NATIONAL TRANSPORTATION SAFETY BOARD

Office of Highway Safety
Washington, DC 20594-2000

Vehicle Factors Group Chairman's Factual Report

VEHICLE FACTORS

HWY22MH006

A. CRASH INFORMATION AND SUMMARY

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

B. VEHICLE FACTORS GROUP

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C. SUMMARY

The Vehicle Factors Group Chairman's Factual Report is a collection of factual information obtained during the detailed inspection of the involved vehicles involved. This report details the mechanical and operational conditions of the Dodge pickup truck (truck) and Ford passenger Wagon (Van) in combination with a Salvation enclosed utility trailer. The truck was examined at Roadrunner Tow & Wrecker Service, located in Andrews, Texas between March 18, 2022, and March 19, 2022. The Van and trailer were examined at Merrick's Towing, located in Andrews, Texas, between March 18, 2022, and March 20, 2022.

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, and any maintenance records were collected and reviewed.

D. VEHICLE INSPECTIONS

1. Vehicle #1: 2007 Dodge Ram[1]

1.1. General Information:

Make:	Dodge
Model:	Ram 4X4 2500 Quad Cab
VIN:[2]	3D7KS28C87G[redacted]
Model Year:	2007
Date of Manufacture:	September 1, 2006
Placed into Service:	September 26, 2006
Mileage:	Unknown
GVWR:[3]:	9,000 lbs.
GAWR[4] (Axle 1):	5,200 lbs.
GAWR (Axle 2):	6,500 lbs.

[1] Hereafter referred to as Dodge.
[2] Vehicle Identification Number.
[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.

Engine:	Cummins 5.9L Turbo Diesel
Transmission:	4-Speed Automatic
Rear Axle Ratio:	3.73
Steering Gear:	Hydraulic Power Assisted
Brake Type:	Four-Wheel Antilock Disc Brakes

1.2. Damage Description:[5]

For uniform description, "left" will refer to the driver's side, and "right" will refer to the curb side of the truck. Damage observed to the major vehicle operation systems will be documented in their respective sections later in this report.

The complete truck sustained extensive crash and post-crash fire damage, see **Figure 1**. The front of the vehicle was displaced towards the left. The hood was crushed rearward. The front of the engine had been rotated to the left, and the fuel lines had separated from the engine. The left-front fender and driver's door were missing. The left A-pillar had been displaced rearward, and along with the cab of the vehicle. All vehicle glass was missing. The sheet metal on the left side of the cargo bed had been crushed rearward, and the top of the cargo bed had been displaced downward. The left frame rail was bent downward at the rear of the cab. The 35-gallon plastic fuel tank, which had been mounted beneath the left-front of the cargo bed, was missing from the mounting straps.

Figure 1: A view looking at the damage sustained to the left front and left side of the truck.

1.3. Weights and Measurements:

[5] See Vehicle Attachment – Vehicle Factors Photographs for additional photographs depicting crash and post-fire damage.

The Dodge was unable to be axle weighed due to the frame distortion so under direction from NTSB staff, the Dodge was loaded onto a flatbed tow truck and transported to a local truck scale. All vehicle components for the Dodge either remained attached to the vehicle or were found in the cargo area of the Dodge. There was also a 100-gallon fuel tank in the bed of the truck which contained fluid, but it was not full. It was unknown if the tank had been full at the time of the crash, but an inspection of the tank did not show the tank had been compromised from the crash or the post-crash fire.

The tow truck was first weighed empty to obtain an unladen weight before loading the Dodge onto the flatbed of the tow truck and then obtaining a second combined-loaded weight. The results are as follows:

Tow truck empty:	16,620 lbs.
Tow truck with Dodge:	23,760 lbs.
Dodge Truck Weight:	7,140 lbs.

1.4. Driver Controls:

All driver controls, switches, and instrument clusters were consumed by the fire.

1.5. Electrical System:

Due to the extensive crash and post-crash fire damage, the electrical system on the truck was compromised, and it was not possible to check the function or integrity of the electrical system. The truck was manufactured with halogen headlamps, but the headlamps were missing. During the crash sequence the left-rear taillamp assembly had become dislodged from the truck. The bulbs from the intact left-rear taillamp assembly were removed, inspected, and photographed. The tungsten filaments inside the bulbs had indications of hot shock deformation.[6]

1.6. Steering System:

The truck was equipped with a hydraulic power-assisted steering gear, a power steering pump, a drag link, a tie rod with left and right ball joints, and steering knuckles.

Although the steering components from the steering gear box were still intact and connected, the damage sustained from the crash and subsequent fire prevented a functional check of the steering system. The steering wheel assembly was missing, the upper, intermediate, and lower steering shafts remained connected. The left side of the steering axle had been displaced rearward into the firewall.

The roadway at the crash scene did not show any evidence, such as gouges and erratic tire marks, to show there had been a pre-crash steering component failure.

1.7. Suspension System:

[6] Hot shock deformation is the result of a hot bulb filament stretching and distorting from a sudden impact.

The suspension on axle 1 (steering axle) was a non-independent system which consisted of a solid axle with upper and lower control arms, multiple linkages, coil springs, and shock absorbers mounted to each axle end. There was also a stabilizer bar with stabilizer bar connecting links at each end.

Axle 1 suspension sustained crash and subsequent fire damage. The left side of axle 1 had been displaced rearward into the rear of the wheel well. Although all the suspension linkages had sustained crash and fire damage, they remained connected to their respective mounting locations.

The suspension on axle 2 (drive axle) was a non-independent system, which consisted of a solid axle with shock absorbers, and multiple leaf spring packs mounted to each axle end.

Axle 2 suspension sustained crash and fire damage. All U-bolts, which attached the leaf spring packs to each end of the axle, were distorted but unbroken. The left side of axle 2 had been displaced rearward, the front torque leaf spring tip was broken, and the front tips of the leaf spring pack were bent downward.

1.8. Tires and Wheels:

The manufacturer's specification label was missing. According to the vehicle manufacturer's build sheet, the truck was equipped with LT265/70R17 All Season Tires mounted on 17 x 8.0 cast aluminum wheels. The spare tire was the same size but mounted on a steel wheel. No air pressure specifications were included on the build sheets.

General information about each of the tires on the truck at the time of the inspection is documented in **Table 1.** All wheels were inspected for cracks, welds, and elongated lug nut holes.

Table 1: Truck tires and wheels at time of inspection:

Axle 1	**Left**	**Right**
Make/Model	Unknown[7]	COOPER Discoverer AT3
Tire Size		LT 265/70R17 (F)
Pressure		0 psi
Tread Depth		13/32 inch[8]
DOT #		UPAH 1AU 4514
MLR		N/A
Tire Plies		N/A
Wheel Size & Type	17 x 7.5 - Steel	17 x 8.0 - Cast
Axle 2	**Left**	**Right**
Make/Model	Unknown	Unknown
Tire Size		

[7] No remains of this tire were located either on the truck or at the crash scene.
[8] Measurement was obtained from an undamaged 18-inch tread patch.

Pressure		
Tread Depth		5/32 inch[9]
DOT #		
MLR		
Tire Plies		
Wheel Size & Type	17 x 8.0 - Steel	17 x 8.0 - Cast

Tire and Wheel Damage:

- The tire mounted to the left side of axle 1 was missing, and the wheel had been distorted around the brake caliper assembly.
- The wheel and brake assembly, mounted to the left side of axle 1, was removed under the direction of NTSB staff and transported to the NTSB headquarters in Washington, DC for further examination. On April 27, 2022, the wheel and brake assembly were inspected. No known pre-crash related defects were found, and the wheel was determined to be a correct size to mount the same size tire that was mounted to the right-side wheel.
- The only tire remnant available to obtain tire information from the sidewall was found on the right-side wheel of axle 1.
- The tire mounted to the right side of axle two was missing except for a tread patch measuring 21-inches in length.
- The tire mounted to the left side of axle 2 was missing.

1.9. Braking System:

The truck was equipped with a hydraulic Antilock Brake System (ABS) with disc brakes on all axles. Testing of the brake calipers was not performed due to crash and post-crash fire damage. See **Table 2** for brake information.

Table 2: Truck Brake Information: [10]

Brake Location	Axle 1		Axle 2	
	Left	Right	Left	Right
Brake Type	Disc	Disc	Disc	Disc
Measured Lining Thickness	IB 15/32	IB 12/32	IB 17/32	IB 17/32
	OB 15/32	OB 13/32	OB 17/32	OB 17/32
Measured Rotor Thickness	1.37	1.31	1.15	1.07

[9] Measurement obtained from an undamaged 21-inch tread patch.
[10] All measurements are in inches.

Manufacturer's Specification - Minimum Rotor Thickness	1.34	1.34	1.27	1.27

Although the brake rotors for the right side of axle 1 and both sides of axle 2 were measured to be below specified minimum thickness', the surface of the brake rotors showed evidence of being in contact with the brake linings, such as shiny brake rotor surfaces. The inspected brake rotors did not show discoloration of the braking surface, to indicate the brake rotors had overheated during a hard braking event.

1.9.1. **Anti-lock Braking Systems (ABS):**

ABSs are designed to aid with keeping a vehicle steerable and stable during heavy braking moments by preventing wheel lock, keeping the maximum friction possible between the tire and roadway, and allowing the vehicle to stop in the shortest distance possible. In addition to the vehicle's physical brakes, ABSs are made up of wheel speed sensors, electronic control units (ECU), and modulator units.

The truck was equipped with an ABS. The vehicle's ABS was unable to be evaluated due to crash and post-crash fire damage. All wiring and wheel speed sensors along with the ECU and modulator unit were destroyed.

1.10. Vehicle Recorded Event Data:

The Cummins Diesel engine was controlled by an Engine Control Module (ECM). The primary function of the ECM is to control the engine's performance, fuel efficiency, and emissions based on various engine and sensor inputs. The ECM is also capable of recording diagnostics associated with engine and/or sensor faults, which may then activate warnings on the dash, as well as record vehicle speed, engine speed, and other parameters during triggered events. The ECM for this vehicle, which was mounted to the left side of the engine, had been destroyed by the post-crash fire.

The trucks Airbag Control Module (ACM), which was located on the center tunnel between the front passenger seating locations, contained an Event Data Recorder (EDR) that was designed to record up to 5-seconds of specific data parameters prior to an airbag deployment, and up to a quarter second of high-speed deceleration during and after the deployment. The ACM sustained unrepairable post-crash fire and thermal damage.

Data parameters that may be recorded by the EDR include:[11]

- Diagnostic trouble code(s) and warning lamp status for electronically controlled safety systems, including the airbag system
- Airbag disable lamp status (if equipped)

[11] Obtained from 2007 Dodge Ram Vehicle Owner's Manual.

- Time of airbag deployment (in terms of ignition cycles and vehicle mileage)
- Airbag deployment level (if applicable)
- Impact acceleration and angle
- Seatbelt status
- Brake status (service and parking brakes)
- Accelerator status (including vehicle speed)
- Engine control status (including engine speed)
- Transmission gear selection
- Cruise control status
- Traction/stability control status
- Tire pressure monitoring system status (if equipped)

1.11. Maintenance History/Recalls:

The Dodge truck involved in this crash was not considered to be a commercial motor vehicle as defined by Title 49 CFR 382.107 and is not required to maintain maintenance records. Recall and warranty work documentation was obtained from the manufacturer, along with a VIN search through NHTSA's recall database conducted on April 6, 2022.

Recalls:

There were four outstanding recalls for the VIN assigned to this vehicle.[12]

1. Manufacturer recall number H46, and NHTSA recall number 09E-001 issued 1/6/2009. The safety issue pertains to the drag link inner joint which could fracture resulting in loss of steering control.

2. Manufacturer recall number N62, and NHTSA recall number 13V-528 issued 11/6/2013. The safety issue pertains to the left tie rod ball stud which may fracture resulting in a loss of directional control.

3. Manufacturer recall number S43, and NHTSA recall number 16V-352 issued 5/24/2016. The safety issue pertains to the front passenger airbag inflator which may rupture during airbag deployment events resulting in metal fragments striking the vehicle occupants.

[12] See Vehicle Attachment – 2007 Dodge Ram Truck Recalls.

4. Manufacturer recall number R25, and NHTSA recall number 15V-313 issued 5/26/2016. The safety issue pertains to the driver airbag inflator which may rupture during airbag deployment events resulting in metal fragments striking the vehicle occupants.

Warranty Work:

On 12/22/2010, warranty work was completed on the engine turbo charger assembly.

1.12. Advanced Driver-Assistance System (ADAS):

The primary goal of an Advanced Driver-Assistance System (ADAS) is to assist drivers with driving and parking functions. ADAS increases car and road safety through automated technology which can alert the driver to problems, and if necessary, take control of the vehicle to assist in avoiding crashes. Some examples of ADAS are adaptive cruise control, emergency brake assist, automatic emergency brake assist, lane-keeping, and lane centering.

At the time this truck was manufactured, none of the ADASs were available either as standard or optional equipment.

2. Vehicle #2: 2017 Ford Transit Passenger Van Combination

2.1. General Information:

Make:	Ford
Model:	Transit 350 MR 12-Passenger Wagon
VIN:	1FBZX2CG5HKB20954
Model Year:	2017
Date of Manufacture:	May 23, 2017
Placed into Service:	September 6, 2017
Mileage:[13]	38,923
Company Unit #:	Van 2
GVWR:	9,000 lbs.
Engine:	3.5L GT DI V6, SN: 17C116000083
Fuel Capacity:	25 gallons
Transmission:	6-speed 6R80 Auto Select Shift
Rear Axle:	3.31 Ratio, Non-Limited Slip
Steering Gear:	Hydraulic Assisted Rack and Pinion
Brake Type:	4-Wheel Disc with ABS

TRAILER:

Make:	Salvation Trailers
Model:	Enclosed Utility Trailer
VIN:	7GG1E0815KW008058
Model Year:	2019

[13] Listed as the mileage for an oil change conducted on February 17, 2022.

Date of Manufacture:	06/2019
GVWR:	3,500 lbs
Brake Type:	None

2.2. Damage Description

The vehicle had extensive crash and post-crash fire damage. There was a large debris field at the crash scene which mostly had items from the van. All combustible materials were consumed by the fire including the tires. All windows were missing. The entire front along with most of the left side sustained contact damage. The front bumper, engine, and transmission were missing from the vehicle. The left frame rail was displaced to the left in an approximate 45-degree angle, and the right frame rail was bowed to the left with the leading edge pointing to the right.

The only mechanical components left at the front of the van were the steering gear and front axle assembly, as shown in **Figure 2**. The engine and transmission were in the debris field. The 25-gallon polyethylene fuel tank was missing from the fuel tank mounting straps. The frame rails were bowed in an upward arch forward of axle 2 spring hangers.

Figure 2: A front view of the 2017 Ford Transit Van showing the extensive crash and post-crash fire damage.

The left front to the van sustained rearward crush damage with the collected exterior sheet metal found at the approximate center of the vehicle, as shown in **Figure 3.** The right- side sliding door had been removed during recovery. See Vehicle Factors Photograph Attachment for more photographs depicting collision and post fire damage.

Figure 3: Left-side view of the transit van showing the extensive damage crash and post-crash fire damage.

The enclosed utility trailer sustained impact damage to left-front corner, and the tongue was bent in an upward direction. The left side of the trailer had some thermal damage, as seen in **Figure 4.**

Figure 4: A view of the left-front and side of the 2019 Salvation trailer.

2.3. Weight and Measurements:

Due to the extensive crash damage sustained by the van, a vehicle weight was not obtained. The axle weight for the trailer of 1,350 lbs. was obtained by the TxDPS utilizing portable scales.

The pre-crash dimensional specifications for the Van are listed in **Table 3**.

Table 3: Pre-crash Van Measurements (inches)

Overall	235.5
Wheelbase	147.6
Front Overhang	40.3
Rear Overhang	47.6
Overall Width	81.3
Overall Height	99.2

2.4. Driver Controls:

All driver control switches and pedals were either destroyed by the crash or consumed by the post-crash fire. There were no driver controls left to document.

2.5. Steering System

The steering system consisted of a hydraulic assisted rack and pinion steering gear with tie rods at each end. The tie rods remained connected to the left and right steering knuckles via ball joint connections.

The steering system sustained crash and subsequent fire damage. The steering wheel was found with the crash debris, and the upper steering shaft had been displaced upward through the dashboard area. Functionality of the steering systems was not possible due to the damage sustained in the crash.

2.6. Suspension

The suspension on axle 1 was an independent system which consisted of wheel ends with multiple linkages and strut assemblies.

The lower control arm for the left side of the front suspension was separated from the ball joint cup at the bottom of the steering knuckle. The front suspension sustained extensive crash damage.

The suspension on axle 2 was a non-independent system which consisted of multi-leaf spring packs, and shock absorbers mounted to each end of a solid axle, along with a stabilizer bar and stabilizer bar connecting links.

The stabilizer bar was twisted and bowed. The leading edge of the main leaf spring mounted to the left side was bent upward.

2.7. Tires and Wheels

Van:

The axles are numbered from axle1 (steering axle) rearward to the single axle on the trailer (axle 3).

The manufacturer's specification label for the Van was originally located in the driver's door latch post pillar but was destroyed by the post-crash fire. The label contained information specific to the VIN assigned to this vehicle, which included suggested tire and wheel information and date of manufacturer.

General information about each of the tires mounted on the Van and trailer at the time of the inspection is documented in **Table 4.** All wheels were inspected for cracks, welds, and elongated lug nut holes. Tire pressure measurements were taken using a commercial grade tire pressure gauge.

Table 4: Van combination tire and wheel information.

Axle 1	**Left**	**Right**
Tire Make	Missing	Missing
Tire Size		
Pressure		
Tread Depth		
DOT #		
Maximum Load Rating		
Tire Plies		
Axle 2	**Left**	**Right**
Tire Make	Missing	Continental
Tire Size		235/65R16
Pressure		0 psi
Tread Depth		O/B 4/32-inch, 7/32-inch center[14]
DOT #		Unknown
Maximum Load Rating		Unknown
Tire Plies		Tread: 2 polyester, 2 steel, 2 polyamide Sidewall: 2 polyester
Axle 3	**Left**	**Right**
Tire Make	TRAILQUEST	TRAILQUEST
Tire Size	ST205/75R15	ST205/75R15

[14] These measurements were taken from a piece of undamaged tire tread that was approximately 15-inches in length and had 2 major tread grooves.

Pressure	34 psi	36 psi
DOT #	R2NK1719	R2NK1719
Maximum Load Rating	1,820 lbs. @ 60 psi	1,820 lbs. @ 60 psi
Tire Plies	Tread: 2-Steel, 2-Polyester Sidewall: 2-Polyester	Tread: 2-Steel, 2-Polyester Sidewall: 2-Polyester

Tire and Wheel Damage:

- The right-front wheel sustained two radial collapses to the outboard wheel flange. There was a gouge measuring approximately 4 ½ – inches long with a width ranging from ½ - inch to 1-inch.
- The left-front wheel sustained two radial collapses to the outboard wheel flange. The inboard side of the wheel sustained an axial collapse and wheel deformation.
- The tires mounted to axle 1 and the left side of axle 2 were missing, and the tire remaining on the right side of axle 2 sustained fire and thermal damage.

2.8. Braking

The van was equipped with a vacuum boost assist hydraulic Antilock Brake System (ABS) with disc brakes on both axles. The trailer was not equipped with brakes. See **Table 5** for brake information.

Table 5: Van brake information:[15]

Brake Location	Axle 1		Axle 2	
	Left	Right	Left	Right
Brake Type	Disc	Disc	Disc	Disc
Measured Lining Thickness	IB 12/32	IB 12/32	IB 13/32	IB 12/32
	OB 12/32	OB 13/32	OB 13/32	OB 13/32
Measured Rotor Thickness	1.30	1.31	0.687	0.686
Manufacturer's Specification – Minimum Rotor Thickness	1.181	1.181	0.591	0.591

[15] All measurements are in inches.

2.9. Anti-lock Braking System (ABS)

A description of an ABS is detailed in section 1.9.1 of this report.

The van was equipped with an ABS. The vehicle's ABS was unable to be tested due to crash and post-crash fire damage. All wiring and wheel speed sensors along with the ECU and modulator unit were destroyed.

2.10. Vehicle Recorded Data

The NTSB investigators removed the Airbag Control Module (ACM) from the Van and transported it back to the NTSB headquarters to be further analyzed. The ACM was submitted to NTSB's Office of Research and Engineering for further interrogation. The Office of Research and Engineering determined that irreparable damage had been done to the internal components and that no data could be extracted from the ACM's event data recorder.[16]

2.11. Maintenance history

The University of the Southwest supplied a maintenance schedule dated from 1/9/2020 through 2/17/2022. The schedule only listed oil and fluids checked along with the tires and belts checked. See the Motor Carrier Factors Chairman's report for more information.

2.12. Recalls and Warranty Claims

Recalls:

Per the van manufacturer and the NHTSA recall database, there are no outstanding recalls.

Warranty Work:

- On 11/1/2017 complete recall number 17S34.
- On 11/20/2017 complete recall number 17S15.

2.13. Advanced Driver-Assistance System (ADAS):

ADAS is described in section 1.12 of this report.

The van was equipped with lane departure warning, reverse park aid, auto headlamps, and driver impairment monitor. The driver impairment monitor detects irregular driving patterns and will supply audible and visual alerts.

[16] See Vehicle Attachment – Van ACM Results.

E. Attachments

Vehicle Attachment - 2007 Dodge Ram Truck Recalls

Vehicle Attachment - Van ACM Results Vehicle Factors

Vehicle Attachment - Photographs

Submitted by:

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