SURVIVAL FACTORS GROUP CHAIRMAN'S FACTUAL REPORT

Schoharie, NY

HWY19MH001

(36 pages)

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

SURVIVAL FACTORS GROUP CHAIRMAN'S FACTUAL REPORT

A. CRASH INFORMATION

Location:	Intersection of State Route 30A and State Route 30, Schoharie, Schoharie County, New York
Vehicle 1:	2001 Ford Excursion "Stretch" Limousine
Operator 1:	Prestige Limousine Chauffeur Service
Vehicle 2:	2015 Toyota Highlander
Operator 2:	Private citizen
Date:	October 6, 2018
Time:	Approximately 1:55 p.m. EDT
NTSB #:	**HWY19MH001**

B. SURVIAL FACTORS GROUP

Thomas Barth, Survival Factors Investigator, Group Chairman
NTSB Denver Regional Office, 4760 Oakland St. Suite 500, Denver, CO 80239

Julie Kang, Project Manager
NTSB 490 L' Enfant Plaza SW, Washington, DC 20594

Kristin Poland, Deputy Director, Office of Highway Safety
NTSB 490 L' Enfant Plaza SW, Washington, DC 20594

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 SURVIVAL FACTORS INVESTIGATION

The Survival Factors Group investigation collected evidence pertaining to the victims, vehicles, and the emergency response. The victim information is contained in Section 1. Background information for regulations, guidance material, and past NTSB investigations is provided in Section 2. Vehicle information is contained in Section 3, and emergency response information is in Sections 4 through 7.

1. Victim Information

The crash involved a total of 20 people, as shown in table 1 below. There was a driver and 17 passengers in the limousine, and 2 pedestrians approaching the Toyota Highlander parked in the parking lot.

Table 1: Victims involved in the crash

Vehicle/location	Driver	Passenger	Pedestrians	Total
Limousine	Injured NA Fatal 1	Injured NA Fatal 17	NA NA	Injured NA Fatal 18
Pedestrians (approaching Toyota)	NA	NA	Fatal 2	Fatal 2
				Fatal 20

The driver of the limousine was a 53 year old male who was fatally injured in the crash. The 17 passengers consisted of 9 females and 8 males ranging in age from 24 to 34 years old. All were fatally injured in the crash. Table 2 provides a reference number, gender, age, weight, and medical examiner case number.

Table 2: Occupants of the limousine

	Gender	Age	ME Case	Weight
1	male	29	MS 18-527	237
2	male	31	MS 18-528	164
3	female	29	MS 18-531	277
4	female	34	MS 18-532	130
5	female	24	MS 18-533	107
6	female	30	MS 18-534	174
7	female	29	MS 18-535	134
8	female	33	MS 18-536	207
9	male	34	MS 18-537	193
10	male	30	MS 18-538	188
11	male	34	MS 18-539	310
12	male	34	MS 18-540	283
13	male	27	MS 18-541	232
14	female	31	MS 18-542	153
15	male	53	MS 18-543	170 (driver)
16	male	34	MS 18-544	245
17	female	26	MS 18-545	214
18	female	34	MS 18-546	147

The total mass of the occupants based on the autopsy weights was approximately 3,565 pounds. The autopsy reports have been requested and are in process. The passenger weights are preliminary and are based on observations of the autopsies.

There were 2 pedestrians approaching the Toyota Highlander involved in the crash. The limousine struck the Toyota, and the Toyota struck two pedestrians that were in its path. They were both fatally injured. Table 3 provides a reference number, gender, age, weight, and Medical Examiner case number.

Table 3: Victims associated with the Toyota Highlander

	Gender	Age	ME Case	weight
1	male	70	MS 18-529	203
2	male	46	MS 18-530	184

2. Vehicle Regulations, Guidance, and Past NTSB Investigations

2.1. Federal Regulations – Vehicle Definition

Manufacturer

United States Code of Federal Regulations (CFR) title 49 part 566 establishes the manufacturer identification of motor vehicles.[1] 49 CFR 566.4 lists the categories of vehicle manufacturers as: incomplete vehicle, intermediate manufacturer, or final stage manufacturer as defined in 49 CFR 568. Ford Motor Company was a final stage manufacturer of the Excursion SUV, and the limousine manufacturer, 21st Century Coach Inc., was also a final stage manufacturer.[2]

21st Century Limousine was required to register with the National Highway Traffic Safety Administration (NHTSA) vehicle manufacturers database, but no NHTSA listing for this manufacturer was found. Part 566 requires manufacturers of vehicles or vehicle equipment to submit identifying information and descriptions of items they produce. Additionally, 21st Century Coach Inc. and any possible intermediate manufacturers that they might have contracted with during the modification process would also be required under 49 CFR 567.3 (c) to assume legal responsibility for all certification related duties for the parts applicable to their work. The investigation was unable to establish a complete history of the limousine, and it was unknown if 21st Century Coach Inc. used any intermediate manufacturers.

Note that some vehicles are manufactured in two or more stages. The requirements for these vehicles fall under Title 49 CFR 568. The limousine was altered from a complete vehicle and fell under different regulations as described below.

Vehicle alterations

An altered vehicle has additions, modifications, or other changes which affect federal motor vehicle safety standards (FMVSSs), and the requirements are contained in Title 49 CFR 567.7.[3] An "alterer" is defined in CFR 567.3 as: "*Alterer* means a person who alters by addition, substitution, or removal of components (other than readily attachable components) a certified vehicle before the first purchase of the vehicle other than for resale." The accident limousine was an "altered" vehicle because

[1] US Code of Federal Regulations, Title 49 – Transportation, Volume: 6, Date: 2018-10-01, https://www.govinfo.gov.
[2] Because 49 CFR 566.4 does not have a term "manufacturer", a vehicle manufactured in one stage would also fall under a "final stage manufacturer".
[3] Vehicles that are altered in a manner which do not affect the FMVSSs are covered under CFR 567.6.

21st Century Coach Inc. purchased a certified Ford Excursion SUV and altered the vehicle to become a stretch limousine for resale.

Part 567.7 requires the alterer to add an additional certification label in addition to the original label onto the vehicle. The information required on this additional label includes the name of the alterer, the date alterations were completed, and the altered gross weight rating (GVWR) and gross axle rating if changed during the alteration process. Although required to have this additional label, the label was not present on the accident limousine.

Note that the federal regulations apply to vehicles up to the first point of retail sale. After this, State requirements apply. The limousine was altered prior to the first retail sale, as established by evidence from the NY State Police. The NY State Police provided the first purchase and ownership of the limo, which indicated that it was first owned by 21st Century Coach Inc. There are sometimes questions regarding the meaning of "before the first purchase". The NHTSA archives of their legal opinions include opinion 10425 which stated that: "An "alterer" is one who, before the sale of a previously-certified new motor vehicle to its first retail purchaser, ….".[4]

The vehicle alterer, 21st Century Coach Inc., was required to ensure that all modifications complied with affected applicable FMVSS. 49 CFR 567.7 requires final-stage manufacturers to complete the vehicle in a manner conforming to the applicable standards, or incomplete and intermediate manufacturers to provide the appropriate information to meet applicable standards to the final-stage manufacturer.

Vehicle Definition

The regulation 49 CFR 567.4 paragraph (3) "Requirements for Manufacturers of Motor Vehicles" establishes a minimum loading capacity as the rated cargo load plus 150 pounds per the seat positions:

> *"Gross Vehicle Weight Rating" or "GVWR" followed by the appropriate value in pounds, which shall not be less than the sum of the unloaded vehicle weight, rated cargo load, and 150 pounds times the number of the vehicle's designated seating positions. However, for school buses the minimum occupant weight allowance shall be 120 pounds per passenger and 150 pounds for the driver."*

The limousine was altered from the original 2001 Ford Excursion, which was defined as a multipurpose passenger vehicle. The altered vehicle fits into the classification of a "bus" according to 49 CFR 571.3, since the altered vehicle was a motor vehicle carrying more than 10 persons. This regulation also defines vehicles based on GVWR, and the altered vehicle raised the GVWR of the limousine to over 10,000 pounds. Additionally, this regulation defines a designated seating position for vehicles manufactured prior to September 1, 2011 as any location accommodating a person at least as large as a 5th percentile adult female, and references a US Department of Health document. (After 2011, a designated seating position was changed to be a seating surface width of at least 13 inches.) The US Department of Health document referenced in the regulations gives a

[4] SF Attachment NHTSA Opinion Letter 10425.

range of adult female seat breadth for 90 percent of the population as a range from 12.3 to 17.1 inches and table 12 cites the 5th percentile adult female seat breadth as 12.3 inches.[5]

2.2. Federal Motor Vehicle Safety Standards (FMVSS)

The FMVSSs were reviewed to determine if any occupant crash protection requirements applied to the rear passenger compartment of the limousine, as summarized below. The limousine, fell under the definition of a bus, and was exempt from many requirements that apply to multipurpose passenger vehicles, except for the driver seat position.[6]

FMVSS 201 Occupant protection interior impact: Not applicable. Vehicles with a GVWR above 10,000 pounds or buses with a GVWR above 8,510 pounds do not apply.

FMVSS 202 Head Restraints: Not applicable. Vehicles with a GVWR above 10,000 pounds and vehicle with certain manufacturing dates do not apply.

FMVSS 207 Seating Systems: Not applicable. Passenger seats on buses are exempt from the performance requirements for seats, attachment assemblies, and installation. (The requirement involves application of a static load applied in both the forward and rearward longitudinal directions for seat attachments and belts.)

FMVSS 208 Occupant Crash Protection: Applicable only for driver seat, other requirements are exempt if the bus is above 10,000 pounds GVWR. Buses with a GVWR between 8,500 and 10,000 pounds and an unloaded vehicle weight of 5,500 pounds or less have some different requirements. Trucks and multipurpose passenger vehicles with a GVWR above 10,000 pounds must meet certain requirements. Buses manufactured between 1972 and 1990 must have a seat belt for the driver only. Buses manufactured after September 1990 have additional requirements for the driver seat only, and buses manufactured after September 1994 with a GVWR less than 8500 pounds also have requirements. The NTSB has an open recommendation, number H-18-59, to include medium sized buses (GVWR more than 10,000 pounds but not greater than 26,000 pounds) in this standard, based on a crash in Concan Texas on March 29, 2017.

FMVSS 209 Seat Belt Assemblies: Applicable to all vehicle types, if seat belts are installed per FMVSS 208. This FMVSS specifies various requirements for seat belts such as webbing, buckles, installation, and maintenance.

FMVSS 210 Seat Belt Assembly Anchorages: Applicable to all vehicles types for belts installed per FMVSS 208. This FMVSS establishes requirements for seat belt assembly anchorages to ensure proper location for effective occupant restraint and to reduce the likelihood of failure. The requirements apply to any component, other than the webbing or straps, involved in transferring seat belt loads to the vehicle structure. FMVSS 210 defines the minimum seat belt anchorage spacing to be 6.6 inches wide. The NTSB has an open recommendation, number H-18-58, to

[5] Weight, Height, and Selected Body Dimensions of Adults: United States - 1960-1962," first published as Public Health Service Publication No. 1000 Series 11-No. 8, June 1965 and republished as DHEW Publication No. (HRA) 76-1074 (incorporated by reference, see § 571.5)

[6] The right front passenger seat and OEM rear seats were originally installed in compliance with some FMVSSs.

increase this spacing to a minimum of 10 inches, based on a crash in Concan Texas on March 29, 2017.

FMVSS 214 Side Impact Protection: Not applicable for vehicles with a GVWR above 10,000 pounds.

2.3. NY State Department of Motor Vehicles (DMV)

All vehicles in NY are subject to requirements under the NY State DMV. The NY DMV Motor Vehicle Inspection Regulations (MVIR) have requirements based on maximum gross weight (MGW), which is the same as GVWR, and specific types of vehicles defined within the regulation, which includes designations for vehicle seating capacity (occupant placements).[7]

Section 79.20 of the MVIR provides the details of vehicles subject to inspection procedures. Subparagraph (7)(i) indicates that when the vehicle is found to comply with the inspection, the certified inspector or inspection station licensee shall affix or issue the proper certificate of inspection, as well as other items. Subparagraph (f) of section (7)(i) states that motor vehicles regulated by passenger transportation, including vehicles commonly referred to as a "stretch limousine", as defined in 17 NYCRR720.1, are subject to NY State Department of Transportation (DOT)periodic inspection requirements, and are exempt from NY DMV inspections per 79.2 (d)(3), as noted below.

Vehicles operating under the certificate of inspection by the NY State DOT are exempt from NY DMV inspection per 79.2 (d) (3).

Section 79.21 of the MVIR defines the inspection requirements for most vehicles under MGW of 10,001 pounds and with 15 or less occupant placements.[8] The requirements include an inspection of seat belt presence and functionality. Section 79.23 defines the inspection requirements for vehicles with a MGW over 10,000 pounds up to 18,000 pounds, known as medium duty vehicles. These vehicles are subject to all the requirements of 79.21 plus additional requirements.

2.4. NY State Department of Transportation (DOT)

The limousine operator, Prestige Limousine Chauffeur Service (PLCS), was an intra-state carrier, and the commercial vehicle compliance was the jurisdiction of the New York State DOT. Under this authority, PLCS was subject to vehicle inspections every 6 months conducted by a certified inspector from the NY State DOT Carrier Compliance Bureau. This is a different process from DMV inspections, which, as noted above, this vehicle was exempt. The NY State DOT inspections included requirements for the VIN, but these inspections do not require inspection of any installed seat belts.

Although the alterer label was not present on the accident limousine, the NTSB investigation found 2 sources of evidence with information about the limousine GVWR and seating capacity. Both documents were from previous inspections by the NY State DOT. One document had forms titled

[7] https://dmv.ny.gov/forms/cr79.pdf

[8] The accident limousine was not subject to this section because under section 79.20, its inspection was required by NY State DOT and not the DMV.

"NYSDOT Passenger and Freight Safety Division Bus Safety Inspection Program" from 7/30/2014, 1/8/2015, and 6/15/2015. All 3 of the forms had a GVWR value of 13,080 pounds, and all stated the seating capacity as "seats" with the value of 18.[9] The other evidence from NY State DOT were forms titled "Driver/Vehicle Examination Report" dated 5/15/2015 that had a GVWR value of 13,850 pounds, and one dated 5/9/2015 with a GVWR listed as 0. These forms noted the seating capacity as "Seating Capacity with Driver: 18".[10]

The NY State DOT inspection did not include requirements for inspecting the passenger seats or seat belts, as there are no occupant seat or seat belt requirements for passengers of vehicles in this weight category. Safety equipment such as seat belts installed in these vehicles is voluntary. If the vehicle is manufactured in accordance to an OEM manufacturer vehicle modification program, such as the Ford QVM program, the operator may be exempt from certain DOT inspection requirements.

2.5. Motor Carrier Safety Administration (FMCSA)

The FMCSA retains oversight for all commercial drivers, and vehicle oversight depends on if the vehicle is used for intrastate or interstate commerce. The limousine was a commercial vehicle according to 49 CFR 390.5 because it was designed or used to transport more than 8 passengers (including the driver) and because it had a GVWR over 10,000 pounds. However, because the limousine was used only for intrastate commerce, the FMCSA did not have oversight of the vehicle. This was under the jurisdiction of the NY State DOT. The limousine was required to have a US Department of Transportation (DOT) registration per a requirement by the NY State DOT.

The FMCSA provides guidance materials for safety, and has classifications for vehicle types. This vehicle was in the classification for a "Mini-bus," which are designed to transport 16 or more people, and above the classification for a "Limousine," which is designed to transport 9 to 15 people. The FMCSA maintains a webpage titled "Safety Resources for Limousines," which provides information resources and regulatory information. Topics concerning operating authority, financial responsibility, and safety oversight are addressed. Use of seat belts is not required or addressed for the Mini-bus class of vehicle. The FMCSA provides guidance to ensure compliance with 49 CFR 392.62: Safe Operation, Buses. This information includes examples of pre-trip safety information. They also have brochures encouraging bus drivers to wear their seatbelts. The National Limousine Association (NLA) website provides links to the FMCSA information.

2.6. Limousine Guidance

Limousine companies often provide guidance on their website for the public when picking a limousine service. A google search indicated that most limousines are advertised with a seating capacity, and some will provide guidance regarding the seating capacity. A "frequently asked questions" section of the Atlantic Limousine website noted that limousine companies sometimes exaggerate how many people can be accommodated, and that a good rule of thumb is to subtract 2 from the advertised seating capacity.[11] Another company, First Class Limousines, listed the

[9] Refer to the docket for the item: Schoharie Investigation Document Limousine Inspections by NYSDOT.
[10] Refer to the docket item: Inspections of Limo Prior Owner.
[11] http://atlanticlimousinemaine.com/faqs/, accessed on March 21, 2019.

capacities of their fleet, but also noted that customers should provide themselves with additional room, and that the maximum capacity is based on "averaged sized people".

There have also been articles in trade publications on the topic of making operators and drivers aware of appropriate capacity decisions. LCT magazine, published by the National Limousine Association, published an article titled "Know Your Limits Before Putting on Vehicle Pounds".[12] The (RoSPA) website posted an article with advice on properly loading a vehicle titled "Minibuses – Loading and Safety.[13]

2.7. Previous NTSB Investigations and Recommendations

The NTSB has a history of investigating bus and limousine crashes that demonstrated safety issues associated with the design of seats and seat belt systems, and a history of making recommendations to improve occupant protection in these vehicles types. The following paragraphs summarize past investigations which pertain to a range of vehicles that fall under the "bus" classification, with a range of GVWRs including: commercial passenger vans (under 10,000 pounds); stretch limousines and medium-size body-on-frame buses (from 10,000 to 26,000 pounds). The NTSB also has thoroughly investigated motorcoach crashes, and through the Motorcoach Enhanced Safety Act, NHTSA updated occupant protection rules to require lap/shoulder belts in all passengers seats of newly built over-the-road buses and other large buses (over 26,000 pounds but excluding school buses), effective November 2016.[14] Selected background information of past NTSB investigations is provided below. The information is organized according the vehicle weight class and crash occurrence date.

<u>Under 10,000 pound GVWR</u>

A crash involving a 15 passenger van that slid out of control on an icy road, crossed a median and was struck by a truck in **Joliet, Illinois** occurred on January 26, 2001.[15] The van was carrying 10 passengers who were all killed including 4 who were ejected. Only the driver was using the available restraints and was also killed. The van was a 2000 Dodge Ram Maxiwagon 3500 van with a GVWR of 8,700 pounds.

A crash involving a 15 passenger van that ran off the road and struck a bridge abutment in **Memphis, Tennessee** occurred on April 4, 2002.[16] The van was occupied by the driver and 6 children. Four of the children and the driver were killed, and 2 children were seriously injured. Only 1 passenger used the available restraints. The van was a 1999 Ford E-350 Club Wagon van with a GVWR of 9,100 pounds.

A crash involving a 15 passenger van that lost control from a tire failure and overturned in **Lake City, Florida** occurred on February 21, 2014.[17] The van was carrying 10 passenger four of which were ejected. The driver and 1 passenger were killed, 1 was seriously injured, and 7 suffered minor injuries. One of the minorly injured passengers used the available restraints. The van was a 2002

[12] http://www.lctmag.com/regulations/article/43089/know-your-limits-before-putting-on-vehicle-pounds.
[13] http://www.rospa.com/roadsafety/adviceandinformation/minibussafety/loading-safety.aspx, accessed on March 21, 2019.
[14] 49 CFR Part 571, Docket No. NHTSA-2013-0121, RIN 2127-AK56.
[15] NTSB HAB-0202
[16] NTSB HAR-0402
[17] NTSB HAB-1502

Ford E-350 van with a GVWR of 9,400 pounds, a curb weight of 5,906, allocating about 233 pounds per person (without luggage).

A multivehicle crash involving a limo van occurred on June 7, 2014 on the New Jersey Turnpike in **Cranbury, New Jersey** which resulted in 1 fatality and 9 injuries. In this case, the alterer of the 2012 Mercedes-Benz Sprinter van had properly registered with NHTSA, applied the appropriate alterer label, and documented the modifications in compliance with the FMVSSs. The added seat placements were required to satisfy occupant crash protection requirements, as the limo van was classified as a multi-passenger vehicle and had a GVWR less than 10,000 pounds. The limo van was a 2012 Mercedes Sprinter 2500 170 EXT with a GVWR of 8,550 pounds, a curb weight of 6,910 pounds, allocating about 182 pounds per person (without luggage).

A crash involving a 15 passenger van that ran off the road in **Moore Haven, Florida** occurred on March 30, 2015.[18] The van was carrying 18 people including a 4 year old child, and had a non-compliant 4th row seat with no seatbelts. Only the front 2 occupants were belted. As a result of the crash, 8 passengers were killed and another 8 passengers were seriously injured. The van was a 2000 Dodge B 3500 van with a GVWR of 8,700 pounds, a curb weight of 4,033 pounds, allocating about 311 pounds per person (without luggage).

A limousine crash investigated by the NTSB involved a stretch limousine that occurred on March 26, 2016 on Interstate 90 in **Elgin Township, Illinois**, which resulted in 1 fatality and 6 injured. The crash impact was a severe frontal collision involving a 1998 Lincoln Town Car stretch limousine with a 120-inch stretch and 10 seats in addition to the 5 original equipment manufacturer (OEM) seats. In this crash, the manufacturer or alterer of the stretched 1998 Lincoln Town car was not identified. No alterer labels, VIN plates or other identifying information was present on the stretched limousine. Further, the seat and seat belt installations added to the stretch portion of the limousine were of poor quality, while the remaining OEM seats appeared to be designed to the previously discussed occupant protection requirements. The GVWR was not found, but it would have been about 10,000 pounds based on the original Lincoln GVWR or 5,376 pounds. Estimating the GVWR at 10,000 pounds and the curb weight at about 6,500 pounds, the allocated passenger weight would be about 267 pounds per person (without luggage).

A crash involving a 15-passenger van that ran off the road and overturned in **Ruther, Glen Virginia** occurred on June 18, 2016.[19] The van was carrying 16 people including a 4-year-old child. Six passengers were ejected and killed; the other passengers in back of the van were seriously injured. The two front seated occupants, who were the only 2 belted occupants, sustained minor injuries. Most of the passenger seat belts in the van were missing or not accessible. The van was a 1998 Dodge Ram 3500 van with a GVWR of 8,700 pounds, a curb weight of 4,033 pounds, allocating about 311 pounds per person (without luggage).

<u>Between 10,000 and 26,000 GVWR</u>

A crash involving a 2000 Krystal Enterprises/Ford F550 that ran off the road and off a bridge in **San Miguel, California** occurred on January 2, 2001.[20] Two passengers were ejected and killed, three passengers sustained injuries (2 serious, 1 minor), and the driver, who was only belted

[18] NTSB HAB-1602
[19] HWY16FH015
[20] NTSB HAB-0201

occupant, sustained minor injuries. Only the front seats were equipped with belts. The body-on-frame 32 passenger bus was a 2000 Ford F550 and Krystal body with a GVWR of 19,000 pounds, a curb weight of 13,550 pounds, allocating about 170 pounds per person (without luggage).

A crash involving a 2007 Chevrolet /Starcraft 29 passenger medium sized bus that lost control and rolled over in **Dolan Springs, Arizona** occurred on January 30, 2009. During the rollover, 15 of the 17 occupants were either partially or fully ejected, 7 were killed, and 9 passengers and the driver were injured. As a result of this crash, the NTSB recommended the development of regulatory definitions and classifications for bus body types (H-10-2), and recommended that the occupant protection standards and other bus safety standards be applied to buses with GVWR over 10,000 pounds, other than school buses (H-10-3).[21] The bus had been equipped with FMVSS 207 compliant passenger seats and FMVSS 210 compliant restraints that were not required. The body-on-frame 29 passenger bus was 2007 Chevrolet Starcraft with a GVWR of 19,500 pounds, a curb weight of 15,077 pounds, allocating about 153 pounds per person (without luggage).

A crash involving a truck-tractor semitrailer median crossover and collision with a 2008 Champion Defender medium sized bus occurred in **Davis, Oklahoma** on September 26, 2014.[22] The bus was occupied by 15 passengers and the driver. As a result of the crash 4 were partially or fully ejected and killed, and remaining occupants were injured. This bus was equipped with passenger seats and lap belts that met the standards specified in FMVSS 207, 208, 209, and similar constructed buses sold for school bus applications had met the rollover protection standard of FMVSS 220. The investigation found that the passenger seat belts were poorly maintained and many were inaccessible to the passengers. None of the passenger were wearing seatbelts. Additionally, the operator of the bus had a seat belt use policy signed by drivers in which they were to not operate the bus unless all occupants were wearing the lap belts. As a result of this crash, the NTSB re-iterated the recommendation from Dolan Springs to require occupant protection on buses over 10,000 pounds (H-10-03). This crash also prompted the development of recommendation H-15-42, for states to enact legislation that provides for primary enforcement of a mandatory seat belt use law for all vehicle seating positions equipped with a passenger restraint system. The body-on-frame 32 passenger bus was 2008 Chevrolet C5500 Champion Defender with a GVWR of 26,000 pounds, a curb weight of 15,250 pounds, allocating about 336 pounds per person (without luggage).

A crash involving a pickup truck crossover and collision with a medium sized bus occurred in **Concan, Texas** on March 29, 2017.[23] All but 1 of the 13 bus occupants were killed, and the surviving passenger was seriously injured. The bus was equipped with seats and lap belts that occupant protection requirements of FMVSS 210, which allows seat belt anchorages to be spaced as little as 6.5 inches apart. The seat manufacturer increased the width of the anchorage points to an average of 10.5 inches apart. About a third of the occupants died of loss of survival space. As a result of this crash, the NTSB recommended that NHTSA amend FMVSS 210 to increase minimum seat belt anchorage spacing. The NTSB re-iterated H-10-3, recommending that NHTSA amend FMVSS 208 to require lap/shoulder belts for each passenger seating position on all new buses with a GVWR above 10,000 pounds to 26,000 pounds and also recommended that medium-size bus manufacturers install lap/shoulder belts in all seating positions as standard, rather than

[21] NTSB HAR-1001. H-10-2 superseded H-99-43 and H-99-44.
[22] HWY14MH014, NTSB HAR-1503.
[23] NTSB HAR-1802.

optional equipment in all newly manufactured medium sized buses. The occupants were wearing the restraints, but the lap belts and seat belt anchor points were shown to provide insufficient protection. The medium size bus was a 2004 Ford E350/Turtle Top Van Terra XL with a GVWR of 10,700 pounds, a curb weight of 7,650 pounds, allocating about 218 pounds per person (without luggage).

Note that NHTSA commented on NTSB recommendation H-10-03 in the final previously referenced motorcoach lap/shoulder belt ruling. The recommendation asked NHTSA to expand the rulemaking to include all buses with a GVWR greater than 10,000 pounds, other than school buses. NHTSA's comments in the final rule for not including buses in this weight range stated that the Motorcoach Safety Plan rulemaking was not intended to address whether seat belts should be required on all buses regardless of weight class. Instead, the Motorcoach Safety Plan was data driven and focused on ejection risk, prolonged emergency egress, and structural vulnerability to roof loading for a rollover event.

Vehicle Seat Position and Survivability References

References for determining a designated seat position and publications indicating survivability were identified as given below.

- The 49 CFR 571.3 is a list of regulatory definitions, and was first created Dec. 25, 1968 with amendment 33FR19703 and then redesignated at 35FR5118 on March 26, 1970. The term "Designated Seat Position" (DSP) was amended for use in the FMVSSs with Final Rule at Amendment 73 FR 58887 issued on October 8, 2008. This defined the minimum DSP as that accommodating a 5% female, and referenced a Public Health Service Publication from 1965 which cited the seat breadth for a 5% female as 12.3 inches. It was then amended with the effective date of Sept. 1, 2011 at amendment 74FR68185 to change the definition from citing the 5% female to just adopting a simple dimension of 13 inches.

- The Federal Aviation Administration has conducted research on survivability of occupants exposed to frontal impacts while seated in lateral (side-facing) bench seats for aircraft applications.[24] The evaluations showed that seating configurations that permit excessive lateral flailing expose the occupants to injury risks. Further, because of the need to provide the same level of safety to occupants in side facing seats as to those in forward and rear facing seats, the study found that excessive upper body flailing and associated injuries could be reduced through a combination of effective seat belt system geometry with a barrier.

- A study of the effectiveness of lap/shoulder belts versus lap belts, versus no restraints in rear outboard seating positions found significant improvements for injury potential to the abdomen and head with lap belts over no restraint, and further improvement with lap/shoulder belts. In side impacts and rollovers, lap belts or lap/shoulder belts provided a significant benefit over no seat belt, and while the lap/shoulder belt did not show a significant benefit over the lap belt in side collisions, it provides a large improvement in

[24] R. DeWeese, D. Moorcroft, A. Abramawitz, J. Pellettiere; Civil Aircraft Side-Facing Seat Research Summary; DOT/FAA/AM-12/18; Federal Aviation Administration Office of Aerospace Medicine, Washington, DC 20591; November 2012.

frontal collisions.[25] These side impact tests showing a benefit of the lap/shoulder belt in forward facing seats may provide additional understanding for the potential benefits of lap/shoulder belts in lateral facing seats involved in front collisions.

- A study by the Department of Transport, London identified risk curves for speed and car driver injury. The curves showed that there exists the opportunity to survive impacts with a velocity change of over 60 miles per hour.[26]
- The concept of "Ride-Down" describes the gradual deceleration experienced by passengers who remain within the compartment of a vehicle and attached to the vehicle during its movement before coming to rest. If a passenger is attached to the vehicle, he or she can take advantage of all the energy absorbed by the vehicle later in the crash.[27]
- A paper by Shanahan provides an overview of human tolerance and crash survivability, with reference to survivable limits considering both aircraft and ground vehicles. The progressive chain of survivability is discussed. This concept is described in more detail in the paper, but essentially is how an occupant must first be in a portion of the vehicle that was not compromised and allowed sufficient space, second how the impact loads applied to the body must be survivable, and last, that the person must be able to survive the post crash environment (safely evacuate).[28]
- A study of severe race car crashes found that with proper restraint and vehicle design, drivers survived crash impacts with velocity changes as high as 60 to 70 mph without significant injury.[29]

3. Vehicles

The crash involved the 2001 Ford Excursion "Stretch" Limousine and the 2015 Toyota Highlander SUV. Both vehicles were towed to the New York State Police Office, located at 760 Troy Schenectady Rd, Latham, NY 12110. Preliminary observations of the vehicles were conducted on October 9 and 10, 2018. Follow up survival factors documentation of the limousine was conducted on February 11, 2019. Vehicle documentation was delayed due to the criminal investigation. The resulting limitations of the documentation are noted.

3.1. 2001 Ford Excursion Limousine

The limousine was operated by Prestige Limousine Chauffeur Service was registered in the State of NY with a valid omnibus plate and was insured. The limousine was a 2001 FORD Excursion

[25] C. Morgan; Effectiveness of Lap/Shoulder Belts in the Back Outboard Seating Positions; DOT HS 808 945; Department of Transportation, National Highway Traffic Safety Administration, Washington DC 20590, June 1999.
[26] D. Richards, R. Cuerden; Road Safety Web Publication 9, The Relationship between Speed and Car Driver Injury Severity; ISBN 978 1 84864 002 0, Department of Transport: London, April 2009.
[27] NTSB NTSB/HAR-01/03, https://www.ntsb.gov/investigations/AccidentReports/Pages/HAR0103.aspx
[28] Shanahan, D.F. Human Tolerance and Crash Survivability, RTO-EN-HFM-113, http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.212.5449.pdf.
[29] Melvin, J., Baron, K., Little, W., Gideon, T. et al., "Biomechanical Analysis of Indy Race Car Crashes," SAE Technical Paper 983161, 1998, https://doi.org/10.4271/983161.

Limousine (Omnibus). It was white in color and had Vehicle Identification Number (VIN): 1FMNU40S51EBXXXXX.[30]

The limousine was based on a 2001 model Ford Excursion XLT with a 6.8-liter V10 engine, and an automatic transmission. The Ford was altered by 21st Century Coach Inc. from the Excursion which had a Gross Vehicle Weight Rating (GVWR) of 8,600 to 8,900 pounds to a stretch limousine.[31] The new, altered vehicle GVWR could not be determined because the investigation did not recover the altered vehicle VIN plate. However, the altered GVWR was approximately 13,000 pounds (refer to section 2.4 of this report).

3.1.1. Limousine Exterior Dimensions and Interior Layout

The stretch limousine was built as a custom vehicle. Specifications and drawings of the altered vehicle were not found. The limousine sustained severe damage in the crash, which obscured some information about the modifications made to the vehicle. Due to the lack of specifications and drawings of the modifications, dimensions for the stretch portion of the limousine and interior layout are estimates based on post-crash measurements.

Much of the pre-crash vehicle information was obtained from an interview and documents provided by the original buyer/owner/operator of the limousine.[32] During the interview, the original buyer/owner/operator recalled picking out the Ford Excursion and having the vehicle stretched a length of 180 inches. However, inspection of the limousine frame by investigators indicated a stretch distance of 144 inches between the welds of the altered body section. Discussions with other limousine operators indicated that it is common to refer to the stretch by the capacity of the vehicle, for example, an 18 stretch may refer to a limousine that could have 18 occupants. The original owner also provided old inspection sheets from the New York State Police (NYSP) that listed the number of total vehicle seats as 18.[33] Figure 1 provides an exterior view of the accident limousine prior to the crash as obtained from the NYSP, which was provided by a previous customer.[34]

[30] Last 5 digits of VIN replaced with X.
[31] Decoding the VIN was used to obtain the Ford Excursion specifications which listed the standard GVWR as 8,600 pounds and the maximum GVWR as 8,900 pounds. (https://www.faxvin.com/vin-decoder/)
[32] The original owner started a company called Royale Limousine and this vehicle was owned by that company, which had the Ford altered by 21st Century Coach Inc.
[33] This number of seats conflicts with other information described in this report, see section 2.1.6.
[34] The photo was not dated, and the person standing next to the limo was obscured with a white box.

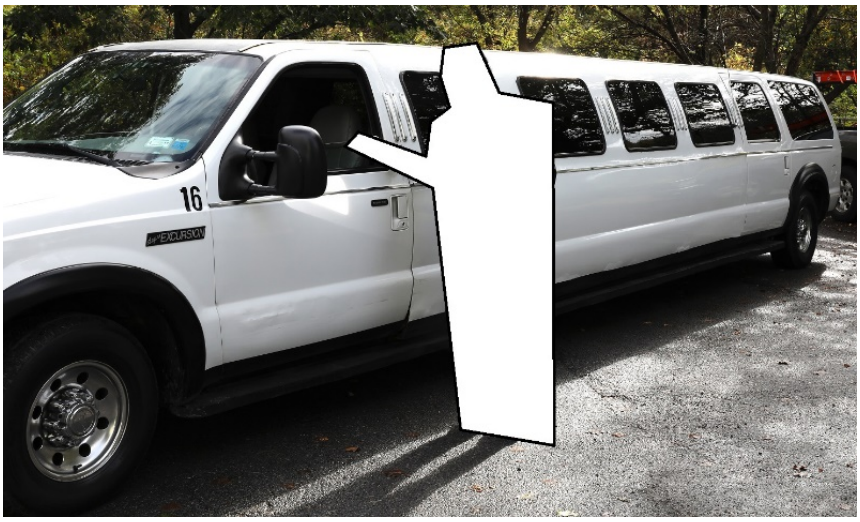

Figure 1: View of the accident limousine from a previous customer, as obtained from the NY State Police

The limousine retained the original 4 side doors and rear cargo hatch and cargo doors from the Ford Excursion. No additional doors or skylights were added. The stretch portion of the limousine added 4 fixed passenger windows on each side. The most forward, first windows on each side were smaller than the other 3.

The limousine retained the driver and front passenger seats from the Original Equipment Manufacturer (OEM). A privacy divider was installed during the alteration process between the front seats and the rear passenger compartment. The stretch limousine also retained the two rows of OEM passenger seats (5 of 6 seats) in the back of the limousine. The row of OEM seats next to the doors had the passenger side seat removed, which made the rear passenger side door as the primary access point for the rear compartment. The rear seating area consisted of a perimeter seating layout in the stretch portion, and 5 OEM seats remaining in the back of the limousine. The original rear cargo area remained. The total seating capacity of the limousine was not clear, because the number of total seats cited in the NYSP inspections did not match the number of seat belts installed. Section 3.1.6 of this report provides details of the passenger cabin seating and seat belts.

The perimeter seats in the stretch portion consisted of 3 bench seats. There was an aft-facing bench seat next to the partition (privacy divider) and side-facing bench seats on each side. The side-facing seat on the passenger side was shorter than the one on the driver's side, and there was bar aft of this seat and forward of the rear passenger side door.

Basic dimensions for the exterior and the location of the structural pillars of the limousine in pre-crash condition were estimated based on drawings for a 2001 Ford Excursion and measurements of the post-crash vehicle, as shown in Figure 2. The structural pillars are labeled A through H from front to back. The A, B, G, and H pillars were original, and the C, D, E, and F pillars were added during the alteration.

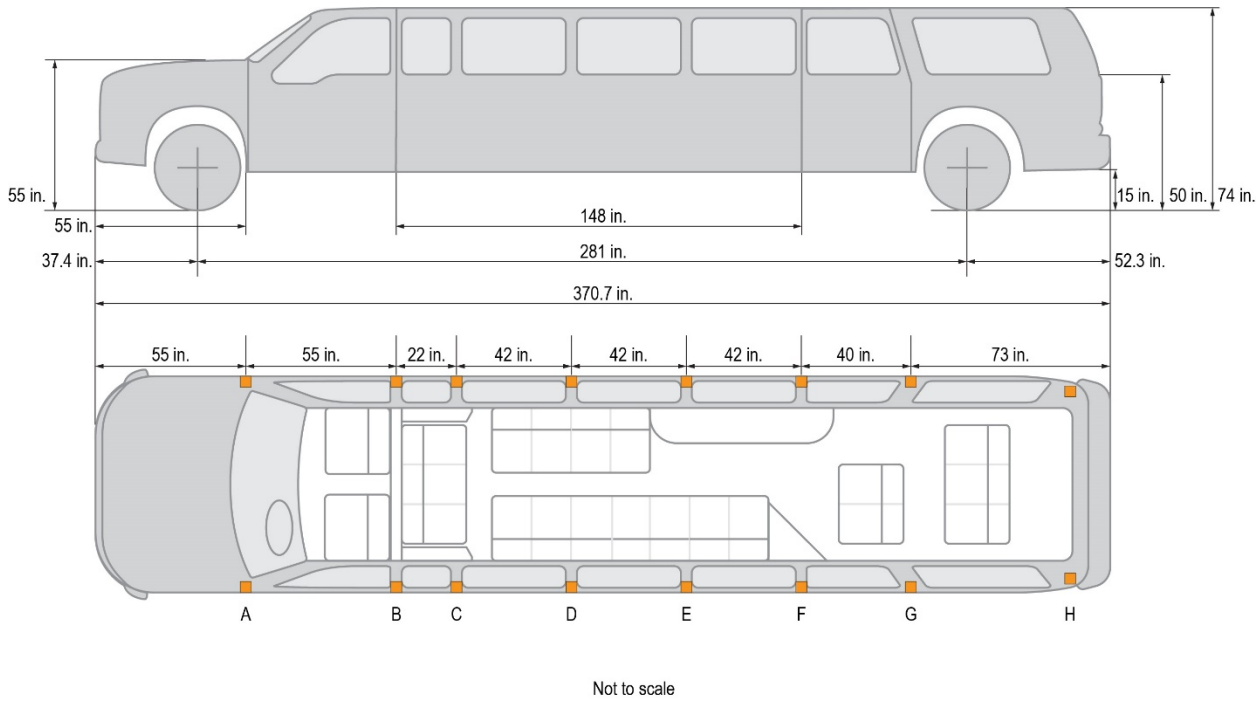

Figure 2: Diagram of the Limousine Exterior and Interior Layout

The privacy partition had a moveable panel to the front compartment. There were small tables on each side of the aft-facing bench seat, and a triangular table just aft of the driver side side-facing bench seat. Figures 3 and 4 provide interior views of the rear passenger seating area of the accident limousine provided by the original owner. He noted that these photos were from 2010.

Figure 3: A 2010 photo of the limousine interior looking forward, as obtained from the previous owner, Advantage Transportation Group

Figure 4: A 2010 photo of the limousine interior looking aft, as obtained from the previous owner, Advantage Transportation Group

3.1.2. Limousine Exterior Examination and Exits

The limousine sustained severe impact damage at the front, with the passenger (right) side displaced towards to the left, as shown in Figure 5. The right front fender and door remained attached but with severe impact damage. The hood was crushed and resting above the engine, which had been displaced aft and into the front seating area, as shown in Figure 6. The driver (left) side fender and driver door were crushed and partially attached, hanging off the left side and above the front axle.

Figure 5: Passenger side view of the postcrash 2001 Ford Excursion limousine (source NTSB)

Figure 6: Front View of the postcrash 2001 Ford Excursion limousine (source NTSB)

The following observations were documented by the vehicle factors investigator during his initial inspection on October 8, 2018.

> The A-pillar on the left side was folded in half. The B-pillar on the left side was missing. The glass from the driver's door and the window to the rear of the driver were missing. The three additional windows on the left side were intact. The rear window was missing.
>
> The right fender was damaged but in place. The front passenger door was still attached at the A-pillar, but the top of the pillar and the top of the door were displaced rearward and to the right. The door was folded almost in half. The B-pillar on the right side had been cut approximately halfway between the floorboard and the roof. The rear two windows on the right side were intact, but the front two windows were missing.
>
> There was considerable corrosion noted throughout the vehicle. The roof was folded upward and had partially detached from the side panels of the vehicle, exposing the sheet metal and headliner. Portions of the body panels had also separated exposing the corrosion within.

A large opening was cut by emergency responders for access post-crash into the driver side, separating the roof from the B and C pillars, and another on the passenger side, separating the roof from the B pillar and removing the C and D pillars. Figure 7 and Figure 8 provide images of the driver and passenger sides respectively, as generated from 3D scanning.[35] The locations of the pillars are indicated and basic exterior dimension are provided. The dimensions were generated by selecting points on the 3-D scan and along the longitudinal axis of the limousine (using the body panel crease and window frames to establish the longitunidal axis).

[35] The NTSB performed 3-D scans to document the postcrash condition of the limousine. The scans were generated using a Faro Focus Scanner. The images are 2-D point clouds from a selected plane.

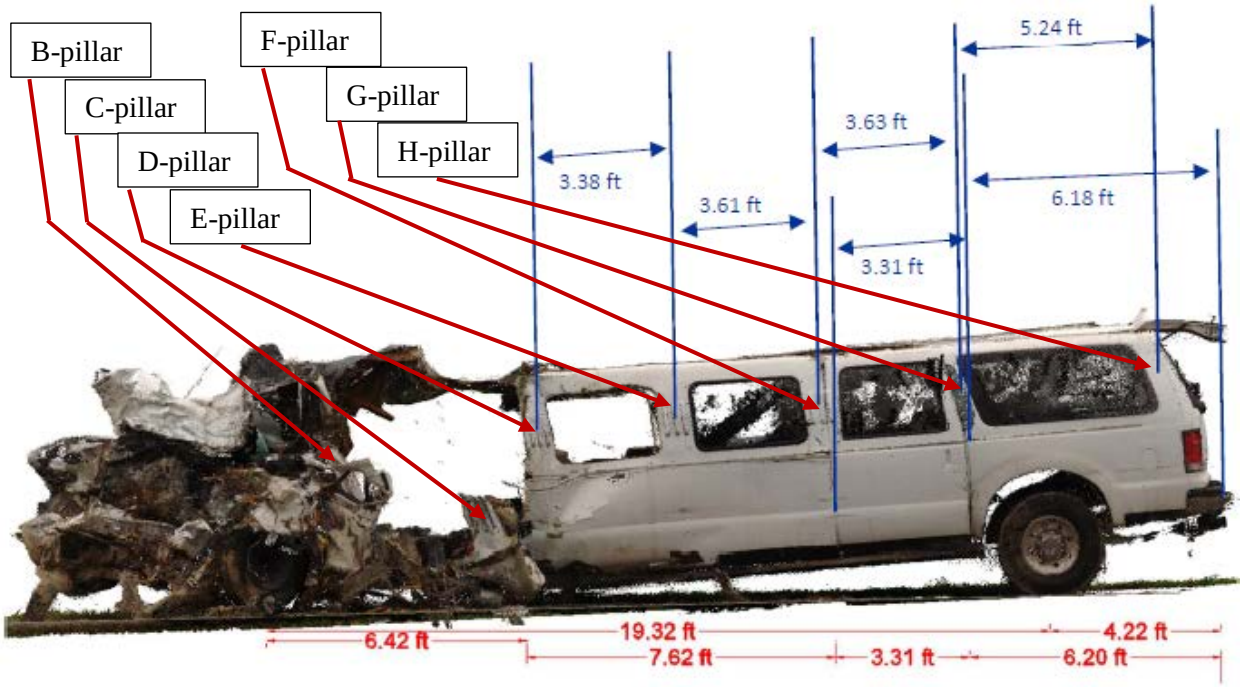

Figure 7: Image from 3D scan of the limousine conducted on October 8, 2018.

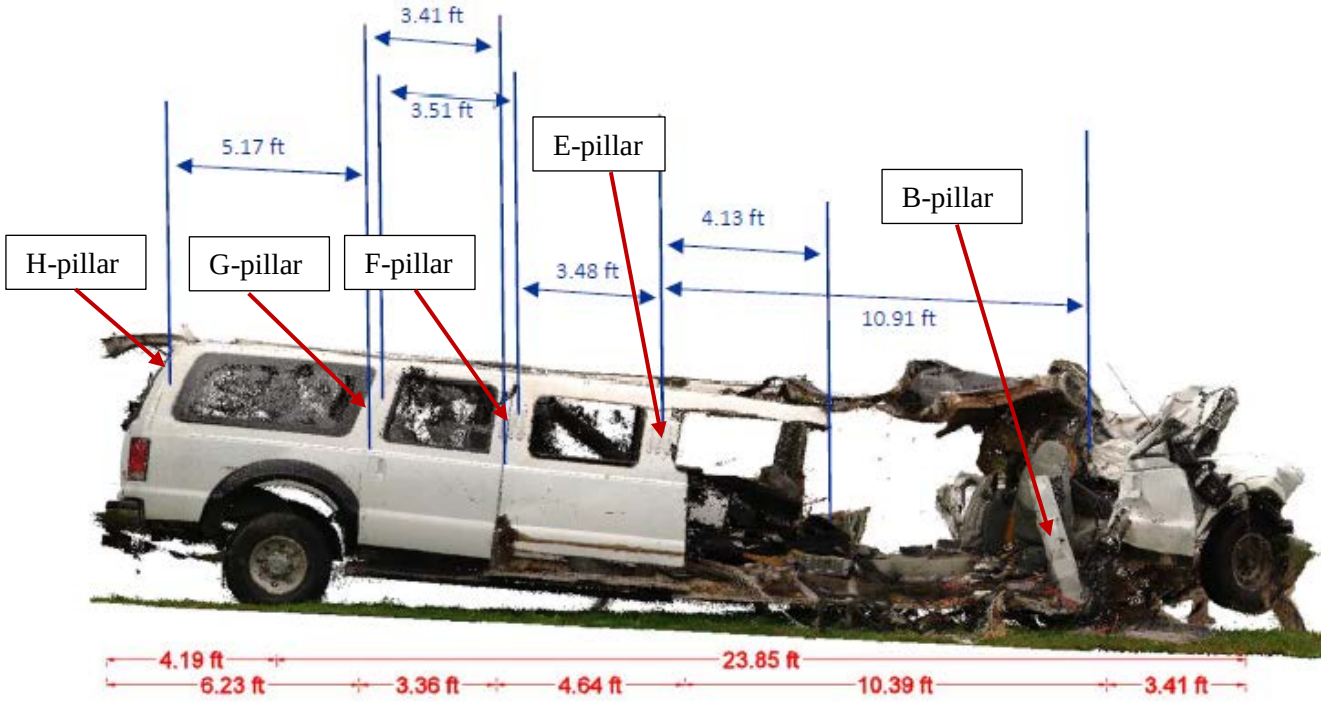

Figure 8: Image from 3D scan of the limousine conducted on October 8, 2018.

Measurements for the post-crash distances between the structural pillars are given in Table 4.[36] These pillar dimensions were taken from the interior at roughly the floor level of the driver (left)

[36] An extended period of time and the mechanical inspection of the vehicle occurred prior to this inspection.

side and passenger (right) side of the limousine. The notes section describes the reference points for each measurement.

Table 4: Measured Dimensions between Structural Pillars in inches

Description	Dimensions	Notes
C-pillar	Left NA (see note) Right 36	No location for the C pillar on the driver side was possible. Right was measured aft of B pillar to center of C pillar.
D-pillar	Left 52 Right 79	Left was aft of B pillar to center of D pillar. Right was measured aft of B pillar to center of D pillar.
E-pillar	Left 43 Right 123	Left was measured from center of D to center of E, because there was extensive damage to the B pillar. Right was measured aft of B pillar to center of E pillar.
F-pillar	Left 44 Right 168	Left was measured from center of E to center of F, because there was extensive damage to the B pillar. Right was measured aft of B pillar to center of F pillar.
G-pillar	Left 45 Right 210	Left was measured from center of F to center of G, because there was extensive damage to the B pillar. Right was measured aft of B pillar to center of G pillar.
H-pillar	Left 60 Right 270	Left was measured from center of G to center of H, because there was extensive damage to the B pillar. Right was measured aft of B pillar to center of H pillar.

The windshield and front driver and passenger windows were destroyed. The added stretch portion of the limousine had 4 fixed passenger “stretch” windows on each side. The front stretch window on the driver side and the two forward stretch windows on the passenger side were displaced or cut away. The second stretch window on the driver side and the third stretch window on the passenger side were missing. The rear door windows and the left and right cargo area windows were intact. The aft window was broken out. The size of the existing large fixed passenger windows was 24 inches tall and 54 inches wide. The size of the windows at the rear doors was 24 inches tall and 28 inches wide at the top, and 32 inches wide at the base. The aft passenger windows were 20 inches tall and 32 inches wide.

An image of a horizontal slice through the vehicle at approximately the passenger floor level was also generated by 3D scanning, as shown with basic dimensions, in Figure 9.

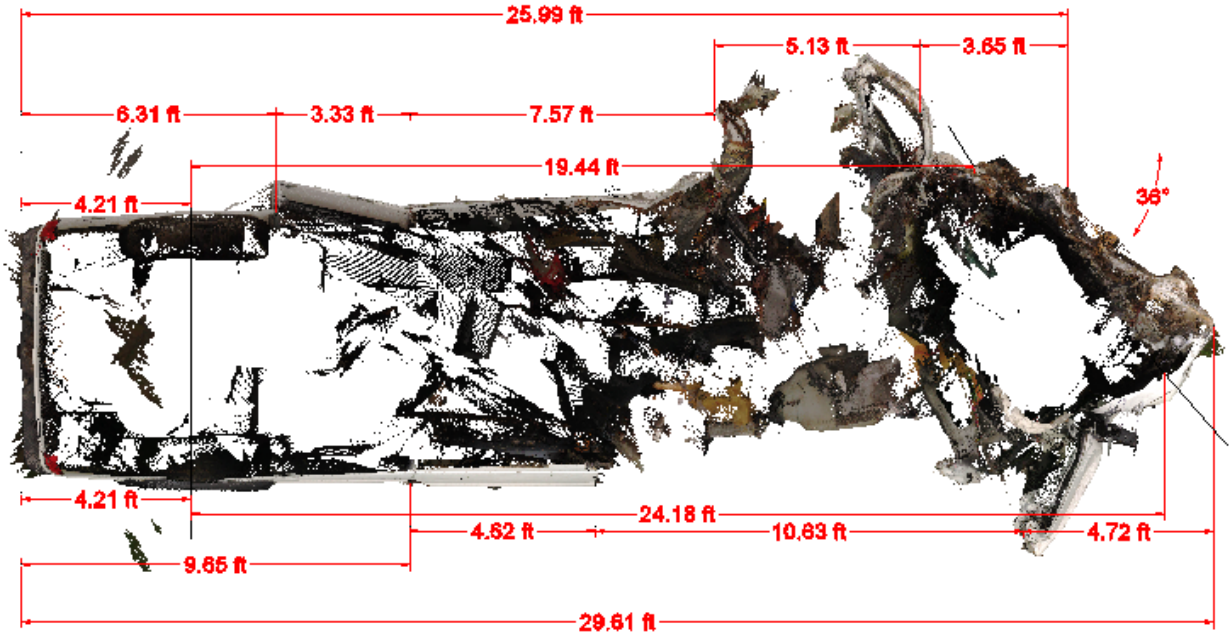

Figure 9: Image of Horizontal Slice at Floor level from 3D Scanning. The front of the vehicle is on the right side of the slice.

3.1.3. Limousine Front Seating Area

The front seating area was severely crushed. The following description was noted by the vehicle factors investigator:

> The rear portion of the engine was in what would have been the driver's footwell area of the vehicle. The steering wheel was displaced upward and was at the roofline of the vehicle. The bottom portion of the driver's seat was displaced upward approximately 90 degrees and compressed into the seatback. The right front passenger seat was deformed in a similar manner.

The driver seat pan was separated from the backrest upon examination, and it was reported that the emergency responders removed the driver seatback to gain access to the driver who was trapped between the seatback and the steering wheel. The seat pan was found partially attached to the floor, which was deformed to a nearly vertical angle and displaced aft into the front portion of the passenger cabin. The seatback was found in the passenger compartment of the limousine.
The driver seat belt buckle assembly remained intact, and the seat belt connector was displaced. A seat belt connector from one of the front seats was found as shown in Figure 10, although it was unknown if it was from the driver or front passenger seat. The upper mounting bracket and attachment bolt of the seat belt was found near the driver seat pan, and the bolt threads did not exhibit signs of deformation. The section of belt attached to the upper bracket exhibited a tension failure pattern with the outer edges of the webbing longer than the middle. The inertia reel was mounted on the lower portion of the displaced B-pillar, the cover was missing, and the seat belt webbing was torn in an opposite pattern exhibited by the webbing attached to the upper bracket.

Figure 10: Front Seat Belt Connector

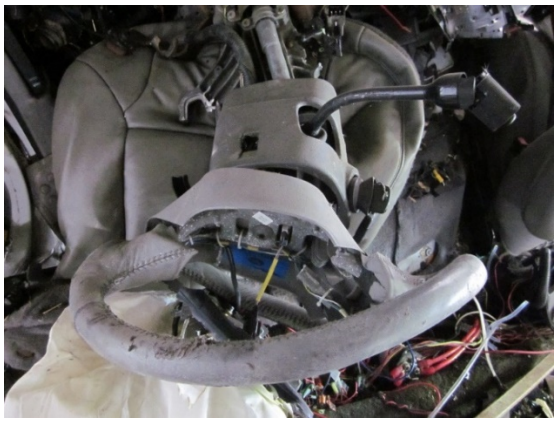

Figure 11: Steering Wheel

The dashboard was displaced aft and in contact with the underside of the driver seat pan. Portions of the deployed driver airbag were visible in the debris. The steering wheel is shown in Figure 11. Note that the steering wheel and other steering components were moved in order to access portions of the vehicle during the mechanical inspection. The driver airbag measured 21 inches in diameter and there was blood and biological material on the front surface.

The front passenger seat was intact, and the floor and dashboard were displaced aft and in contact with the seat. The seat pan was deformed with the front edge upward at an approximate 45 degree angle. The backrest was deformed forward at an approximate 70 degree angle.

The deployed passenger airbag was visible on the deformed dashboard, as shown in Figure 12. The front passenger seatbelt was visibly attached to the inertial reel which remained attached to the lower B-pillar, and the trim panel was partially displaced as shown in Figure 13. The upper attachment of the front passenger seat belt was not located, and the upper half of the B-pillar was cut and displaced. The front passenger seat, airbag, and belt did not have evidence of being occupied at the time of the crash. The front passenger seat belt had damage consistent with responder cutting operations which occurred in this vicinity. The passenger side airbag measured 22 by 22 inches.

According to the owner's manual, the right front seat lap/shoulder belt was equipped with a yellow label that deploys from a plastic cover in the event of the belt being used in a crash, referred to in this report as a "crash label".[37] There was no evidence that the label had deployed.

[37] See SF Attachment: 2001 Ford Excursion Owner's Manual, page 100.

Figure 12: Passenger Airbag

Figure 13: Front Passenger Seat Belt

The privacy partition was displaced, a portion was found in the debris pile, and separated out by the NYSP, as shown in Figure 14. The partition measured 45.5 inches wide by 20.75 inches tall. It exhibited deformation on the upper portion, located 35 inches from the left (driver side) edge, and deformation at the center bar of partition 28 inches from the driver side edge.

Figure 14: Passenger privacy partition

3.1.4. Limousine Rear Doors and Cargo Area

The left rear OEM doors were intact. The left rear door would not fully close due to damage at the forward surfaces. The right rear door was functional. Both doors were labeled as emergency exits, as shown in Figure 15. The rear doors had child locks (found unlatched) located near the door latches and included labels describing their use, as in Figure 16.

Figure 15: Right Rear Door

Figure 16: Right Rear Door Latch

The OEM rear cargo hatch consisted of a widow panel which was hinged at the top, and side by side doors below the rear window, as shown from the exterior in Figure 17 and the interior in Figure 18. The hatch glass was broken out and the rear cargo doors were intact and operational. The rear hatch was labeled as an emergency exit, and had a ring pull tab to release the hatch, as shown in Figure 19.

Figure 17: Right Rear Door

Figure 18: Right Rear Door Latch

Figure 19: Right Rear Door

Upon documentation, the cargo area was empty, however, the NYSP indicated that a large battery was stored in the cargo area at the time of the crash. A small plastic cover from the battery case was lodge in the upper headliner on the driver's side near the upper handle for the driver side passenger door. Battery acid appeared to be on the headliner leading up to the location of this plastic piece. The cargo area contained a box of sand and debris that appear to have been placed there after the crash. The seatbacks of the last row of seats, which comprised the front of the cargo area were deformed forward, which is described in the seat section of this report.

3.1.5. Passenger cabin structure, roof, and interior trim

The limousine rear passenger compartment was inspected for evidence of intrusion, structural failure, or collapse. The left front portion of the compartment had an area of intrusion extending roughly 4 feet aft at the outer driver side (left sidewall). The intrusion was less further inboard and near the roof. Sections of the roof and both the driver and passenger sides were cut away. Aft of the intrusion zone, the roof, sidewalls and floor exhibited localized deformation, there was no evidence of major intrusion or collapse of the structure. The basic shape of roof line, sidewalls and floor were intact. The structure of the original passenger cabin interfaces with the stretched portion, and structure of the stretched portion and were intact. The aft, OEM portion of the limousine exhibited relatively minor deformations and was structurally intact.

The 3-D scan images previously shown were used to illustrate the post-crash condition of the limousine as compared to the estimated dimensions pre-crash. Figure 20 shows the driver side followed by an overhead view of the post-crash limousine, with line drawing overlays to show the approximate pre-crash outline and other features of the limousine. The pre-crash dimensions are based on the documentation and dimensional data for a 2001 Ford Excursion.[38]

[38] SF Attachment 2001 Ford Excursion Dimensional Data.

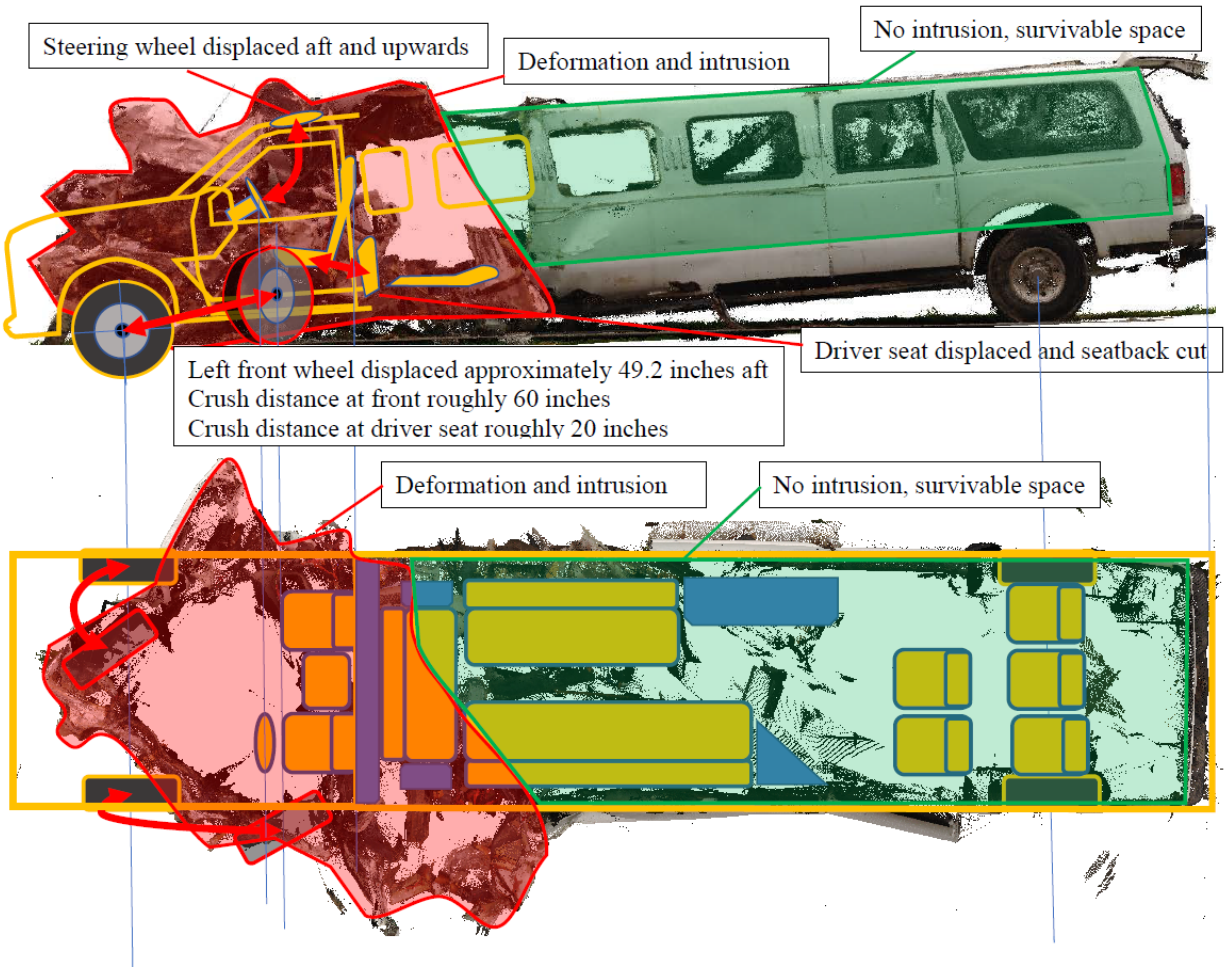

Figure 20: Diagram of the passenger cabin with rear passenger cabin with approximate outlines of the precrash vehicle body shape and representations of the seats and furniture.

The headliner at the middle and forward portion of the passenger compartment had contained mirrors and lights that were severely damaged and displaced. There was evidence of extensive occupant contact and biological material located above the aft facing seat and near the driver region. The floor at the left front of the passenger compartment was buckled just aft of the driver seat and partition.

The upper surface of the bar remained attached to the passenger side sidewall. The bar was 52" inches long at the sidewall, and had a wavy inboard contour. It was 14 inches at its widest points and 10.5 inches at its narrowest points. The bar was attached to the E and F pillars with metal straps. It extended 14 inches forward of the E pillar and terminated 5 inches forward of the F pillar.

There was a triangular table originally position just aft of seat position 16 and just forward of the left side OEM rear door and OEM seat 17. This table was found separated from the vehicle. The impression of the table that remained in the floor carpeting measured 39 inches diagonal, 22 inches horizontal, and 34 inches longitudinal. The table measured 24 inches long and 18 inches wide at the forward edge of the triangle. Photographs of the pre-crash limousine indicated that there were small tables at the forward outboard corners of the passenger cabin. These were displaced and not found.

3.1.6. Passenger Cabin non-OEM Seats and Seat Belts

A diagram of the limousine is provided in figure 21. The front seats (driver seat and front passenger seat numbers 1 and 2 respectively) are not labeled. The rear passenger seats are numbered according to the quantity of seat belts found in the limousine, in a counter-clockwise fashion. Note that the manner in which the seat belts were installed would leave very little room for each passenger in the stretch seating area, especially for the driver side lateral bench seat. The range of potential definitions of seating capacity is provided below.

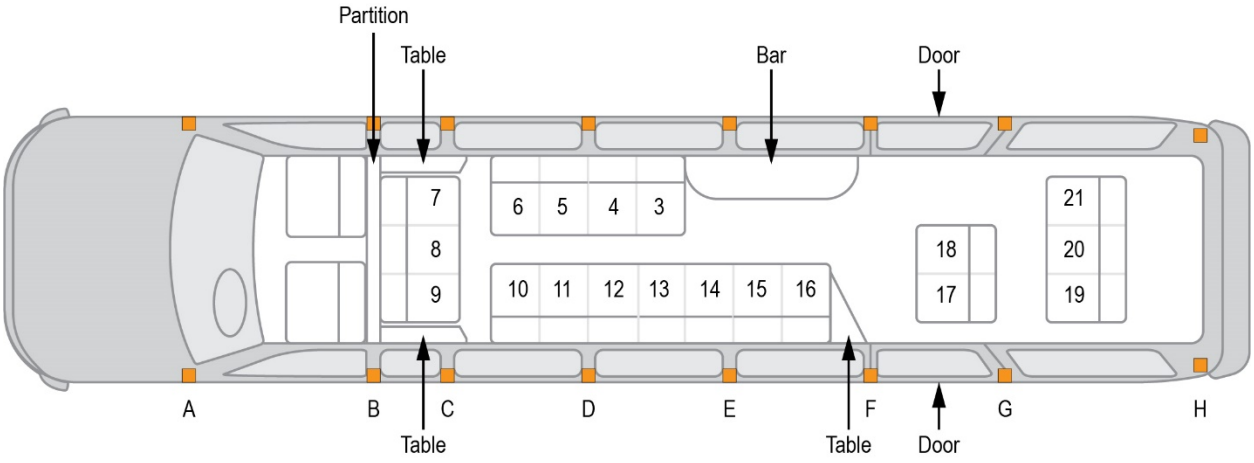

Figure 21: Diagram of the passenger cabin with rear

The limousine had no clear definition of the total number of seat positions because the capacity of the bench seats in the perimeter seating area differs depending on the source of the information. Depending on the approach the limousine could have a capacity ranging from 18 to 22 people. The investigation found no information from the current operator indicating a capacity. It was also not determined how many occupants were seated in each seat during the crash. The sources of information for determining the number of seat places on each seat are:

- A New York Department of Transportation (NYDOT) commercial motor vehicle inspections Driver/Vehicle Examination Report obtained from a previous owner of the limousine;[39]
- The number of people sitting in the limousine on this trip;
- The NHTSA definition of seat placements (pre-2011) of 12.3 inches;
- The number of installed seat belts.

Using the above approaches, the following seating capacity and seat placement widths could apply to this limousine, as shown in Table 5. Note that NHTSA has issued a supplemental laboratory test procedure for determining the number of designated seating positions in a row of seats for use in compliance with FMVSSs.[40]

[39] Two Driver/Vehicle Examination Reports were obtained, dated 5/9/15 and 5/15/2015. They are available in the accident docket. A field of the report titled "Locally Defined Fields" stated "seating capacity with driver: 18."
[40] SF Attachment NHTSA Supplemental Laboratory Test Procedure for DSPs.

Table 5: Limousine seating capacity and seat placement width using various approaches

	Aft-Facing seat	Driver-side lateral	Passenger-side lateral
NYDOT total seats: 18 (7 OEM)	2 places	6 places	3 places
Seat placement width:	21.7 inches	16.2 inches	23 inches
Crash Trip total seats: 19 (7 OEM)	? (2 or 3)**	? (5 or 6)**	? (3 or 4)**
Seat placement width:	21.7 inches	16.2 inches	23 inches
Installed seat belts: 21 (7 OEM)	3 places	7 places	4 places
Seat placement width:	15.3 inches	13.9 inches	16.25 inches
NHTSA Definition: 22 (7 OEM)	3 places	7 places	5 places
Per 49 CFR 571.3 (as described in section 1.1 of this report) Seat placement width:	15.3 inches	13.9 inches	13.0 inches

** All 17 passengers were in the rear passenger cabin, but the actual number of occupants in each seat on this trip was not established.

Steel frames from the non-OEM seats were found in the interior. The seat cushions were displaced. The non-OEM seat frames were constructed of welded square tubular steel. The seat pan frame tubes were 1 inch square, and the legs were 0.75 inch square. Typical dimensions for the depth of the seat pan frame was 14.5 inches and the height was 8.5 inches as measured from the floor. The seat pan frames had been mounted to the floor using metal straps and 2 individual screws through the metal strap and then through sheet metal floor pan as shown in Figures 22 and 23. Note that the seat placement number have been revised from the photo to reflect the numbering system used in this report (as opposed to the method used during on-scene inspection).

The metal straps appeared to be common mild steel pipe hanging strap. This type of strap in the 0.75 inch width, is made from 28 to 20 gauge (0.0375 inch) thick galvanized mild steel. The aft facing bench seat frame and the passenger side bench seat frame were attached at the fore and aft legs (no middle leg) through the straps. The driver side bench seat frame was attached at the fore and aft legs through the metal straps. There was also a center leg that rested on the floor, as apparent from floor impressions, but it was not screwed into the floor.

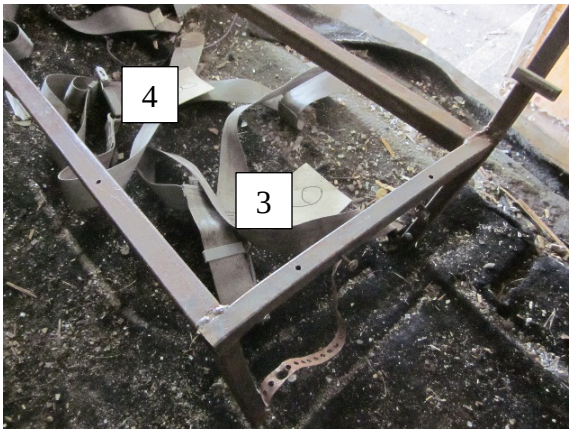

Figure 22: Right side bench seat frame

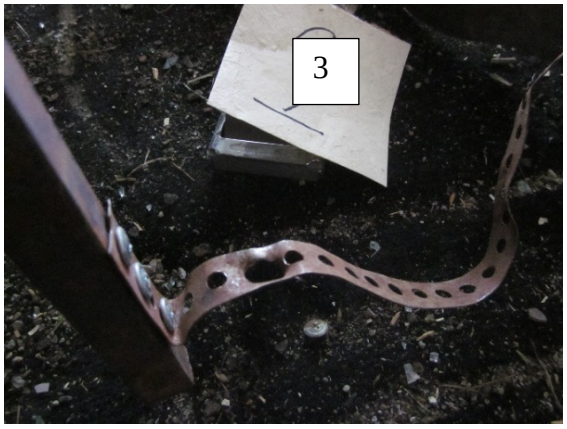

Figure 23: Right side bench seat detail

A review of aftermarket bench seats available for purchase (typically for adding into recreational vehicles) indicated that a typical seat mounting provision is 3/16 inch thick alloy steel brackets fixed with 9/16 inch diameter bolts.[41]

Non-OEM seat cushions

The non-OEM seat cushions were found in the debris pile, except the seat back for the passenger side bench seat, which likely was destroyed when emergency responders cut into that portion of the limousine sidewall. They were constructed of 0.75 inch thick plywood with approximately 4 inches of foam and a vinyl covering. The seat pan cushions were rectangular, and were 18.5 inches deep. The seatback cushions had a wavy upper contour, which were 18 inches at the tallest points and 16.5 inches at the shortest points. The peak to valleys were about 13 inches apart. Figure 24 shows the lateral-facing seats (with the cushions put back in approximate position) and the rear OEM passenger seats.

Figure 24: View of limousine interior looking aft, with lateral seat cushions put back in approximate position during post crash inspection

The passenger side lateral bench seat measured 65 inches long. According to the pre-crash photos, the seatback had 3 peaks and 2 valleys. The aft-facing bench seat, at the front of the passenger compartment, measured 46.5 inches wide and the backrest had 2 peaks and 1 valley. The driver side lateral bench seat measured 97 inches long. The seatback had 4 peaks and 3 valleys.

Air conditioner components were mounted at the outer edge of the vehicle body on the passenger side, just forward of the D pillar and under the lateral bench seat. The largest component, a condenser that measured about 12 inches long and 4 inches wide, remained mounted to the floor. Other components were dislodged from the floor. The driver side had similar components, that were displaced from their mountings.

The seat belt anchor points were labeled according to the seat position number, which is provided in a triangle. The anchor points consisted of a D-ring bracket holding either a connector, a buckle, or both, which was bolted to the floor. When both a connector and a buckle

[41] https://www.carid.com/articles/seat-mounting-brackets-proper-and-safe-way-to-install-your-new-seat.

were attached, both were attached to the vehicle structure using the same bolt. The positions of the floor anchor bolts are provided in Figure 25, with the line of bolts for that group of seats located in reference to a pillar, and the dimensions between anchor bolts are provided in Table 6.

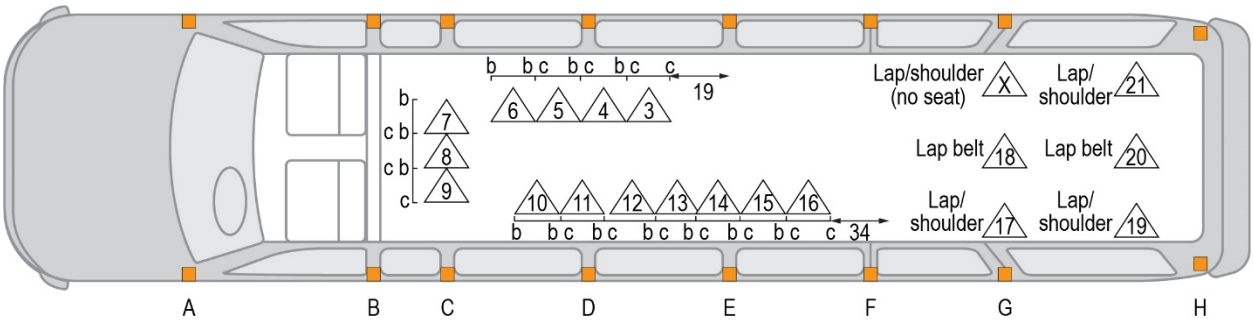

Figure 25: Limousine passenger cabin seat belt anchor points, with a “b” and “c” designating buckle and connector respectively for the stretch seating. (The buckles for the rear OEM seats were on the interior side for seats 17, 19, 21, and on the right side for seats 18 and 20.)

Table 6: Passenger Cabin Seat Belt Anchor Points, as shown in Figure 20.

Aft Facing Seats			
Seat 7: 9 inches from buckle to connector			
Seat 8: 9 inches from connector to buckle			
Seat 9: 7 inches from buckle to connector			
Driver Side		**Passenger Side**	
Seat number*	Belt component	Seat number*	Belt component
10: 10 inches	Buckle	6: 11 inches	Buckle
11: 14 inches	Buckle/connector	5: 20 inches	Buckle/connector
12: 15.5 inches	Buckle/connector	4: 13 inches	Buckle/connector
13: 5.75 inches	Buckle/connector	3: 10 inches	Connector
14: 20.25 inches	Buckle/connector		
15: 11.5 inches	Buckle/connector		
16: 13.5 inches	connector		
OEM Seat belts (dimensions given in following section)			
Seat 17: lap/shoulder belt with anchor on driver side G pillar			
Seat 18: lap belt with anchors on seat			
X (no seat): lap/shoulder belt with anchor on passenger side G pillar			
Seat 19: lap/shoulder belt with anchor above rear driver side window			
Seat 20: lap belt with anchors on seat			
Seat 21: lap/shoulder belt with anchor above rear passenger side window			

*Number next to seat position represents distance between the anchors.

The seat belt sets were used to approximate the maximum seat placements on each seat, and then the belt configurations that would line up with the occupants are illustrated in Figure 26. The width of the seat placements using this method was 15.5 inches, 13.8 inches, and 16.25 inches for the aft-facing, driver-side lateral, and passenger-side lateral, respectively.

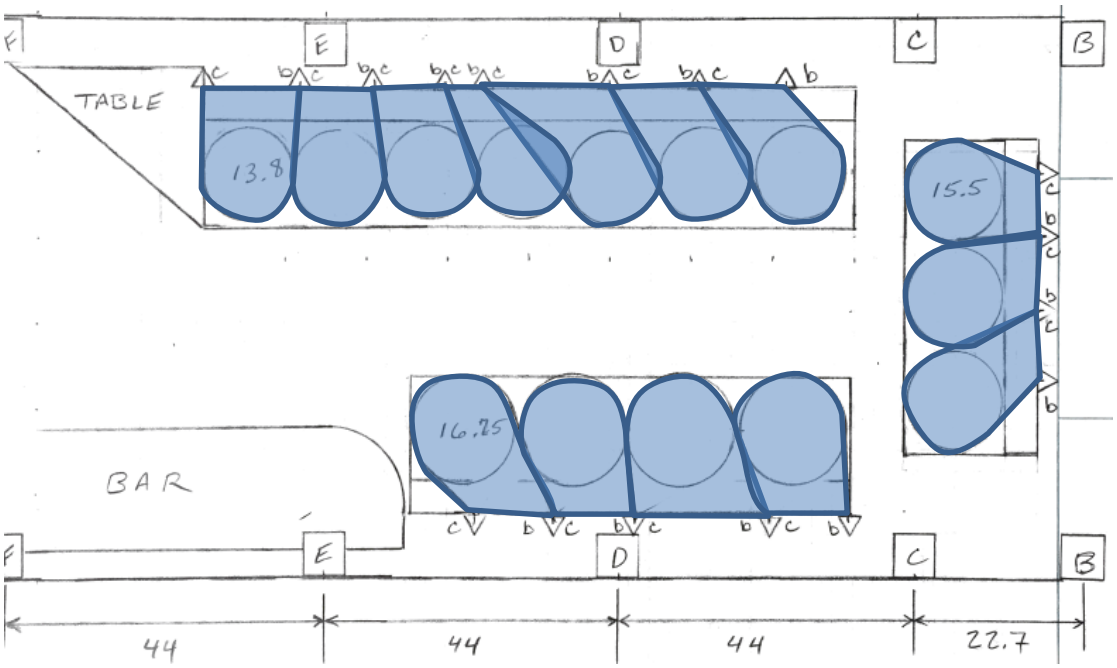

Figure 26: Perimeter seating layout with seat belt anchor locations and approximated body positions for restrained passengers. (Note that the figure is oriented with the front of the limousine to the right.)

OEM seats and belts

There were 2 rows of OEM seats at the back. The forward row, which was next to the rear exit doors, had the passenger side outboard seat removed to allow passengers to board and exit the limousine more easily. The outboard lap/shoulder belt for the removed seat remained attached to the G-pillar and was found in the stowed position. The rear split bench seats of the limousine were attached to the floor with steel mounting tracks and frames with 4 bolts per seat position, as shown in figure 27.[42]

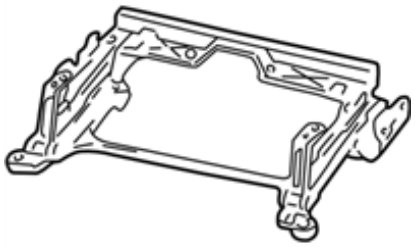

Figure 27: Rear split bench seat attachment for a 2001-2005 Ford Excursion

[42] www.fordpartsgiant.com, Ford Part No.: YC3Z-78617C25-AA.

The forward row of OEM seats (seat positions 17 and 18) had the following overall dimensions: seat cushion height was 5.5 inches, entire seat cushion width was 38 inches, seat cushion depth was 18.5 inches, and the seatback was 20 inches tall. Seat 17 (the outboard seat) had a headrest that was 10 inches wide, 4.5 inches high, and the outboard edge of the headrest was about 5 inches from the outboard edge of the seat. This seat had a lap/shoulder belt that was mounted on the left side G pillar and was in the stowed position. The buckle was 19" inches from the left outboard edge of the seat.

Seat 18 (the middle seat) had a folding insert that contained two cup holders. The seat was equipped with a lap belt. The lap belt incorporated a retractor that provided for automatic adjustment of the lap belt.[43] The buckle portion was located 16 inches from the right outboard edge of the seat. Both belts were intact and functional upon examination. The forward row of OEM seats had a seatback with a folding panel attached on the backside of the seatback (between the forward and rear row of OEM seats). This panel was 35 inches wide and 18 inches deep. This panel was described in the 2001 Ford Excursion owner's manual as a closeout panel, used to separate the cargo area from the seating area when a seat is folded down.[44]

The aft row of OEM seats (seat positions 19, 20, and 21) had the following overall dimensions: seat cushion height was 5 inches, entire seat cushion width was 47 inches, seat cushion depth was approximately 19 inches, and the seatback was 19 inches tall. The seatback was deformed into a bow shape in the forward direction. At the top edge of the seatback, the depth of the bow had a maximum indent of about 5 inches, and was located 24.5 inches from the passenger side outboard edge, as shown in Figure 27. Seat 19 (the outboard driver side seat) was equipped with a lap/shoulder belt with a D-ring that was mounted 29" aft of the left side G pillar and forward of the H pillar and was in the stowed position, as shown in Figure 28. The buckle was located 33 inches from the passenger side outboard edge of the seat (right side wall).

Figure 28: Limousine OEM seat position 19 D-ring location between G and H pillar.

[43] See SF Attachment: 2001 Ford Excursion Owner's Manual, page 103.
[44] See SF Attachment: 2001 Ford Excursion Owner's Manual, page 91.

Seat 20 (the middle seat) was equipped with a lap belt with a manual tightening mechanism. The connector portion included approximately 39 inches of webbing and the buckle was mounted 16 inches from the passenger side outboard edge of the seat.

Seat 21 (the outboard passenger side seat) was equipped with a lap/shoulder belt with a D-ring that that was mounted 29" aft of the right side G pillar and forward of the H pillar and was found in the stowed position. The buckle was 16 inches from the passenger side outboard edge of the seat.

3.2. 2015 Toyota Highlander Sport Utility Vehicle (SUV)

Inspection of the 2015 Toyota Highlander is pending. It was a private vehicle and had been parked in the lot of the Apple Barrel County Store, located at 115-NY 30A, Schoharie, NY 12157 at the time of the crash. The SUV was blue in color and had a VIN: 5TDJKRFH0FS1XXXXX and a GVWR of 4,358 lbs. It was registered in the State of NY with a valid passenger car license plate.

4. Law Enforcement Information

4.1. New York State Police Department (NYSP)

The New York State Police had jurisdiction for investigating the crash. The NYSP event history report for this crash event 18-056075 was obtained.[45] The first 911 call was taken at 1:57 p.m. and the event history was closed at 10 p.m. The report noted that the call was initiated by a private individual via a 911 call. The report provided information that unit 3G46 was enroute at 1:58 p.m. No information of other responding units or event timing was included in the event history.

4.2. Schoharie County Sheriff's Office (SCSO)

The Schoharie County Sheriff's Office had primary jurisdiction for responding to the crash. Information was obtained through the Schoharie County Office of Emergency Services.

4.3. Schoharie County Sheriff's Office of Emergency Services (SCOES)

The Schoharie County Office of Emergency Services was the umbrella organization for the Schoharie County Public Service Answering Point (PSAP) and emergency dispatch for sheriff, fire/rescue, and Emergency Management Services (EMS). The EMS contact point and the county paramedic on scene were employed by SCOES.

The Schoharie County Computer Aided Dispatch (CAD) Incident Detail Report for incident 2018-00013197 was obtained.[46] The incident was created by an incoming 911 call reporting a serious motor vehicle accident at 1:55 p.m. The first units were dispatched and enroute at 1:56 p.m. and the first arrived at 1:59 p.m. The incident was closed on October 7, 2018 at 4:50 a.m. A group interview with representatives from the SCOES was conducted and the interview notes are provided in the SF Attachment.[47]

[45] Attachment: NYSP Event History Report.
[46] SF Attachment: SCSOES CAD Incident Detail Report
[47] SF Attachment: NTSB Interviews.

4.4. Medical Examiner and Coroner

The NYSP forensic team coordinated the autopsies of all victims with the Albany Medical Center, which were performed by the forensic pathologist Dr. Michael Sikirica, Forensic Medical Services, 50 Broad St. Waterford NY 12188. An NTSB investigator was granted access to the autopsies, and attended 4 autopsies on Monday, October 8, 2018. These included the two female passengers who were transported by EMS from the scene, a male passenger, and the limousine driver. The examination indicated that all victims died of blunt force trauma. The driver examination exhibited evidence of seat belt usage, and the passenger examinations did not.

The NTSB investigator spoke to the forensic team and asked about evidence of belt use by the passengers. Members of the forensic team indicated that other than the driver, no belts had to be cut in order to extricate victims and there was no indication of belt use by the passengers.

5. Fire/Rescue Information

The Schoharie Volunteer Fire Department had primary jurisdiction for the fire/rescue services, and additional fire departments assisted pursuant to mutual aid agreements. The event was elevated to a level D Mass Casualty Incident. The Fire Coordinator and Fire Chief for Schoharie County were interviewed about the crash.[48] The fire/rescue responders were asked about evidence of belt use by the passengers. They responded that the driver had been belted but it was difficult to determine if any passengers had been wearing belts. They noted that they had not heard of any incidents in which responders had to cut belts in order to facilitate extrications.

6. Emergency Medical Services (EMS)

The Schoharie County EMS had primary jurisdiction, and a variety of paid public, volunteer, and private EMS resources were also dispatched to the crash. Two patients were transported from the scene, and the Patient Care Reports (PCRs) were obtained. Mutual aid EMS services that responded included: Air Methods, Albany Med Flight, LifeNet of New York, STAT Flight, Esperance Volunteer Fire Department Rescue Squad, Central Bridge Fire District, Scho-Wright Ambulance Service, Schoharie County Sheriff's Department, Life Net of NY Glen.

An Advanced Life Support (ALS) paramedic from Schoharie County EMS, unit Medic 1, was dispatched and enroute at 1:58 p.m., on-scene at 2:08 p.m. The paramedic included a narrative description in the patient care report.

A brief summary of paramedic's response based on the PCR narrative report is provided here. The paramedic heard the crash alert on the radio of a 2 vehicle crash with unknown injures at 1:58 p.m., and self-dispatched. At 2:00 p.m. the severity of the incident was elevated, and he upgraded his response to lights and sirens. He arrived on scene at 2:08 p.m. and noted that there were already police, fire, and rescue apparatus on-scene. He assessed the scene and saw that rescue fire fighters were already in the process of extrication. The first victim removed from the limousine was a male, and he was placed on a backboard. The victim was being carried up to a Scho-Wright ambulance. The paramedic moved to the ambulance to meet them, and saw a

[48] SF Attachment: NTSB Interviews.

different victim on the ground near the ambulance. He quickly assessed this second victim, who was determined to be deceased.

The paramedic then assessed the male victim who had been carried to the ambulance, and determined that he was not breathing and not viable. At 2:11 p.m. he approached the limousine to assess the scene and instruct fire fighters to identify viable patients. He also requested 2 helicopters in addition to the 1 that he was aware had already been requested by the Incident Commander (IC).

He was in the process of assessing the victims, and at 2:17 p.m. a female victim was identified as potentially viable. At 2:18 p.m. this patient was extricated and prepared for transport. She was taken to a Central Bridge volunteer Basic Life Support (BLS) ambulance. She was given initial treatment and at 2:23 p.m. a Life Net crew boarded the ambulance and the patient was further treated and at 2:38 p.m. it was decided to begin transport to Cobleskill hospital by ground rather than transport by air in order to continue care that would be disrupted by movement to the helicopter. Instead, the helicopter was instructed to reposition from the on-scene landing zone to Cobleskill hospital in preparation for patient transport to a level 1trauma center. The patient arrived at Cobleskill hospital at 2:49 p.m. The helicopter arrived at Cobleskill hospital at 3:00 p.m. and the patient was off loaded from the ground ambulance to the Life Net helicopter.

The other patient was transported from the scene by Middleburgh Emergency Volunteer Ambulance Corps (MEVAC) unit 4717 and run 366. The PCR indicated that the patient was a female and deceased. The PCR noted that this unit transported the patient to Cobleskill Hospital and was enroute at 2:16 p.m., at scene at 2:26 p.m., at destination at 2:42 p.m.

7. Hospital Information

7.1. Cobleskill Regional Hospital

Two female passengers from the limousine were transported by ground ambulance to Cobleskill Regional Hospital, located at 178 Grandview Dr. Cobleskill NY, 12043. One passenger was pronounced deceased upon arrival at the hospital, and not treated at the hospital. The other patient was transferred to an air transport to Albany Medical Center upon arrival at the hospital, and not treated at the hospital.

7.2. Albany Medical Center

The female limousine passenger who was air transported from Cobleskill Regional Hospital was taken to Albany Medical Center, located at 43 New Scotland Ave, Albany, NY 12208. She was pronounced deceased at the medical center.

E. DOCKET MATERIAL

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

LIST OF ATTACHMENTS

SF Attachment: 2001 Ford Excursion Owner's Manual
SF Attachment: NHTSA Opinion Letter 10425
SF Attachment: 2001 Ford Excursion Dimensional Data
SF Attachment: NHTSA Supplemental Laboratory Test Procedure for Determining DSPs.
SF Attachment: NYSP Event History Report
SF Attachment: Schoharie County SO 911 Center CAD Incident Detail Report
SF Attachment: NTSB Interviews

END OF REPORT

Thomas Barth, Ph.D.
Senior Survival Factors Investigator / Biomechanics Engineer