c)
[15] Measured in two adjacent tread grooves at any location on the tire, according to the Federal Motor Carrier Safety Regulations, Title 49 of the US Code of Federal Regulations, Part 393.75(Tires)
[16] According to the Commercial Vehicle Safety Alliance (CVSA) Out-of-Service criteria (Part II, section 11.a.1)

Pressure	98 psi		104 psi	
Tread Depth	3/32, 3/32, 3/32, 3/32 inch		4/32, 3/32, 3/32, 3/32 inch	
DOT #	4D4D 35J 1214		4D4D 35J 2514	
Maximum Load Rating	9,090 lbs @ 130 psi (single)		9,090 lbs @ 130 psi (single)	
Tire Plies	Tread 5-Steel Sidewall 1-Steel		Tread 5-Steel Sidewall 1-Steel	
Axle 2	**Left**		**Right**	
	Outside	Inside	Inside	Outside
Tire Make	BRIDGESTONE R150	BRIDGESTONE R150	FIRESTONE FS 400	FIRESTONE FS 400
Tire Size	315/80R22.5 (L) 161/157 J	315/80R22.5 (L) 161/157 J	315/80R22.5 (L)	315/80R22.5 (L)
Pressure	92 psi	92 psi	97 psi	Deflated
Tread Depth	6/32, 4/32, 4/32, 4/32 inch	0/32, 1/32, 3/32, 0/32 inch	4/32, 5/32, 5/32, 5/32 inch	2/32, 1/32, 1/32, 1/32 inch
DOT #	EK 4D2NT 4111	EK 4D2NT 4111	4D4D 35J 2514	4D4D 35J 1515
Maximum Load Rating	7,310 lbs @ 120 psi (dual)	7,310 lbs @ 120 psi (dual)	8,770 lbs @ 130 psi (Dual)	8,770 lbs @ 130 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
Axle 3	**Left**		**Right**	
Tire Make	GOODYEAR G289		FIRESTONE FS 400	
Tire Size	315/80R22.5 (L)		315/80R22.5 (LRL)	
Pressure	88 psi		90 psi	
Tread Depth	8/32, 9/32, 10/32, 9/32 inch		1/32, 2/32, 2/32, 0/32 inch	
DOT #	M172WHAW3514		4D4D 35J 1214	
Maximum Load Rating	9,090 lbs @ 130 psi (single)		9,090 lbs @ 130 psi (single)	
Tire Plies	Tread 5-steel Sidewall 1-Steel		Tread 5-Steel Sidewall 1-Steel	

1.8. Braking

The motorcoach was equipped with pneumatic drum brakes. Axles 1 and 3 had 5 ½-inch automatic slack adjusters and axle 2 had 7-inch automatic slack adjusters. The motorcoach was equipped with size 24-inch, clamp style, service brake chambers (Type 24) on axle 1, size 30-inch, DD3 style, service/parking brake chambers on axle 2 (type 30/30), and size 12-inch, clamp style, service brake chambers (Type 12) on axle 3.

The brake pedal was distorted and the brake pedal mounting plate along with the brake pedal were found in the debris pile. The brake pedal control rod from the pedal to the brake valve was bent and broken in the thread area on the clevis side. The brake pedal control rod was threaded through a jamb nut and into the clevis. The brake control rod was broken at the jamb nut. The brake valve was broken away from its mounting bracket. The brake pedal assembly and brake pedal control rod were sent to the NTSB materials laboratory for a closer inspection.

On February 8, 2017, an inspection was conducted on the fractured brake control rod. The fracture was confirmed to have been consistent with "ductile overstress fracture", and was a result of the crash. [17]

Brake pushrod stroke measurements, for axles 2 and 3, were taken by utilizing a service vehicle at the inspection site. The brake air pressure was built to 100 psi. Investigator Turner attached the air hose from the service vehicle to the thermoplastic airlines that were attached to the service air ports on each individual brake chamber. Air applications of 100 psi were applied to each brake chamber. The distance the pushrod traveled during the 100 psi brake applications is recorded as "Pushrod Stroke" in **Table 3**. The maximum pushrod stroke for size 24 brakes is 1 ¾ inches, for size 30 brake chambers is 2 inches, and for size 12 brake chambers is 1 3/8 inches. 1/8 inch over maximum stroke limit equals half a defective brake. ¼ inch over maximum pushrod stroke equals a full defective brake.[18]

Table 3: MCI Motorcoach Brake Measurement[19]

Brake Location	Axle 1		Axle 2		Axle 3	
	Left	Right	Left	Right	Left	Right
Brake Type	Bendix 24/Drum	Bendix 24/Drum	Bendix 30/30 Drum	Bendix 30/30 Drum	Bendix 12/Drum	Bendix 12/Drum
Pushrod Stroke	1 3/8	1 3/4	N/A	N/A	7/8	1
Measured Lining Thickness	Top: 13/32	Top: 12/32	Top: 0/32	Top: 10/32	Top: 5/32	Top: 9/32
	Bottom: 10/32	Bottom: 12/32	Bottom: 0/32	Bottom: 10/32	Bottom: 5/32	Bottom: 11/32
Measured Drum Diameter	14.685 inches	14.710 inches	14.637 inches	14.572 inches	14.576 inches	14.612 inches
Manufacturer's Specification[20] [21]	14.880	14.880	14.830	14.830	14.830	14.830

[17] See Vehicle Attachment - NTSB Motorcoach Brake Pedal and Linkage Inspection Report
[18] Per the CVSA Out-of-Service criteria (Part II, section 1. a.4. (a)(b))
[19] All measurements are in inches
[20] The measurements cast on the drums from the manufacturers were provided in "metric units" and have been converted to "imperial measurements" for consistency
[21] The manufacturer's specification is the maximum allowed inside diameter measurement of a brake drum.

Axle 2 brakes were found to have been backed off their original adjustment, so no pushrod stroke adjustment was taken. The brake drums and brake pads on all axles were visually inspected. All brake linings, except for axle 2 left and axle 3 left, were found to be more than the minimum thickness limit of 1/4 (8/32) inch. Axle 2 brake linings, on the left end of the axle, were down to the rivets and were measured to be at 0/32 inch. When the number of defective brakes is equal to or greater than 20 percent of the service brakes on the vehicle, the vehicle is Out-of-Service. The motorcoach had two defective brakes out of six which equaled 30 percent and was an Out-of-Service condition. [22] All six of the brake drums were found to be well within manufacture specifications.[23]

1.8.1. Anti-lock Braking System (ABS)

All air-braked motorcoaches manufactured after March 1998, are required to be equipped with anti-lock braking systems (ABS).[24] An ABS was not mounted on this motorcoach nor was it required for this year motorcoach.

1.9. Vehicle Recorded Event Data

The motorcoach was equipped with an electronically controlled Detroit engine. The DDEC module that was found mounted on this engine was a newer version than one that had been originally equipped with this year engine. The newer DDEC module had the ability 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 deceleration or hard braking. The DDEC module was removed and placed into CHP evidence.[25]

1.10. Crash Avoidance System

There was no crash avoidance system available for this year of motorcoach nor was it required.

1.11. Driver Controls

All of the driver controls, the instrument panel, and dash were found displaced from the vehicle and in the debris pile. There were no switches still intact or located in the instrument panel.

2. VEHICLE #2: 2015 INTERNATIONAL TRUCK TRACTOR AND 2012 UTILITY SEMITRAILER

2.1. GENERAL INFORMATION

[22] Per the CVSA Out-of-Service criteria (Part II, section 1. a.)
[23] 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.
[24] 49 CFR Part 393.55 (c)
[25] Refer to the NTSB Research and Engineering Factors report

TRUCK TRACTOR:

Make/Model:	2015 International Pro-Star
VIN:	3HSDJSNR0FNXXXXXX
Company Unit #:	117
Date of Manufacture:	January 2014
GVWR:	52,350 lbs
GAWR (steering axle):	12,350 lbs
GAWR (drive axle):	20,000 lbs
GAWR (rear axle):	20,000 lbs
Engine:	Navistar, N13, Six-Cylinder, 430 hp, Diesel
Transmission:	Eaton Fuller, 10-speed, Manual

Additional equipment and specifications are included in International Vehicle Records.[26]

SEMITRAILER:

Make/Model:	2012 3000R Utility Trailer Manufacturing Company, VS2RA, Refrigerated Semitrailer
VIN:	1UYVS2537DMXXXXXX
Company Unit #:	321
Date of Manufacture:	March 2012
GVWR:	65,000 lbs
GAWR (per axle):	20,000 lbs

Additional equipment and specifications are included in Utility Vehicle Records.[27]

2.2. Damage Description

The truck tractor sustained no mechanical damage due to the crash. Some superficial damage was noted to the axle 2 and axle 3 tires which will be described in detail later in the report.

The semitrailer sustained extreme damage to approximately the last 20 feet of the trailer. The rear doors along with the steel frame assembly holding the doors, were in the debris pile. The rear doors were comprised of polished, stainless-steel aluminum exterior skins with a diamond pattern, fiberglass interior skin, and bonded foam, sandwiched between the two skins. The doors were distorted and torn. The stainless steel, rear door frame assembly, was found to have been cut into multiple pieces during the recovery process.

The rear bumper and rear impact guard were found to be rolled downward and forward, under the floor of the trailer. The rear bumper and rear impact guard were still attached together and rotated forward as one piece. The rear bumper was mounted just below the rear doors and contained two latches for the rear door locks to engage into when closed. The rear bumper had six rear light mounting locations, three on the left extreme and three on the right extreme. The lighting locations were to accommodate the turn signals, brake lamps, and tail lamps. The rear impact guard was mounted to the rear bumper and the sub-frame assembly. The rear impact guard was made of a steel, square tube approximately 4 inches by 4 inches in height and width, and

[26] See Vehicle Attachment - International Vehicle Records
[27] See Vehicle Attachment – Utility Vehicle Records

approximately 95 inches in length. The left side of the rear impact guard was broken and separated from the attachment welds at the left mounting bracket. The right side of the rear impact guard was broken at the attachment weld to the bumper bracket.

The flooring of the semitrailer was buckled upward. The crossmembers under the floor were displaced forward and separated from their mounting positions, more on the left than the right. The sub-frame assembly that the sliding tandems move fore and aft on was bent upward and broken at both the leading and trailing edges. The rear axle (axle 5) was displaced forward with the left tires and wheels resting on top of the left tires and wheels of the forward axle (axle 4). Portions of the trailer wall were found to be separated from the vehicle and located in the debris pile. The ceiling on the rear of the trailer had black transfer marks and was collapsed upon the load inside of the trailer. The front of the semitrailer sustained damage to both the right and left sidewalls of the trailer, approximately four feet rear of the leading edge of the trailer.[28]

2.3. Weights and Measurements

No axle weights were taken for the truck tractor combination after the crash. The information in **Table 4**, was provided by International. The information in **Table 5** was provide by Utility Trailer MFG. CO.

Table 4: Truck Tractor Weights and Measurements

GVWR	52,350 lbs
Un-laden with full fuel tanks	27,780 lbs
Fuel	240 total gallons
Frame Rail OAL[29]	367.4 inches
Wheelbase Range	221 - 270 inches

Table 5: Utility Refrigerated Semitrailer Weights and Measurements

GVWR	65,000 lbs

[28] See Vehicle Photographs – Semitrailer Damage
[29] Overall Length

Un-laden	13,800 lbs
Fuel	50 gallons
OAL	636 inches
OAH[30]	162 inches
OAW[31]	102.375 inches

The semitrailer was loaded with 39,360 lbs. of product at the time of the crash.

In addition to the observed damage, the NTSB Evidence Documentation Team mapped the combination unit using a FARO laser scanner, which generated a 3-dimensional model of the damaged vehicle.

2.4. Tires and Wheels

The axles are numbered from axle1 (steering axle) to the last axle on the trailer (axle 5).

Per the VIN plate, mounted on the inside of the left door frame, the truck tractor was specified to be equipped with 295/75R22.5 tires, mounted on 22.5X8.25 rims. The tires were specified to be inflated to 105 psi for axle 1 (steer axle) and 85 psi for the axles 2 and 3(drive axles).

Tire size and inflation recommendations listed on the semitrailer VIN plate, mounted to the left front of the semitrailer, listed a variety of tire sizes with inflation pressures ranging from 75 psi to 100 psi. The tires that were found to be mounted on this semitrailer were 295/75R22.5 G. The VIN plated specified the following for these tires; they were to be mounted on 22.5X8.25 rims and to be inflated to 100 psi for both trailer axles.

All 8 tires mounted on axle 2 and axle 3 of the truck tractor sustained roadway abrasions, in one location, across the entire width of the tread area.[32] The roadway abrasions for the inside and outside tires were at the same locations on both tires. In the areas of the roadway abrasions, there was some blueing.[33]There was a collection of scuffed off rubber at the trailing edges of the

[30] Overall Height
[31] Overall Width
[32] See Vehicle Photograph – Truck Tractor Tires with Roadway Abrasions
[33] Blueing – The general color that results in rubber that has been subjected to a high heat buildup in the tire. (Tire Forensic Investigation by Thomas R. Giapponi)

roadway abrasions. No roadway abrasions were located on the tires for axles 1, 4, and 5. **Table 3** includes the tire and wheel information documented at the time of inspection.

Table 3 Truck Tractor and Semitrailer Combination Tire Information

Truck Tractor:

Axle 1	**Left**		**Right**	
Tire Make	FIRESTONE FS591		FIRESTONE FS591	
Tire Size	295/75R22.5 (G)		295/75R22.5 (G)	
Pressure	96 psi		86 psi	
Tread Depth[34]	18/32, 18/32, 18/32, 18,32 inch		18/32, 18/32, 18/32, 18,32 inch	
DOT #	4DBT65N2416		4DBT65N3116	
Maximum Load Rating	6,175 lbs. @ 110 psi (single)		6,175 lbs. @ 110 psi (single)	
Tire Plies	Tread 5-steel Sidewall 1-Steel		Tread 5-steel Sidewall 1-Steel	
Axle 2	**Left**		**Right**	
	Outside	Inside	Inside	Outside
Tire Make	KELLY KDA	YOKOHAMA TY517	KELLY KDA	KELLY KDA
Tire Size	295/75R22.5 (G)	295/75R22.5 (G)	295/75R22.5 (G)	295/75R22.5 (G)
Pressure	88 psi	88 psi	92 psi	92 psi
Tread Depth	18/32, 18/32, 18/32, 19/32 inch	13/32, 13/32, 13/32, 13/32 inch	12/32, 12/32, 12/32, 12/32 inch	12/32, 12/32, 12/32, 12/32 inch
DOT #	DA37BCKW3215	47BTEC20415	DA37BCKW3215	DA37BCKW3215
Maximum Load Rating	5,675 lbs. @ 120 psi (Dual)	5,675 lbs. @ 110 psi (Dual)	5,675 lbs. @ 120 psi (Dual)	5,675 lbs. @ 120 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
Axle 3	**Left**		**Right**	
	Outside	Inside	Inside	Outside
Tire Make	KELLY KDA	KELLY KDA	BFGOODRICH DR444	BFGOODRICH DR444
Tire Size	295/75R22.5 (G)	295/75R22.5 (G)	295/75R22.5 (G)	295/75R22.5 (G)
Pressure	98 psi	98 psi	100 psi	100 psi
Tread Depth	22/32, 22/32, 22/32, 22/32 inch	22/32, 22/32, 22/32, 22/32 inch	12/32, 12/32, 12/32, 12/32 inch	12/32, 12/32, 12/32, 12/32 inch
DOT #	DA37BCKW3215	DA37BCKW3215	M5EJBMVX4615	M5EJBMVX4615

[34] The tread depth was measured from the outboard to the inboard sides of the tires.

Maximum Load Rating	5,675 lbs. @ 120 psi (Dual)	5,675 lbs. @ 120 psi (Dual)	5,675 lbs. @ 110 psi (Dual)	5,675 lbs. @ 110 psi (Dual)
Tire Plies	Tread 5-steel Sidewall 1-Steel	Tread 5-steel Sidewall 1-Steel	Tread 4-steel Sidewall 1-Steel	Tread 4-steel Sidewall 1-Steel

Semitrailer:

Axle 4	**Left**		**Right**	
	Outside	Inside	Inside	Outside
Tire Make	GOODYEAR G316 (LHT)	BRIDGESTONE M720	BFGOODRICH ST244	FIRESTONE FS591
Tire Size	295/75R22.5 (G)	295/75R22.5 (G)	275/80R22.5 (G)	295/75R22.5 (G)
Pressure	76 psi	74 psi	84 psi	80 psi
Tread Depth	6/32, 6/32, 6/32, 5/32 inch	2/32, 2/32, 3/32, 0/32 inch	4/32, 3/32, 3/32, 4/32 inch	5/32, 4/32, 4/32, 4/32 inch
DOT #	2G8T6NC0812	MJ37TKBW1311	UNKNOWN	4DBT65N2416
Maximum Load Rating	5,675 lbs. @ 110 psi (Dual)	5,675 lbs. @ 120 psi (Dual)	5,675 lbs. @ 110 psi (Dual)	5,675 lbs. @ 110 psi (Dual)
Tire Plies	Tread 4-steel Sidewall 1-Steel	Tread 5-Steel Sidewall 1-Steel	Tread 4-Steel Sidewall 1-Steel	Tread 5-steel Sidewall 1-Steel
Axle 5	**Left**		**Right**	
	Outside	Inside	Inside	Outside
Tire Make	BRIDGESTONE M720	GOODYEAR G305 (LHD)	BRIDGESTONE R195	SAMSON GL28ST
Tire Size	295/75R22.5 (G)	295/75R22.5 (G)	295/75R22.5 (G)	295/75R22.5 (G)
Pressure	DEFLATED	DEFLATED	80 psi	84 psi
Tread Depth	9/32, 9/32, 9/32, 7/32 inch	10/32, 10/32, 10/32, 9/32 inch	4/32, 4/32, 4/32, 4/32 inch	11/32, 11/32, 11/32, 11/32 inch
DOT #	M5EJBMVX2315	UNKNOWN	UNKNOWN	UNKNOWN
Maximum Load Rating	5,675 lbs. @ 120 psi (Dual)	5,675 lbs. @ 110 psi (Dual)	5,675 lbs. @ 120 psi (Dual)	5,675 lbs. @ 110 psi (Dual)
Tire Plies	Tread 5-Steel Sidewall 1-Steel	Tread 4-steel Sidewall 1-Steel	Tread 5-Steel Sidewall 1-Steel	Tread 5-steel Sidewall 1-Steel

2.5. **Braking**

The truck tractor combination was equipped with dual air system with drum brakes on all five axles. The truck tractor combination was equipped with size 24, long stroke, service brake chambers (Type 24 L clamp) on axle 1, size 30, long stroke, service/parking brake chambers on axles 2 through 5 (type 30/30 L clamp). All brake chambers mounted on axles 1 through 5 were of the long stroke type.

Brake pushrod stroke measurements, for the truck tractor combination, were taken by building air pressure to 100 psi, releasing the parking brakes, marking the pushrods, and then applying a full pressure application of the brake pedal. The distance the pushrod traveled during the brake applications is recorded as "Pushrod Stroke" in **Table 4**.

Table 4. Truck Tractor Combination Brake Measurements

Truck Tractor

Brake Location	Axle 1		Axle 2		Axle 3	
	Left	Right	Left	Right	Left	Right
Brake Type	Bendix 24L/Drum [35]	Bendix 24L/Drum	Bendix 30/30 L Drum[36]	Bendix 30/30 L Drum	Bendix 30/30 L Drum	Bendix 30/30 L Drum
Pushrod Stroke (inches)	1 5/8	1 1/2	1 5/8	1 1/2	1 5/8	1 5/8

Semitrailer

Brake Location	Axle 4		Axle 5	
	Left	Right	Left	Right
Brake Type	Bendix 30/30L/ Drum	Bendix 30/30L/ Drum	Bendix 30/30 L Drum	Bendix 30/30 L Drum
Pushrod Stroke (inches)	2 1/4	2 3/4	2.0	2.0

Axle 4 right-side pushrod stroke was found to exceed the maximum stroke limit regulations. The truck tractor combination had one defective brake out of ten which is only 10 percent of the service brakes. To be an Out-of-Service condition, the defective brakes must meet or exceed 20 percent. All other brakes were found to be within regulation.

Figure 3 shows the configuration of the parking brake controls (push-pull valve) inside the truck tractor. The red octagon knob on the left is to charge the semitrailer with air when coupled with the truck tractor. The yellow diamond shaped knob is for charging the truck tractor brakes. The yellow knob also sets the tractor brakes and the semitrailer brakes when coupled together. It is possible to operate the parking brakes independently. You can set just the truck tractor parking brakes when coupled to a semitrailer by holding the red knob in while pulling the yellow knob out.

[35] Maximum Brake Stroke For a 24-Inch, Long Stroke Brake Chamber is 2 Inches (CVSA OOS Criteria, April 1, 2016)

[36] Maximum Brake Stroke For a 30-Inch, Long Stroke Brake Chamber is 2 ½ inches (CVSA OOS Criteria, April 1, 2016)

Figure 3: Truck Tractor Push-Pull Valve Brake Knobs

2.6. Anti-lock Braking System (ABS)

The truck tractor and semitrailer were equipped with ABS. When the truck tractor was started, the trailer ABS light illuminated at the top of the instrument cluster. The semitrailer abs light and brake wiring had been damaged sometime during the crash.

2.7. Vehicle Recorded Event Data

The truck tractor was equipped with an electronically controlled Navistar engine. The electronic control module (ECM) on this year engine had the capability to capture or 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. The ECM was downloaded by NTSB Research and Engineering personnel.[37]

2.8. Instrument Panel Switch Locations

Cruise Control	Unknown
Wipers	Off
Retarder Switch	The three-position rocker switch was in the "3" position
Fan Knob	was turned to the left and at the lowest setting
Temperature	was set just left of the half way mark, on the cool side
The air conditioning knob	was set at maximum air conditioning

[37] Refer to Research and Engineering Factual

2.9. **Lamps and Reflective Devices**

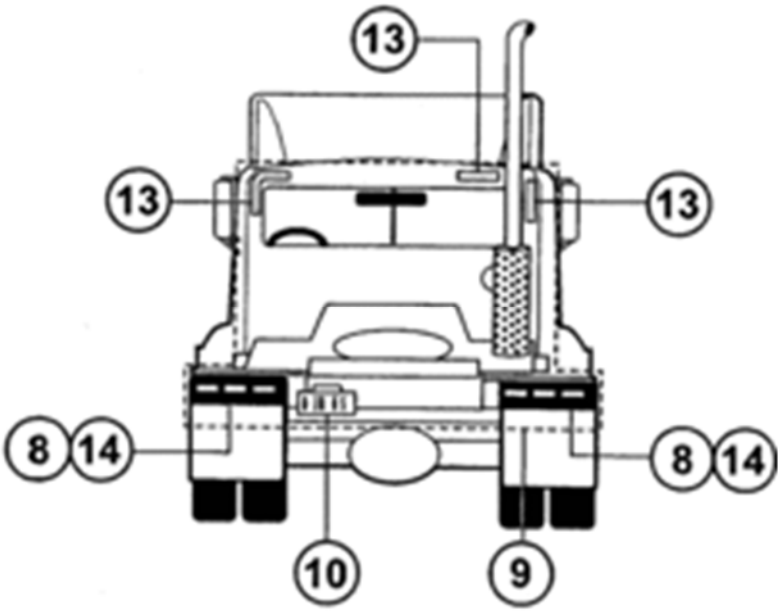
Table 5 illustrates the different configurations of when the headlamps would be on and when they would be off. The only time the headlamps would be illuminated is when the headlamp switch is in the on position, the ignition key is on, and the parking brakes are released.

Table 5: Headlamp Operation

Headlamp Switch	Key On	Key Off	Parking Brakes Set	Parking Brakes Released	**Headlamps**
Off		Yes	Yes		**Off**
On	Yes		Yes		**Off**
On	Yes			Yes	**On**
On		Yes		Yes	**Off**

All external lighting on the truck tractor was in working order. Since the truck tractor was manufactured in 2014, the vehicle must comply with the position and number of lamps and reflective devices required by 49 CFR 393.11(a)(1). During the inspection of the truck tractor, investigators confirmed the truck tractor was in compliance with regulation. See **Figures 4 and 5.**

Figure 4: Truck Tractor Lamp and Reflective Requirements[38]



[38] Graphic Obtained From 49 CFR 393.11(figure 1)

Figure 5: Legend for Truck Tractor Requirements[39]

Area	Equipment
1	Headlamps - Lower Beam
	Headlamps - Upper Beam
	Parking Lamps - Attention: *Required only on vehicles less than 2032mm wide*
	Front Turn Signal/Hazard Warning Lamps
2	Front Clearance Lamps - Attention: *Required for vehicles 2032mm wide or wider*
3	Front Identification Lamps (ID)
4a	Front Side Marker Lamps
4b	Front Side Reflex Reflectors
5a	Rear Side Marker Lamps - *Not required on Truck Tractors*
5b	Rear Side Reflex Reflectors - *Not required on Truck Tractors*
6	Rear Clearance Lamps Attention: *Required for vehicles 2032mm wide or wider, but not required on Truck Tractors*
7	Rear Identification Lamps (ID) Attention: *Required for vehicles 2032mm wide or wider, but not required on Truck Tractors*
8	Tail Lamps
	Stop Lamps
	Rear Turn Signal/Hazard Warning Lamps
	Rear Reflex Reflectors
9	Backup Lamp
10	License Plate Lamp
11	Center High Mounted Stop Lamp Attention: *Required for vehicles less than 2032mm wide and 4536kg*

ADDITIONAL EQUIPMENT FOR SPECIFIC TRUCKS AND BUS VEHICLES

Area	Equipment
12a	Intermediate Side Marker Lamps
12b	Intermediate Side Reflex Relectors

TRUCK TRACTORS

	DESCRIPTION
Area	Conspicuity Treatment
13	Rear Upper Body Marking
14	Rear Marking

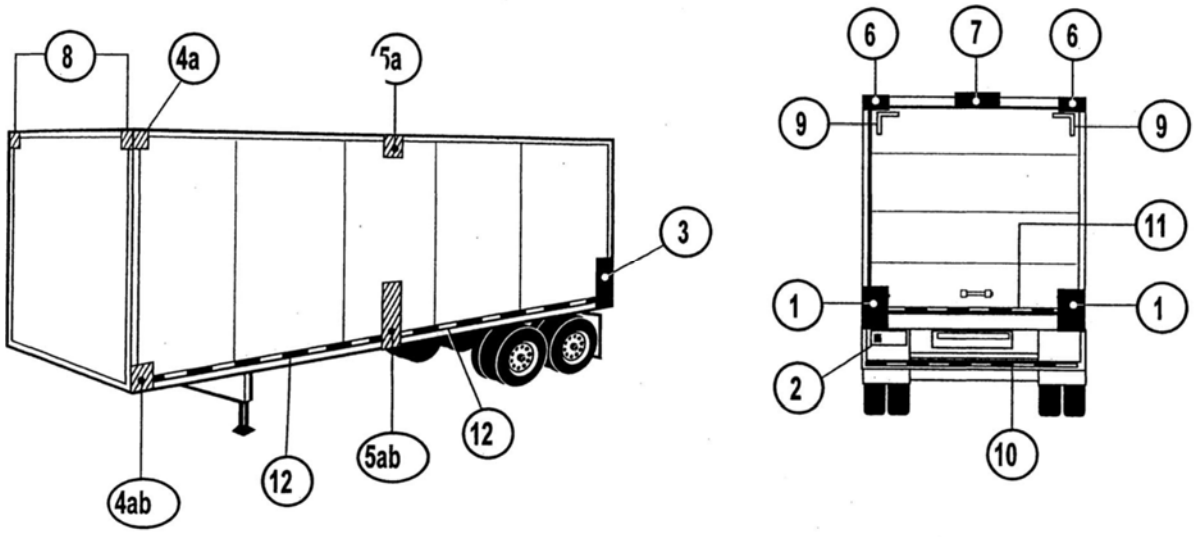
[39] Graphic Obtained From 49 CFR 393.11 (figure 1)

The truck tractor and semitrailer had been separated during the recovery process. To truly evaluate the semitrailer lighting at the time of the crash, investigators re-connected the electrical from truck tractor to the semitrailer. Once the electrical was re-established between the truck tractor and semitrailer, investigators conducted lighting functions. All lighting mounted on the semitrailer were Light-Emitting Diode (LED). Due to the damage to the rear of the semitrailer and subsequently the electrical, the rear lights (turn signals, tail lamps, brake lamps, and marker lights) were inoperable. The mid-point turn signals were operational and functioned as not only as turn signals, but as hazard lights as well. The marker lights mounted to the top edge of the semitrailer, from the front to the rear, were operational as well. The marker lights mounted to the lower portion of the semitrailer, which also went from the front of the semitrailer to the rear, were not operational.

The rear of the semitrailer would have had five, red marker lights, across the top. There would have been one at the left extreme, three in the middle, and one at the right extreme. Since the marker lights were mounted to the stainless-steel door frame assembly, they were missing from the vehicle. Since the six tail lamp assemblies, mounted in the rear bumper, were non-operational with the truck electrical, investigators supplied power directly to the individual lights. Five of the six lights were able to be powered on. The middle left-side tail lamp had been displaced from it's mounting location. The red lens was missing, the LED assembly was missing, and the exterior housing was hanging the electrical wires.

The semitrailer had retroreflective material attached along the sides and on the rear as required by 49 CFR 393.11(b). A sample piece of the retroreflective material was removed from the semitrailer for further testing. During the inspection of the semitrailer, investigators confirmed the truck tractor was in compliance with regulation. See **Figures 6 and 7.**

Figure 6: Semitrailer Lamp and Reflective Device Requirements[40]



[40] Graphic Obtained From 49 CFR 393.11 (figure 8)

Figure 7: Legend For Semitrailer Lamp and Refective Device Requirements[41]

Area	Equipment
1	Tail Lamps
	Stop Lamps
	Rear Turn Signal Lamps
	Rear Reflex Reflectors
2	License Plate Lamp (s)
3	Rear Side Marker Lamps
	Rear Side Reflex Reflectors
4a	Front Side Marker Lamps
4b	Front Side Reflex Reflectors

ADDITIONAL EQUIPMENT FOR TRAILERS EXCEEDING THE FOLLOWING PARAMETERS

LENGTH 9.1 m (30 ft.) OR LONGER

Area	Equipment
5a	Intermediate Side Marker Lamps
5b	Intermediate Side Reflex Reflectors

WIDTH 2.032 m (80 in.) OR WIDER

Area	Equipment
6	Rear Clearance Lamps
7	Rear Identification Lamps
8	Front Clearance Lamps

WIDTH 2.032 m (80 in.) OR WIDER AND GVWR 4,536 kg (10,000 lb.) OR MORE

	DESCRIPTION
Area	Conspicuity Treatment
9	Rear Upper Body Marking
10	Bumper Bar Marking
11	Rear Lower Body Marking
12	Side Marking

F. MAINTENANCE HISTORY

Maintenance and inspection records for the motorcoach were obtained from USA Holiday by the NTSB Motor Carrier Factors Group Chairman. All maintenance records were examined

[41] Graphic Obtained From 49 CFR 393.11 (figure 8)

and USA Holiday, was found in compliance with annual inspections, maintenance record keeping, and retention regulations.

Maintenance and inspection records for the truck tractor and semitrailer were obtained from Tri-State Collision, LLC, by the NTSB Motor Carrier Factors Group Chairman. All maintenance records were examined and Tri-State Collision, LLC, was found to be following the annual inspections, maintenance record keeping, and retention regulations.

G. RECALLS AND WARRANTY CLAIMS

Per the motorcoach manufacturer, there were no recalls issued for this motorcoach. There were three service bulletins issued for this motorcoach.

- Service Bulletin Number 115A - MCI redesigned the parking brake system and this service bulletin was to update the existing 102D3 and 102DL3 motorcoaches by removing the interlock between the parking brake and service brakes.

- Service Bulletin Number 119 – This service bulletin required a secondary ground cable be added from the alternator to the frame. This procedure was recommended by the alternator manufacturer.

- Service Bulletin Number 120 – This service bulletin was to install a retrofit kit to electronically isolate there B500/R and HD4060/R ECU

Per the truck tractor manufacturer, there were no recalls or warranty claims issued. Per the semitrailer manufacturer, there were no recalls issued, but there was one warranty note issued.

- The warranty note, number 362767, was to replace the old-style Side Skirt / Wingplate springbracket attachment with the new updated version.

H. DOCKET MATERIAL

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

LIST OF VEHICLE ATTACHMENTS

MCI Vehicle Records

MCI Steering Gear Examination Report from ZF-TRW Commercial Steering

NTSB MCI Brake Pedal and Linkage Inspection Report

International Vehicle Records

Utility Vehicle Records

LIST OF VEHICLE PHOTOGRAPHS

MCI Steering Wheel and Instrument Panel

MCI Steering Gear Input Shaft

Rear of Semitrailer

Truck Tractor Tires with Roadway Abrasions

END OF REPORT

Jerome F. Cantrell
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