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FEDERAL TRANSIT ADMINISTRATION

Bus Safety Study: A Report to Congress

NOVEMBER 2013

FTA Report No. 0051
Federal Transit Administration

PREPARED BY

Center for Urban Transportation Research
University of South Florida

U.S. Department of Transportation
Federal Transit Administration

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PREPARED BY

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Metric Conversion Table

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liter	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: volumes greater than 1000 L shall be shown in m^3				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C

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13. ABSTRACT

Section 20021(b) of the Moving Ahead for Progress for the 21st Century (MAP-21) legislation requires the Secretary of Transportation to submit a report of the results of a "Bus Safety Study" to the Committee on Banking, Housing, and Urban Affairs of the Senate and the Committee on Transportation and Infrastructure of the House of Representatives. The report's objectives are to 1) examine the safety of public transportation buses that travel on highway routes where 50 percent or more of the route is on roads having a speed limit of more than 45 miles per hour, 2) examine the laws and regulations that apply to commercial over-the-road buses (OTRBs), and 3) provide recommendations as to whether additional safety measures should be required for public transportation buses that travel on highway routes.

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ABSTRACT

Section 20021(b) of the Moving Ahead for Progress for the 21st Century (MAP-21) legislation requires the Secretary of Transportation to submit a report of the results of a "Bus Safety Study" to the Committee on Banking, Housing, and Urban Affairs of the Senate and the Committee on Transportation and Infrastructure of the House of Representatives. The report's objectives are to 1) examine the safety of public transportation buses that travel on highway routes where 50 percent or more of the route is on roads having a speed limit of more than 45 miles per hour, 2) examine the laws and regulations that apply to commercial over-the-road buses (OTRBs), and 3) provide recommendations as to whether additional safety measures should be required for public transportation buses that travel on highway routes.

DEFINITIONS

Accident – as defined in 49 Code of Federal Regulations (CFR) 390.5, an occurrence involving a commercial motor vehicle operating on a public road that results in at least one of the following:

- A fatality
- Bodily injury to a person who, as a result of the injury, immediately receives medical treatment away from the scene of the accident
- Disabling damage to one or more motor vehicles, requiring the vehicle(s) to be towed or otherwise transported from the scene by a tow truck or other vehicle

Bus – as defined in the National Transit Database (NTD), a transit mode ("motorbus" is also used) comprised of rubber-tired passenger vehicles operating on fixed routes and schedules over roadways. Vehicles are powered by diesel, gasoline, battery, or alternative fuel engines contained within the vehicle.

Bus – (developed for use in this study only) includes vehicles used in passenger operations that are 35 feet in length or greater. This would include standard public transit buses and over-the-road buses (motorcoaches), as examples.

Collision – as defined in the NTD, a vehicle accident in which there is an impact of a transit vehicle with:

- Another transit vehicle
- A non-transit vehicle
- An object
- A person(s) (suicide excluded)
- An animal
- A rail vehicle
- A vessel
- A dock

Commercial motor vehicle – as defined in 49 CFR 390.5, any self-propelled or towed motor vehicle used on a highway in interstate commerce to transport passengers or property when the vehicle:

- Has a gross vehicle weight rating or gross combination rating, or gross vehicle weight or gross combination weight, of 10,001 pounds or more, whichever is greater; or
- Is designed or used to transport more than eight passengers (including the driver) for compensation; or

- Is designed or used to transport more than 15 passengers, including the driver, and is not used to transport passengers for compensation; or
- Is used in transporting material found by the Secretary of Transportation to be hazardous and transported in a quantity requiring placarding under regulations prescribed by the Secretary under 49 CFR, subtitle B, Chapter I, subchapter C.

Crash – An event that produces injury and/or property damage, involves a motor vehicle in transport, and occurs on a trafficway or while the vehicle is still in motion after running off the trafficway. Often used in place of the terms "accident" or "collision," but does not necessarily conform to the formal definitions of those terms.

Ejection – Refers to occupants being totally or partially thrown from the vehicle as a result of an impact or rollover.

Fatality – as defined in 49 CFR 390.5, an injury that results in the death of the individual within 30 days of an accident.

For-hire motor carrier – as defined in the Federal Motor Carrier Safety Regulations, a person engaged in the transportation of goods or passengers for compensation.

Highway routes – includes public roads with posted speed limit of greater than 45 miles per hour (mph), including separated/dedicated bus lanes and bus highway routes that are operated on high occupancy vehicle (HOV) lanes and shoulders while in revenue service.

Limited-access highway – as defined in the NTD, a controlled-access road to which access from adjacent properties is limited in some way. It can mean anything from a city street, to which the maintaining authority limits driveway access, to a freeway (or other equivalent terms). The precise definition may vary by jurisdiction. Often, on these kinds of roads, low-speed vehicles and non-motorized uses including pedestrians, bicycles, and horses, are not permitted.

Major incident – as defined in the NTD, an incident that meets at least one of the following thresholds:

- A fatality (30 days or less from the collision and not due to natural causes)
- An injury requiring immediate medical assistance away from the scene
- Property damage greater than or equal to $25,000
- Evacuations due to life safety reasons

Motorcoach – a bus characterized by an elevated passenger deck located over a baggage compartment. For the purpose of this study, "motorcoach" and "over-the-road bus" are synonymous.

Over-the-road bus (OTRB) – as defined in 49 CFR 37.3 and 42 USC 12181, a bus characterized by an elevated passenger deck located over a baggage compartment. For the purpose of this study, "over-the-road bus" and "motorcoach" are synonymous.

Primary roads – as defined by the U.S. Bureau of the Census MAF/TIGER Feature Class Codes, generally divided, limited-access highways within the interstate highway system or under state management, distinguishable by the presence of interchanges. These highways are accessible by ramps and may include some tollways.

Public road – as defined in 23 CFR 460.2, a road under the jurisdiction of and maintained by a public authority and open to public travel. This would include bus fixed guideways, such as that used by bus rapid transit (BRT).

Public transportation – as defined in 49 USC 5302(1), is regular, continuing shared-ride surface transportation services that are open to the general public or open to a segment of the general public defined by age, disability, or low income (49 USC 5302(14)). Public transit, as used in this study, is synonymous with public transportation.

Public transportation bus – public transportation that is provided by transit buses, consistent with the NTD definition of bus or motorbus. The terms bus transit, public transit, and transit are synonymous with public transportation bus.

Revenue service – as defined within the NTD, the time when a vehicle is available to the general public and there is an expectation of carrying passengers.

Rollover – any vehicle rotation of 90 degrees or more about any true longitudinal or lateral axis. Includes rollovers occurring as a first harmful event or subsequent event.

Safety (developed for use in this study only) - includes injuries and fatalities used to compare public transportation and commercial over-the-road carriers for benchmarking purposes.

Safety incidents – as defined within the NTD, a collision, derailment, fire, hazardous material spill, act of nature (Act of God), evacuation, or Other Safety Occurrences Not Otherwise Classified (OSONOC) occurring on transit-controlled property and meeting established NTD thresholds.

Secondary roads – as defined by the U.S. Bureau of the Census MAF/TIGER Feature Class Codes, are main arteries, usually within the U.S. Highway, State Highway or County Highway systems. These roads have one or more lanes of traffic in each direction, may or may not be divided, and usually have at-grade intersection with many other roads and driveways. They often have both a local name and route number.

RESULTS IN BRIEF

Section 20021(b) of the Moving Ahead for Progress for the 21st Century (MAP-21) legislation requires the Secretary of Transportation to submit a report of the results of a "Bus Safety Study" to the Committee on Banking, Housing, and Urban Affairs of the Senate and the Committee on Transportation and Infrastructure of the House of Representatives. The report's objectives are to 1) examine the safety of public transportation buses that travel on highway routes where 50 percent or more of the route is on roads having a speed limit of more than 45 miles per hour, 2) examine the laws and regulations that apply to commercial over-the-road buses[1] (OTRBs), and 3) provide recommendations as to whether additional safety measures should be required for public transportation buses that travel on highway routes.

Methodology

This study analyzed the safety of public transit buses and OTRBs based on a review of accidents that resulted in injuries and fatalities when public transit buses (35 feet or more in length; may include OTRBs used in public transit service) were traveling on "highway routes" (routes on which 50% or more of the route is provided on a roadway with a speed limit of greater than 45 mph). This study focused on those incidents for which vehicle systems or components, preventive maintenance or vehicle inspections, or other vehicle-related issues were identified as contributing factors for those events. The study does not evaluate events attributed to human factors, such as those resulting from driver error or fatigue, as examples.

The report includes a summary of national statistics regarding injuries and fatalities involving public transit buses and OTRBs. This perspective is supplemented by a more thorough review and analysis of bus safety incidents in nine specific corridors served by both public transit buses and commercial OTRBs (primarily used in motorcoach and tour operations). The use of this sample allowed the collection of data for detailed injury and collision events through the review of police accident reports and narrative provided by transit agencies through their National Transit Database (NTD) reporting. The corridors selected are served by transit agencies of varying sizes and are geographically dispersed.

Prevalence of Transit Service on Highway Routes

The MAP-21 study requirement specifies an analysis of public transit buses operating on highway routes. However, identification of a national road network with posted speed limits above 45 mph is not available, nor are national safety statistics regarding transit buses operating on highway routes. Multiple datasets

[1]A bus characterized by an elevated passenger deck located over a baggage compartment.

were considered to identify high-speed roadways, including the Federal Highway Administration's (FHWA) Highway Performance Monitoring System (HPMS), which contains information on all public roads for arterial and collector functional systems; United States Census TIGER files, which contain all street centerlines with categories for primary and secondary roads; and the Bureau of Transportation Statistics Highway file. After close consideration, the study team chose to use the TIGER dataset and the MAF/TIGER Feature Class Code (MTFCC)[2] to identify high-speed roads.

Fixed-route schedule data from a sample of 69 transit agencies were analyzed to determine the prevalence of public transit service on high-speed roadways. Using those roads categorized as "primary roads" as defined by the U.S. Census,[3] the analysis determined that 385 routes (17%) and more than 118,000 of total scheduled route miles (3%) operated by these transit agencies were provided on primary roads.

Comparison of OTRB and Public Transit Using National Statistics

OTRB and public transit services generally operate under very different environments and conditions. The amount of public transit services provided on high-speed roads represents a far smaller proportion of total mileage than that of OTRB. As an industry, the majority of public transit bus service is operated over much shorter distances with frequent stops for passenger boarding and alighting. Public transit service operated on high-speed roadways occurs primarily during peak hour conditions on facilities with capacity constraints and congestion, resulting in lower operating speeds (often characterized as commuter or express routes). These differences are reflected in the safety data presented for both industries.

Public Transit Safety

Table 1 provides national public transit safety data statistics for NTD Reporting Years 2008 – 2012.

Collisions comprise most of the major safety incidents reported in the NTD (when "other safety occurrences" are not considered). Collisions on limited-access highways, the proxy for highway routes, ranged from 42 to 53 over the study period, totaling 243 for all 5 years and representing just 1.5 percent of all collisions. There were 241 injuries to bus passengers or bus operators over the 5 years from 2008 to 2012, ranging from 43 to 63 each year. These injuries represent just 1.1 percent of all injuries from collisions. During the reporting

[2]MAF/TIGER refers to US Bureau of the Census Master Address File/Topologically Integrated Geographic Encoding and Referencing.

[3]Primary Roads, as defined by the US Bureau of the Census, MAF/TIGER Feature Class Codes, are generally divided, limited-access highways within the interstate highway system or under state management and are distinguished by the presence of interchanges. They are accessible by ramps and may include some toll highways.

period, there was only one fatality reported nationally that was the result of a collision on a limited-access highway. The accident occurred in 2011 in Houston and resulted in the death of the bus driver. Neither vehicle defects nor vehicle-related conditions were indicated as causal or contributing factors in the narrative provided in the NTD report.

Table 1

Public Transit Safety, 2008–2012[1]

Bus Totals	2008	2009	2010	2011	2012
All Safety Incidents[2]	11,222	12,058	11,070	9,083	6,981[5]
Safety Incidents Less "Other Safety Occurrences"	3,490	3,425	3,472	3,530	3,302
Collision Incidents	3,130	3,120	3,207	3,248	3,110
Injuries to Bus Occupants from Collision Incidents[3]	4,197	4,230	4,611	4,832	4,834
Fatalities to Bus Occupants from Collision Incidents[3]	4	1	0	6	4
Collision Incidents on "Limited-Access Highways"[4]	42	53	50	52	46
Injuries to Bus Occupants from Collisions on "Limited-Access Highways"[3,4]	43	45	44	63	46
Fatalities to Bus Occupants from Collisions on "Limited-Access Highways"[3,4]	0	0	0	1	0

[1]Data from NTD for years specified; includes directly-operated and purchased motorbus services.

[2]Includes collisions, fires, hazardous material spills, weather/natural disaster related incidents, and "other safety occurrences not classified." No NTD security incidents (i.e., public safety incidents) are included in these data.

[3]Injuries and fatalities to persons on transit vehicle only, passengers and/or operator.

[4]"Limited-Access Highway" as defined in the NTD. Also includes incidents found to be on high-speed roadways such as interstates that were classified as "divided highway" or "ramp."

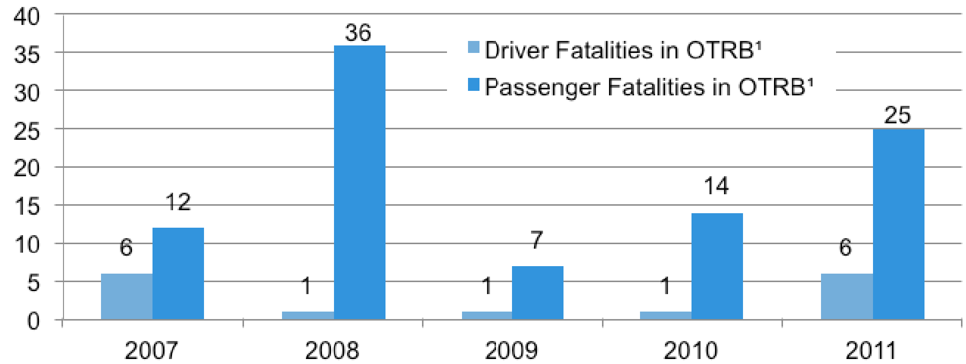
[5]Data in this cell are through October 2012 only. The remaining 2012 data are through December 2012.

Over-The-Road Bus Safety

Figure 1 illustrates driver and passenger fatalities that occurred while OTRBs were operating on high-speed roadways. Figure 2 illustrates the number of crashes and vehicle events for OTRB that correspond to the fatalities in Figure 1. These do not include any OTRB crashes that occurred while operating public transit services.

Figure 1

OTRB Driver and Passenger Fatalities on High Speed Roadways[2]

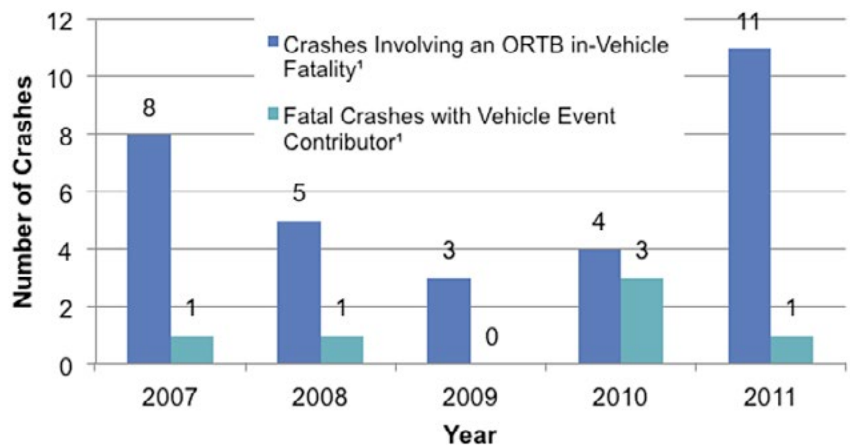


[1]Data from National Highway Traffic Safety Administration's (NHTSA) Fatality Analysis Reporting System (FARS) database for years specified. NTD was used to exclude those fatalities that occurred on OTRBs while in public transit service.

[2]High speed roadway defined as location where speed limit is greater than 45 mph.

Figure 2

OTRB Crashes and Vehicle Events on High Speed Roadways[2]



[1]Data from NHTSA's Fatality Analysis Reporting System (FARS) database for years specified. NTD was used to exclude those fatalities that occurred on OTRBs while in public transit service.

[2]High speed roadway defined as location where speed limit is greater than 45 mph.

During the study period, OTRB fatalities peaked in 2008, in large part due to a single crash involving 17 fatalities, which accounted for nearly half of the total OTRB fatalities for the entire year.[4] In 2007, driver fatalities represented one third of the total for the year (driver fatalities typically represent a much smaller proportion of total fatalities than in 2007). In 2011, there were 11 crashes that resulted in fatalities, with one crash resulting in 15 of the 31 total fatalities that year.

Figure 3 identifies the number of non-fatal injury accidents and corresponding injured persons, as reported by OTRB carriers for 2007 through 2010.

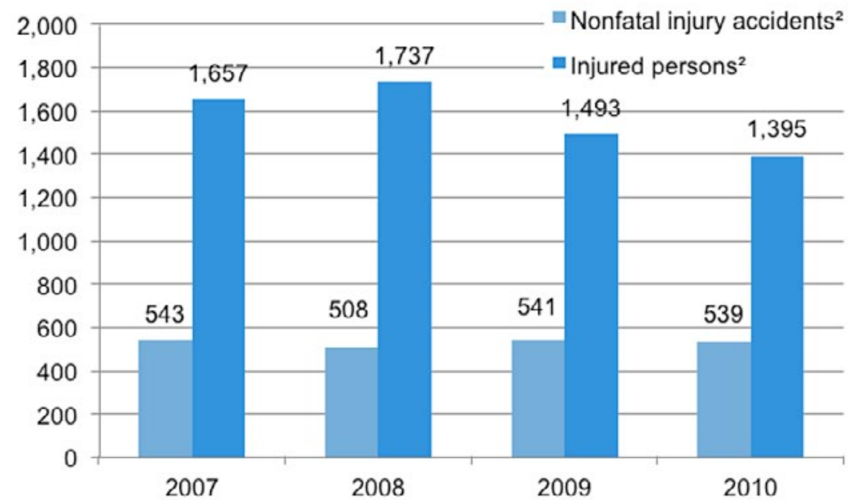
Non-fatal injury accidents showed little fluctuation over the study period, from a high of 543 non-fatal injury accidents in 2007 to 508 in 2008. There was

[4]The crash of a charter motorcoach that occurred near Sherman, Texas, on August 8, 2008.

significant variation in the number of persons injured in those events, from a high of 1,737 injured persons in 2008 to 1,395 injured persons in 2010. The data suggest randomness of events and resultant injuries, not attributable to any noticeable trends.

Figure 3

OTRB Carrier[1] Reported Total Non-Fatal Injury Accidents and Injured Persons



[1]OTRB/motorcoach carriers only; does not include vehicles operated by transit agencies.

[2]Motor Carrier Management Information System (MCMIS) summary data as cited in NTSB's *Report on Curbside Motorcoach Safety*; includes all persons injured in or outside a vehicle at the scene of the crash who were transported to a medical facility for immediate medical attention.

Table 2 provides a comparison of fatalities that occurred on OTRBs and transit buses for 2007 through 2010. The data are presented in units of service that include passenger trips, passenger miles, and revenue service miles, as described below.

Table 2

Fatalities per Unit of Service in OTRB and Transit, 2007- 2010

	2007		2008		2009		2010	
	OTRB[1]	Transit[2]	OTRB[1]	Transit[2]	OTRB[1]	Transit[2]	OTRB[1]	Transit[2]
Per 100 Million Passenger Trips[3]	2.40	0.11	4.99	0.07	1.24	0.02	2.16	0.00
Per 100 Million Passenger Miles[3]	0.03	0.03	0.06	0.02	0.02	0.004	0.02	0.00
Per 100 Million Revenue Service Miles[3]	1.00	0.31	2.08	0.20	0.52	0.05	0.67	0.00

[1]From FARS on all roadways national; does not include OTRBs providing public transit services.

[2]From NTD on all roadways nationally; includes OTRBs used in providing public transit services.

[3]From NTD and ABA Motorcoach Census Years 2007 through 2010.

Fatalities occurring on OTRBs significantly outpace fatalities on transit buses when normalized for the amount of service provided by each industry annually. There were 80 OTRB and 11 transit bus fatalities for the entire 4-year period. OTRB and transit bus fatalities are somewhat similar in the number of fatalities per passenger trip. However, these values can be somewhat misleading. While the number of total revenue service miles provided by each of the two modes is comparable, the number of passenger trips provided by transit greatly exceeds those provided by OTRBs. This is primarily due to the average passenger trip length. For the year 2010, OTRB average passenger trip length was almost 110 miles; for transit, it was approximately 4 miles.

Consistent with the scope of this study, the study team focused only on vehicle-related contributing factors indicated in accidents that resulted in injuries or fatalities within both modes. Table 3 illustrates the prevalence of vehicle-related factors in OTRB crashes as indicated in NHTSA's FARS and Federal Motor Carrier Safety Administration (FMCSA)/National Highway Traffic Safety Administration's (NHTSA) *Bus Crash Causation Study (BCCS)*.[5] Figure 4 illustrates vehicle-related crash factors that were not necessarily associated with fatalities or injuries.

Table 3

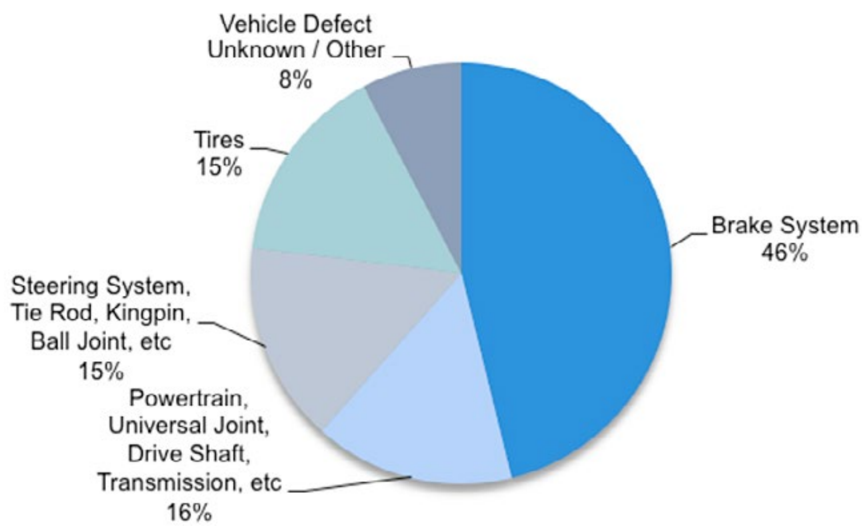
Vehicle-Related Factors Indicated in Crashes

Root causes of NTSB OTRB Investigated Crashes Identified as Vehicle Condition[1]	FARS Fatal OTRB Crashes Cited a Vehicle-Related Factor[2]	BCCS Injury and Fatality Crashes Cited a Vehicle Failure[3]
13%	19%	12%

[1]U.S. DOT Motorcoach Safety Plan 2012.
[2]From 2007-2011 on roadways of 45mph or higher, 31-crash sample.
[3]2009 FMCSA/NHTSA Bus Crash Causation Study.

Figure 4

GES Sample of OTRB Crashes with Vehicle-Related/Contributing Factors[1]



[1]From NHTSA's General Estimates System (2007-2011); includes only OTRB crashes.

[5]Federal Motor Carrier Safety Administration, Office of Analysis Research and Technology, Bus Crash Causation Study. Publication No. FMCSA-RRA—10-003, January 2010.

Bus Safety Study Corridors

To conduct a more meaningful analysis than that afforded through the examination of aggregated national data, this study focuses on the safety of OTRB and public transit systems operating within nine specific corridors (i.e., interstate or other limited-access facilities). Figure 5 identifies the location of each corridor studied and the transit agencies operating within those corridors. Table 4 provides safety information totals for those transit systems.

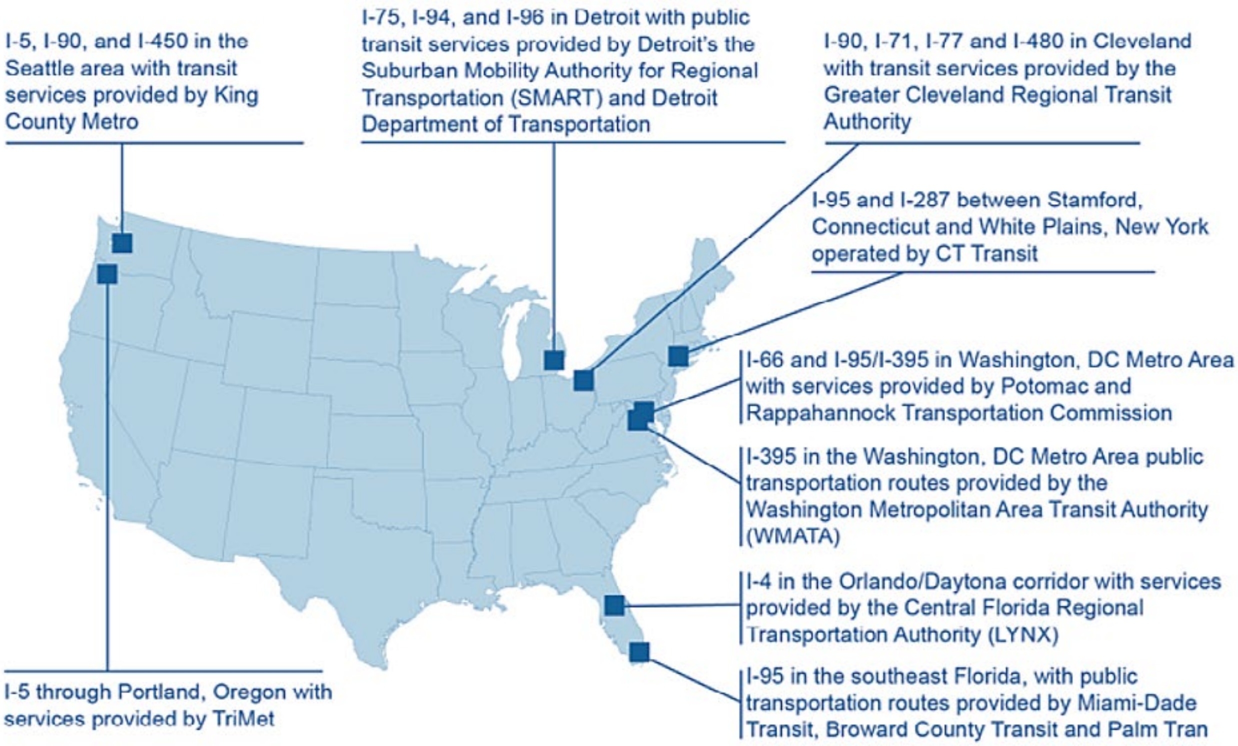


Figure 5

Study Corridors

Table 4

NTD Motorbus Safety Information Totals for Transit Systems Included in the Study, 2008–2012[1]

Bus Totals	2008	2009	2010	2011	2012
All Safety Incidents (less "Other Safety Occurrences")[2]	565	523	510	597	540
Collision Incidents	530	489	480	571	499
Collision Incidents per 1 Million Revenue Miles[3]	2.38	2.23	2.31	2.78	n/a
Injuries to Bus Occupants from Collision Incidents[4]	620	702	716	904	721
Injuries to Bus Occupants per 1 Million Revenue Miles[3]	2.78	3.20	3.44	4.38	n/a
Fatalities to Bus Occupants from Collision Incidents[4]	3	0	0	1	1
Fatalities to Bus Occupants per 1 Million Revenue Miles	0.01	0	0	0.004	n/a
Collision Incidents on Identified Highway Corridors[5]	10	9	12	10	7
Injuries to Bus Occupants from Collisions on Identified Highway Corridors[4,5]	15	8	10	2	4
Fatalities to Bus Occupants from Collisions on Identified Highway Corridors[4,5]	0	0	0	0	0

[1]Data from NTD for years specified; includes directly-operated and purchased motorbus services.

[2]Safety incidents include collisions, fires, hazardous material spills, and weather/natural disaster related incidents (no NTD security incidents, i.e., public safety incidents, are included in these data).

[3]NTD service supply data are not yet available for 2012.

[4]Injuries and fatalities to persons on the transit vehicle only, passengers and/or operator.

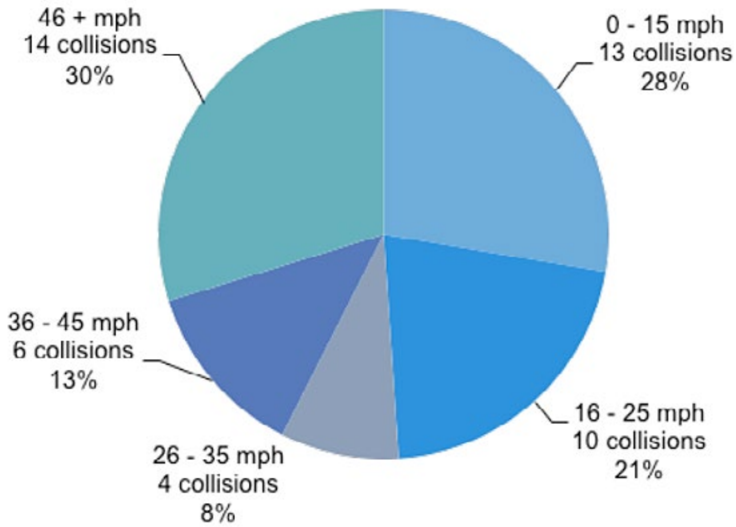
NOTE: Available data were not sufficient to estimate revenue miles for portions of routes operating on identified corridors.

Of the 48 total collisions found on the identified highway corridors, more than half (27 collisions or 56%) resulted in no injuries to the passengers or the bus operator. Nine of the collisions resulted in injuries to the bus operator only, with no passenger injuries. Further review of NTD data and other information for each collision determined that none resulted from a vehicle system failure or defect. Two of the 48 collisions involved OTRBs operating in contracted public transit service; the remaining 46 involved regular transit buses in directly-operated public transit service.

Figure 6 shows the speeds at which the collisions occurred. Whereas all of these 48 collisions occurred on the highway corridors sampled for this study, only 14 occurred at speeds of greater than 45 miles per hour. Thirteen collisions occurred at speeds of 15 miles per hour or less, or when the vehicle was stopped in traffic. These data indicate that the majority of the collisions within these highway corridors did not occur at normal highway speeds. One reason for this could be that transit buses are typically operating service within these corridors during peak periods when traffic congestion is higher than during other times of the day.

Figure 6

NTD Motorbus Collision Speed Information Totals for Transit Systems Included in the Study, 2008–2012[1]



[1]Data from NTD for years specified; includes directly-operated and purchased motorbus services, for collisions on identified corridors for this study. Speeds listed are estimated. One collision did not have estimated speed information in its reports.

Table 5 identifies safety information totals for OTRBs extracted from the crash databases for states within which the study corridors are located. As illustrated, there were no injuries or fatalities associated with those OTRB crashes with vehicle-related contributing factors.

Table 5

OTRB State Crash Database Safety Information Totals, 2007–2012[1]

Year	2007	2008	2009	2010	2011	2012
Total OTRB Crashes on Identified Highway Corridors	10	36	36	22	23	10
OTRB Injury Crashes on Identified Highway Corridors	1	4	5	3	2	1
OTRB Injuries from Crashes on Identified Highway Corridors	1	62[2]	23	3	2	1
OTRB Fatalities from Crashes on Identified Highway Corridors	0	0	0	0	0	0
OTRB Vehicle-related or Contributing Factor Crashes on Identified Highway Corridors	0	0	0	2	0	1
OTRB Vehicle-related or Contributing Factors Cited in Crashes	0	0	0	Vehicle Fire Driveshaft	0	Motor Trouble

[1]Assembled from eight of the nine states that maintain crash records for the study corridors; not every state was able to provide five years of crash records.

[2]Includes one crash in Florida with 42 injuries on an OTRB not in public transit service.

The corridor-focused examination of collisions and crashes for OTRB and transit buses that resulted in injuries and fatalities reinforced two findings: 1) catastrophic events drive the large number of OTRB

injuries, both on the national level and within the study corridors; and 2) vehicle issues continue to be present in OTRB crashes (although they comprise a small percentage of contributing factors overall, with human error appearing to be the most prevalent), while none were present in the bus transit incidents reviewed.

Review of Safety Literature

This study included a review of National Transportation Safety Board (NTSB) Highway Accident Reports (HARs), National Highway Traffic Safety Administration (NHTSA) Special Crash Investigations (SCIs), and other research reports and technical papers prepared for NTSB, NHTSA, and FMCSA.

NTSB HARs and research reports focused on occupant crash protection and bus rollovers/structural integrity-related findings. Those crashes documented in the NTSB HARs were the impetus for research and rulemaking activities underway to improve OTRB safety in the areas of passenger securement, window glazing and retention, stability control, and rollover structural integrity standards. SCIs and other NHTSA reports focused on these topics as well as on fire safety and emergency evacuation. FMCSA established a list of safety-improvement target areas that included crash avoidance measures, occupant protection, and vehicle maintenance, as well as a number of targets associated with human elements involved in crashes.

Review of Laws, Regulations, and Standards

This included the review of regulations that address both vehicle design (e.g., the Federal Motor Vehicle Safety Standards, FMVSS) and vehicle operations (e.g., the Federal Motor Carrier Safety Regulations, FMCSR). Any laws or regulations from states within which the study corridors are located that establish standards or minimum operating criteria for either OTRBs or public transportation systems were also included in this review. In addition, the review included industry developed voluntary bus safety standards, as well as standards and practices developed by accredited standards development organizations (SDOs).

Findings

MAP-21 requires that this study include "... recommendations as to whether additional safety measures should be required for public transportation buses that travel on highway routes." **The analysis of information regarding injuries and fatalities of occupants of transit buses did not disclose any basis for requiring additional safety measures be observed when transit buses are carrying passengers over highway routes.**

NHTSA's proposed regulations on electronic stability control systems and occupant protection place great emphasis on rollovers and prevention of passenger ejections. The review of data and associated literature (including

NTSB and SCI reports) indicate that catastrophic OTRB accidents and associated injuries and fatalities are linked to rollover events. These rollover events often result in passenger ejections and partial ejections. Some also produce a reduction in survivable space within the vehicle due to roof collapse (a proposed rulemaking for motorcoach structural integrity is under development).

An analysis of FARS data conducted by NHTSA identified 54 OTRB crashes resulting in 186 fatalities. Of these fatal accidents, 24 were rollover events that accounted for 97 fatalities (53% of all occupant fatalities); 76 percent of the fatalities in these rollover events were passengers who were ejected. Due to the operation of public transit vehicles primarily occurring with frequent stopping and within constrained, congested roadways, the average speeds of these vehicles do not generally provide the conditions necessary to generate rollover events. The analysis of the schedule data of 69 transit agencies showed that only 3 percent of all fixed-route miles were operated on the interstate system. A search of FARS data focused on those events that resulted in rollovers illustrated this difference in operating environments. Table 6 compares OTRB and transit bus in the areas of total fatalities, fatalities in rollover events, and fatalities involving passenger ejections or partial ejections in those rollovers.

Table 6

Fatalities in Rollovers and Corresponding Passenger Ejections/Partial Ejections, OTRB and Transit, 2007–2011[1]

	OTRB	Transit Bus
Total Fatalities	108	1
Fatalities in Rollover Events	84	0
Fatalities in Rollovers Involving Ejections/Partial Ejections	41 (38 ejections & 3 partial ejections)	0

[1]Includes only those crashes that occurred on high speed roadways and operating in service as defined in this study.

Source: FARS

For public transit systems that do operate on highway routes, there are no data to suggest that rollovers and passenger ejections are problematic.

The data compiled for this study present no direct correlation between the operation of public transit bus services on highway routes and an increase in injuries and fatalities of transit passengers. There is no evidence to suggest that public transit service operated on highway routes provides a higher level of risk that could lead to severe injuries or fatalities.

In summary, there are different operational characteristics of OTRBs and transit, including the percent of service operating on highway routes, average trip lengths, average vehicle speed, and vehicle chassis types. In addition, there are significant differences in fatalities and injuries, particularly those resulting from rollovers and ejections. As a result, the conclusions do not include safety improvements related to passenger restraints, electronic stability control, window glazing, or others that are designed to mitigate injuries and fatalities in rollover or loss-of-control events.

Also considered in this study were incidents in which vehicle systems or vehicle components were indicated as causal or contributing factors to the event. Vehicle contributing factors to crashes represented a small portion of overall crash contributing factors in OTRBs, representing less than 20 percent in each of three analyses cited in this report. The review of transit data revealed no collisions attributed to vehicle system or vehicle component failures.

Conclusions

The following conclusions are based on the collection and analysis of transit bus and OTRB safety data, the review of relevant regulations, standards, and industry recommended practices, and a review of available literature. The study conclusions are provided below.

Conclusion 1: Federal Regulations and Standards

The examination of the existing FMCSR and those FMVSS applicable to public transit buses, and the analysis conducted for this study do not provide sufficient evidence to suggest that the existing regulations and standards be modified to require them for public transit operating on highway routes. However, NHTSA's rulemakings are considering upgraded FMVSSs for OTRBs (including those used in the provision of public transit services), and the agency will be analyzing various factors in deciding how to move forward with its proposed modifications to the FMVSS. FMCSRs are contained within Parts 390-399 of Title 49 of the Code of Federal Regulations, Transportation. These regulations apply to commercial motor vehicles and their operators that transport property or passengers in interstate commerce. Public transit agencies may observe these regulations, but they are not required to do so. FMVSS are regulations that apply to the manufacture and sale of new vehicles or equipment, and reflect minimum safety performance requirements. NHTSA's rulemaking activities including the proposed revisions to FMVSSs, such as those regarding electronic stability control, and lap and shoulder belts for passenger seats, in general exempt public transit.

Conclusion 2: State Laws and Regulations

Based on the examination of state laws and regulations, an expanded, comprehensive review of regulations and standards developed by all states is warranted. The findings of this examination should be used in the development of national transit bus safety standards and vehicle safety performance measures. The review of state laws and regulations for those states within which the study corridors are located resulted in the identification of a number of states that have developed standards related to vehicle systems and equipment, inspection, maintenance, training, and accident reporting and review. While there is variability in the application of state regulations and standards, some corridor states reviewed have comprehensive bus operational and safety standards.

Conclusion 3: Industry Standards and Recommended Practices

Based on the review of the standards and recommended practices, SDO or industry association developed standards should be used as resources in the development of national transit bus safety standards and vehicle performance measures. Accredited SDOs and industry associations have standards programs that provide recommended bus design and safety equipment requirements, and recommended practices for bus operator and maintenance training and vehicle system maintenance. Public transit agencies do apply some of these standards and practices, but there is variability in their use.

Conclusion 4: Research

Based on the data analysis and associated research conducted, further study is needed to address those incidents resulting in injuries or fatalities for which human factors are indicated as probable causes or contributing factors. In the corridor analysis conducted for this study, vehicle contributing factors represented a small portion of overall crash contributing factors in OTRBs (less than 20%), with no vehicle-related factors reported in public transit. Documented public transit bus and OTRB incidents, including those included in NTSB HARs and NHTSA SCIs reviewed as part of this study, continue to focus on the human elements involved in these events. FMCSA/NHTSA's *Bus Crash Causation Study* concluded that human errors by bus drivers, other vehicle drivers, and pedestrians or bicyclists were the critical reasons for bus crashes in 90 percent of the cases examined.[6] While the review and documentation of human elements were not included within the scope of this study, during the data and literature reviews, the majority of those causal and contributing factors examined were related to driver error, fatigue, or other human factors.

[6]Federal Motor Carrier Safety Administration, Office of Analysis Research and Technology, *Bus Crash Causation Study.* Publication No. FMCSA-RRA—10-003, January 2010.

CHAPTER

1

Introduction

In the U.S. Department of Transportation's (USDOT) *Transportation for a New Generation Strategic Plan Fiscal Years 2012-16*, improving transportation safety continues to be the agency's top priority, with a stated goal of focusing on those activities that will reduce transportation-related fatalities and injuries. In the advent of Moving Ahead for Progress for the 21st Century (MAP-21), USDOT's safety mission has been expanded, providing new authority to strengthen public transportation safety–including bus transit system safety. This authority will result in the establishment of safety standards for all transit modes and may lead to improvements in the way in which public transit buses are built, maintained, and operated. Recognizing the similarities that exist between the over-the-road bus (OTRB) and public transit bus industries and advances that continue to be made in commercial vehicle safety, there may be opportunities to improve public transit bus vehicle and operational safety through example.

Background

The Federal Transit Administration (FTA) has a statutory obligation to provide public transportation systems with the tools and resources needed to ensure the safe operation of those systems, while at the same time ensuring the safety of transit customers, transit employees, and others through transit safety regulation and legislation. Similarly, the Federal Motor Carrier Safety Administration (FMCSA) is responsible for ensuring the safe and effective operation of passenger and freight transportation in interstate commerce, including that provided by over-the-road bus. The National Highway Traffic Safety Administration (NHTSA) is responsible for reducing deaths, injuries and economic losses resulting from motor vehicle crashes. FTA, FMCSA, and NHTSA actively pursue improved safety of transportation systems. FMCSA has regulatory responsibilities over motor carriers and NHTSA has the authority to set and enforce safety performance standards for motor vehicles and motor vehicle equipment; whereas, FTA will be establishing national vehicle safety standards and performance measures for public transit systems.

These agencies also undertake significant investment in research to address the root causes of fatalities and injuries occurring on public transit systems and OTRBs and develop countermeasures to prevent them. This research covers topics of significant national focus such as driver fatigue and behavior; vehicle maintenance, vehicle operational characteristics, and associated performance standards; crash avoidance systems; and occupant safety and protection. It also includes an ongoing assessment and examination of reporting requirements for these agencies. Through the research conducted by these agencies, various regulatory and program oversight changes have been and continue to be made to improve system safety for those operating under the purview of FTA, FMCSA, and NHTSA.

Description of Bus Safety Scope

To effectively address and advance transit bus safety research and associated programs, Section 20021(b) of MAP-21 legislation requires FTA to conduct and submit the results of a "Bus Safety Study" to the Committee on Banking, Housing, and Urban Affairs of the Senate and the Committee on Transportation and Infrastructure of the House of Representatives. The objectives of this study are to 1) examine the safety of public transportation buses that travel on highway routes; 2) examine the laws and regulations that apply to commercial over-the-road buses; and 3) provide recommendations as to whether additional safety measures should be required for public transportation buses that travel on highway routes. (The statutory text from MAP-21 is provided in Appendix A).

This study analyzed the safety of public transit buses and OTRB based on a review of accidents that resulted in injuries and fatalities when public transit buses (35 feet or more in length; may include OTRBs used in public transit service) were traveling on "highway routes" (routes on which 50% or more of the route is provided on a roadway with a speed limit of greater than 45 mph). This study focused on those incidents for which vehicle systems or components, preventive maintenance or vehicle inspections, or other vehicle-related issues were identified as contributing factors for those events. The study does not evaluate events attributed to human factors, such as those resulting from driver error or fatigue, as examples.

The initial discussion includes a statement of the prevalence of public transit routes operated on highway routes identified through a scan of system websites and other resource information, coupled with the knowledge base of the study team. This was followed by general observations and the presentation of national data on injuries and fatalities that have occurred on public transit and OTRBs. These analyses established a baseline from which to begin the discussion of conclusions to support improved bus safety in the areas of vehicle systems, structural design, vehicle performance standards, maintenance, and other equipment related improvements. General observations and national injury and fatality data are presented and nine corridors across the United States were selected within which to conduct a more thorough review and analysis.

Also included within the scope of this study and provided within this report is the identification of federal laws and regulations that address vehicle design and operations. These include the Federal Motor Vehicle Safety Standards (FMVSS) and regulations issued by the FMCSA. Any state laws or regulations that establish minimum operating criteria for either OTRB or public transit are also included.

In addition, the voluntary safety standards developed by the American Public Transportation Association (APTA) that are relevant to this study are provided.

The study conclusions provide support for improved public transit safety, specifically focused on vehicle systems, maintenance, and structural design. The conclusions also identify safety areas, discovered through the accompanying analyses, requiring additional research.

The results of this review and associated analyses are provided in the sections that follow.

Methodology

Both national and corridor data were used for the OTRB and transit bus industries for the period of 2007 to 2012, with a few exceptions, as indicated in the body of this report. National baseline data were identified that allowed general observations on injuries and fatalities that have occurred on public transit and OTRBs. From this initial examination, researchers were able to frame the discussion of those conclusions that may lead to improved bus safety in the areas of vehicle systems, structural design, and other equipment. While these general observations and nationwide injury and fatality data are presented, nine corridors across the United States were selected within which to conduct a more thorough review and analysis. The nine corridors selected included the following:

- I-95 in southeast Florida
- I-395 in the Washington, DC metro area (District of Columbia and northern Virginia)
- I-4 in the Orlando/Daytona corridor, FL
- I-5 through Portland, OR
- Interstate network in the Seattle area (including I-5, I-90, and I-405)
- I-95 and I-287 between Stamford, CT and White Plains, NY
- I-66 and I-95/I-395 in the Washington, DC metro area (District of Columbia and northern Virginia)
- I-75, I-94, and I-96 in Detroit, MI
- I-90, I-71, I-77, and I-480 in Cleveland, OH

The examination of the safety of public transit buses that travel on highway routes used the safety and security data sets available from the National Transit Database (NTD). The NTD data were filtered to focus on those public transit agencies operating within the nine study corridors. The NTD data were extracted for these systems and included specific indicators of accident events as well as injuries and/or fatalities and a review of any narrative provided to identify events that occurred along the highway routes identified for those systems. Once this information was obtained and specific accidents could be identified, the study team contacted each agency in an attempt to obtain accident reports or other information prepared by the agency or the police reports, when available.

The review of OTRB accidents that resulted in injuries and/or fatalities included the examination of the following data sets:

- NHTSA Fatality Analysis Reporting System (FARS)
- NHTSA Special Crash Investigations (SCI)
- NHTSA National Automotive Sampling System (NASS)
- NHTSA NASS General Estimates System (GES)
- Motor Carrier Management Information System (MCMIS)
- State crash databases from corridor locations

Upon the completion of the review of public transit bus and motorcoach accident data, the two modes were compared. The data presented include the total injuries and fatalities by mode, accident contributing factors (when documented through either agency internal reporting or police accident reports), and any conclusions that can be made related to the conditions which led to the injuries and/or fatalities sustained in the accident. The specific causal factors and vehicle occupant safety conditions include only those related to vehicle maintenance and equipment failures (including structural failures). Causal or contributing factors discussed in this examination will not include those resulting from human factors, such as driver error or fatigue.

This study included a synthesis review of existing literature on OTRB safety for relevant discussion points. The primary documents reviewed for this effort were Highway Accident Reports (HARs) prepared by the NTSB and Special Crash Investigation (SCI) reports issued by the NHTSA. Other research documents and special reports are also discussed. The contents of the literature review are contained in Appendix B.

The research also includes an inventory and summary of the laws, regulations, and guidance documents that address and are applicable to the design and in-use operation of commercial OTRB and public transit buses at both the state and federal levels. Included within this summary are the relevant sections of the FMCSRs promulgated at 49 CFR Parts 392, 393, and 396; FMVSS (49 CFR Part 571); and any state regulations enforcing or furthering these standards or establishing separate state standards.

The final task in this effort was the development of a list of conclusions that cover the relevance and, if necessary, the need for additional safety measures for public transit buses that travel on highway routes. The conclusions provided in the final section of this report are based on the data collection and analysis activities delineated above, an examination of relevant bus safety research, and a review of federal and state rules and regulations. These conclusions also draw from "NHTSA's Approach to Motorcoach Safety" (Docket No. NHTSA-2007-28793-001), the Motorcoach Enhanced Safety Act of 2012 (incorporated into MAP-21), and other US DOT and NTSB reports.

Limitations of the Study

A summary of the study limitations is provided below; an expanded discussion is provided in Appendix C.

- Bus Safety Study data used in this report are maintained by several agencies (predominantly FTA, FMCSA and NHTSA), each with unique departmental priorities that are reflected in the types of data collected. Comparison could not be conducted between each dataset for each mode.
- OTRB injury statistics are presented from the MCMIS and are maintained as total number of injured persons in the crash among all vehicles involved in the crash. This does not allow for comparing injuries sustained by occupants of the OTRB to the injuries sustained by the transit vehicle occupants. This level of data for OTRB is unavailable.
- OTRB crash data from the study corridors are sourced from Police Accident Reports (PARs) from nine states, among which, data collection and maintenance methods vary.
- Completeness of crash records from PARs is somewhat inconsistent. In some cases, the state's scanned multi-page PARs were available for analysis, while for other states, findings were extrapolated from coded database records. In both situations, intermittent problems existed in determination of public or private bus ownership and discerning semi-truck from bus accidents.
- One of the nine states did not report and two others were able to provide only three of the five years of crash records requested for the analysis.
- In NTD's Major Incident reporting form, the location field is open-ended and information can be entered in any number of formats (e.g., Interstate 90, I-90, Route 90, East 90, EB 90, or a named facility, such as John Wayne Parkway, all of which refer to the same roadway), this made sorting by specific corridor problematic.
- The NTD Major Incident reporting form does not provide information on where in the transit vehicle an affected passenger was located or whether that passenger was sitting or standing.
- The NTD Major Incident reporting form does not provide information on the total number of passengers on board a vehicle during a collision.
- NTD Safety data do not indicate if a vehicle system failure or defect were factors in the collisions.
- While the NTD Major Incident reporting form does allow for a narrative description of each event, there is no standard format in the presentation of the data and, therefore, there is wide variation in the level of detail provided.

Public Transit Bus Safety – National

The NTD was established by the U.S. Congress to be the country's primary source for information and statistics on the transit systems that operate in the U.S. Those agencies receiving grants from FTA under the Urbanized Area Formula Program (§5307) or the Other than Urbanized Area (Rural) Formula Program (§5311) are mandated by statute to report data to the NTD. Currently, more than 660 transit providers in urbanized areas report directly to the NTD via an online reporting system. More than 1,300 additional systems operating in rural areas report to the NTD, either directly or through their state departments of transportation. NTD data are used to apportion more than $5 billion of FTA funds to agencies in urbanized areas (UZAs). According to www.ntdprogram.gov, FTA provides safety incident data to "government agencies, industry experts, academic institutions and others to develop benchmarks from performance statistics of transit systems nationwide." (Appendix D contains a condensed NTD glossary of terms relevant to this study.)

The annual NTD reports summarize transit service and safety data, and the Safety and Security portion of the reports is used in this study to capture relevant information on transit collisions. According to NTD definitions, a bus collision is reported as a "Major Safety Incident" if it meets at least one of the following thresholds:

- A fatality (30 days or less from the collision and not due to natural causes)
- An injury requiring immediate medical attention away from the scene
- Property damage greater than or equal to $25,000
- Evacuations due to life safety reasons (imminent danger)

Table 1-1 provides information on bus safety for all of the more than 660 NTD reporters for the calendar years 2008 through 2012. First, the number of all bus safety incidents is presented for each year, which encompasses collisions as well as fires, hazardous material spills, weather/natural disaster related incidents, and "other safety occurrences not classified" (no security data, i.e., public safety data, are included in these totals). Then, the number of safety incidents is narrowed to only collisions and, finally, to those collisions occurring on "limited-access highways." In the NTD, a limited-access highway is defined as a "controlled-access road to which access from adjacent properties is limited in some way. It can mean anything from a city street, to which the maintaining authority limits driveway access, to a freeway (or other equivalent terms). The precise definition may vary by jurisdiction. Often, on these kinds of roads, low-speed vehicles and non-motorized uses including pedestrians, bicycles, and horses, are not permitted." For this study, when looking at national totals, limited-access highways, as defined in the NTD, serve as a proxy for roadways with speed limits of greater than 45 mph (along with relevant incidents discovered under other classifications such as "divided highway" and "ramp"). It should be noted that the data presented in Table 1-1 can include OTRBs operating in public transit service.

Table 1-1

NTD Motorbus Safety Information Totals for All Reporting Agencies, 2008–2012[1]

Bus Totals	2008	2009	2010	2011	2012
All Safety Incidents[2]	11,222	12,058	11,070	9,083	6,981[5]
Safety Incidents Less "Other Safety Occurrences"	3,490	3,425	3,472	3,530	3,302
Collision Incidents	3,130	3,120	3,207	3,248	3,110
Injuries to Bus Occupants from Collision Incidents[3]	4,197	4,230	4,611	4,832	4,834
Fatalities to Bus Occupants from Collision Incidents[3]	4	1	0	6	4
Collision Incidents on "Limited-access Highways"[4]	**42**	**53**	**50**	**52**	**46**
Injuries to Bus Occupants from Collisions on "Limited-access Highways"[3,4]	**43**	**45**	**44**	**63**	**46**
Fatalities to Bus Occupants from Collisions on "Limited-access Highways"[3,4]	**0**	**0**	**0**	**1**	**0**

[1]Data from NTD for years specified; includes directly-operated and purchased motorbus services.

[2]Includes collisions, fires, hazardous material spills, weather/natural disaster related incidents, and "other safety occurrences not classified." No NTD security incidents (i.e., public safety incidents) are included in these data.

[3]Injuries and fatalities to persons on the transit vehicle only, passengers and/or operator.

[4]"Limited-access Highway" as defined in the N D. Also includes incidents found to be on high-speed roadways such as interstates that were classified as "divided highway" or "ramp."

[5]Data in this cell are through October 2012 only. The remaining 2012 data are through December 2012.

From Table 1-1, it can be seen that collisions comprise most of the safety incidents (not including "Other Safety Occurrences Not Classified"). Collisions on limited-access highways ranged from 42 to 52 over the years 2008 to 2012, totaling 243 for all five years, representing just 1.5 percent of all collisions. Regarding the injuries to bus passengers or bus operators, there were a total of 241 over the five years from 2008 to 2012, ranging from 43 to 63 each year. These injuries represent just 1.1 percent of all injuries from collisions. During the reporting period, there was only one bus occupant fatality from a collision on a limited-access highway, occurring in 2011. That fatal accident occurred in Houston, Texas and resulted in the death of the bus driver. Neither vehicle defects nor vehicle-related conditions were indicated as causal or contributing factors in the narrative provided in the NTD report.

OTRB Safety – National

OTRB fatalities are reported from NHTSA's FARS, which contains a census of fatal traffic crashes in the United States and Puerto Rico. FARS documents those motor vehicle crashes that have occurred on a road customarily open to the public that resulted in a fatality within 30 days of the crash.

GES data come from a nationally-representative sample of police-reported motor vehicle crashes of all types, from minor to fatal. The system began in 1988 and was created to identify traffic safety problem areas, provide a basis for regulatory and consumer initiatives, and form the basis for cost and benefit analyses of traffic safety initiatives. The information is used to estimate how many crashes of different kinds take place and what happens when they occur.

FMCSA maintains the Motor Carrier Management Information System (MCMIS). MCMIS contains information on the safety fitness of commercial motor carriers (and hazardous material shippers subject to the FMCSR and the Hazardous Materials Regulations, HMR.

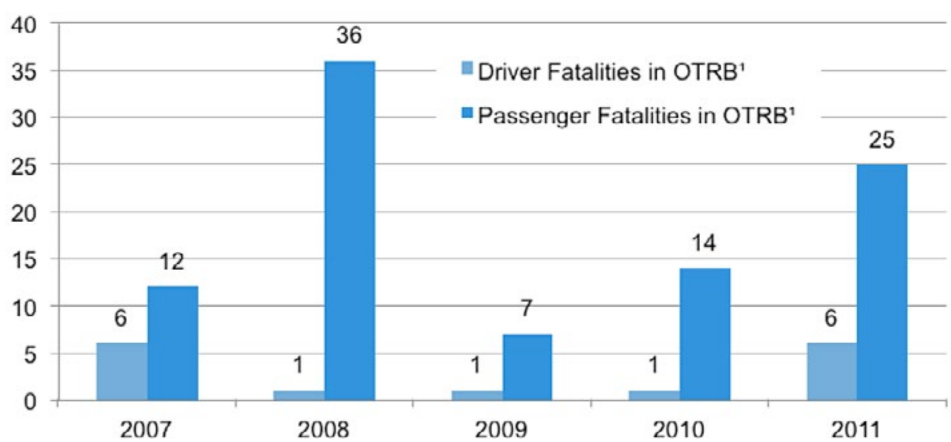
Each year, the American Bus Association commissions a Motorcoach Census, which provides key statistics in a comprehensive benchmarking of the Motorcoach Industry and provides estimates of service that document the size and activity of the motorcoach passenger transportation industry in the United States and Canada.

OTRB Fatalities, Injuries, and Levels of Service

Figure 1-1 identifies the driver and passenger fatalities that occurred while OTRBs were operating on high-speed roadways. Figure 1-2 illustrates the number of crashes and vehicle events for OTRB that correspond to the fatalities in Figure 1-1. These do not include any OTRB crashes that occurred while in public transit service.

Figure 1-1

OTRB Driver and Passenger Fatalities on High Speed Roadways[2]

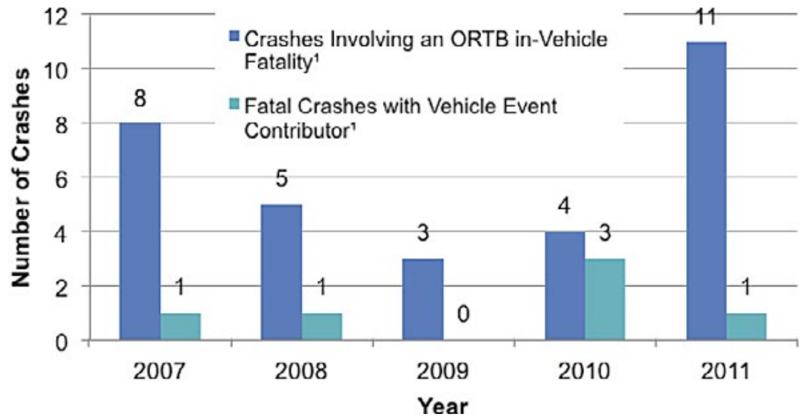


[1]Data from NHTSA's Fatality Analysis Reporting System (FARS) database for years specified. NTD was used to exclude those fatalities that occurred on OTRBs while in public transit service.

[2]High speed roadway defined as location where speed limit is greater than 45 mph.

Figure 1-2

OTRB Crashes and Vehicle Events on High Speed Roadways[2]



[1]Data from NHTSA's Fatality Analysis Reporting System (FARS) database for years specified. NTD was used to exclude those fatalities that occurred on OTRBs while in public transit service.

[2]High speed roadway defined as location where speed limit is greater than 45 mph.

During the study period, fatalities peaked in 2008, in large part due to a single crash involving 17 fatalities, which accounted for nearly half of the total OTRB for the entire year.[7] In 2007, driver fatalities represented one third of the total for the year (driver fatalities typically represent a much smaller proportion of total fatalities than in 2007). In 2011, 11 crashes resulted in fatalities, with one crash resulting in 15 of the 31 total fatalities that year. Crashes with vehicle-related factors or vehicle contributing causes were present in four of the five years in the study period. Vehicle contributing causes reached their maximum both in proportion of total crashes and in count in 2010. The Vehicle-Related and Contributing Crash Causes section below provides detail on the types of defects cited in these fatal crashes.

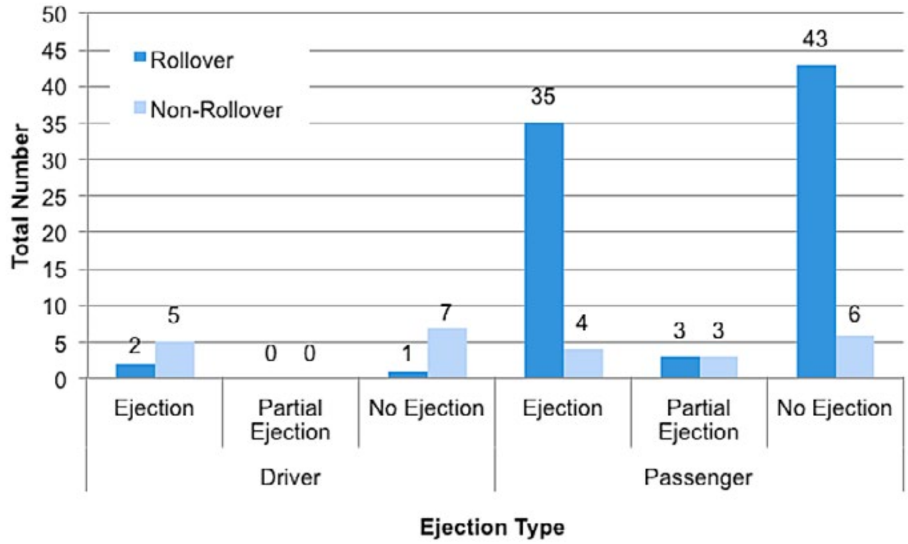
Figure 1-3 identifies fatalities related to ejections and vehicle rollovers that occurred in OTRB crashes. Figure 1-4 identifies the total OTRB non-fatal injury accidents and number of injured persons for 2007 through 2010.

Rollover crashes accounted for nearly three out of every four fatalities (73.6%) occurring in OTRB on high-speed roadways during the study period. Rollover crashes resulted in more non-ejection fatalities than ejection fatalities for OTRB passengers (43 versus 35). Driver fatalities occurred in rollover crashes a smaller percentage of the time (20%) than in non-rollover crashes, with 3 fatalities in rollover crashes and 12 in non-rollover crashes during the study period.

[7]The crash of a charter motorcoach that occurred near Sherman, Texas on August 8, 2008.

Figure 1-3

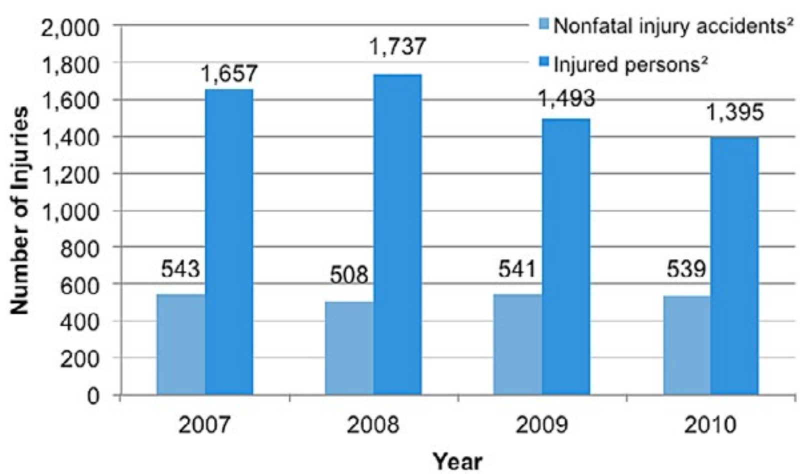
Driver and Passenger OTRB Fatalities in Ejections and Vehicle Rollovers[1]



[1]Data from NHTSA's FARS database for the study period 2007–2011.

Figure 1-4

OTRB Carrier[1] *Reported Total Non-Fatal Injury Accidents and Injured Persons*



[1]OTRB/Motorcoach carriers only, does not include vehicles operated by transit agencies.

[2]MCMIS summary data as cited in NTSB's *Report on Curbside Motorcoach Safety*, includes all persons injured in or outside a vehicle at the scene of the crash who were transported to a medical facility for immediate medical attention.

Non-fatal injury accidents showed little fluctuation over the study period, from a high of 543 non-fatal injury accidents in 2007 to 539 in 2010. There was significant variation in the number of persons injured in those events from a high of 1,737 injured persons in 2008 to 1,395 injured persons in 2010. The data suggest randomness to events and resultant injuries, not attributable to any noticeable trends.

The American Bus Association has documented the amount of service provided by the motorcoach industry in North America since 2007. The most recent census completed includes service information through the year 2010. The target population of the Motorcoach Census includes the entire OTRB transportation service industry in the United States and Canada. According to the 2007 Census, Canada was home to 8.6 percent of all motorcoach carriers and 12.6 percent of all motorcoaches in the industry.[8]

Table 1-2

U.S. OTRB Crash Fatalities and Injuries per 100 million units of Service Provided[1]

	2007	2008	2009	2010
Fatalities[1] per 100 Million OTRB Passenger Trips[3]	2.40	4.86	1.11	2.16
Fatalities[1] per 100 Million OTRB Passenger Miles[3]	0.03	0.06	0.01	0.02
Fatalities[1] per 100 Million OTRB Service Miles[2]	1.00	2.03	0.46	0.67
Injuries[2] per 100 Million OTRB Passenger Trips[3]	220.64	227.95	206.50	200.98
Injuries[2] per 100 Million OTRB Passenger Miles[3]	2.53	2.67	2.55	1.83
Injuries[2] per 100 Million OTRB Service Miles[3]	92.16	95.07	86.50	62.53

[1]From the NHTSA FARS database for years specified, limited to fatalities in OTRB vehicles on high speed roadways.

[2]MCMIS summary data from the NTSB's special study on curbside buses, all OTRB service crash involved vehicle injuries included.

[3]From the Motorcoach Census 2007-2010, includes U.S. and Canada.

According to the Motorcoach Census, average OTRB trip length was between 81.1 and 87.2 miles in years 2007 through 2009, and increased to 109.6 miles in 2010.[9]

OTRB Safety by Service Type

From the 2007 Census to its most recent year in 2010, there has been a proportional increase in the amount of fixed-route service in the OTRB industry relative to the amount of charter, tour, and sightseeing service. "Charter, tour, and fixed route services which utilize the curbside business model, have demonstrated a higher overall accident rate, higher injury and fatality rate than conventional motorcoach service."[10] Curbside providers have experienced lower vehicle maintenance out of service and unsafe driving rates than conventional providers, but higher rates of driver fatigue and driver fitness-related issues.

[8]American Bus Association Foundation, Motorcoach Census 2011 – A Benchmarking Study of the Size and Activity of the Motorcoach Industry in the United States and Canada in 2010, June 18, 2012.

[9]*Ibid*.

[10]National Transportation Safety Board, *Report on Curbside Motorcoach Safety, Special Report*, NTSB/SR-11/01, Washington, DC. 2011.

Vehicle-Related and Contributing Crash Causes

Table 1-3 illustrates the prevalence of vehicle-related factors in OTRB crashes as indicated in NHTSA's FARS and FMCSA/NHTSA's *Bus Crash Causation Study (BCCS)*.[11]

Table 1-3

Vehicle-Related Factors Indicated in Crashes

Root causes of NTSB OTRB Investigated Crashes Identified as Vehicle Condition[1] 13%	FARS Fatal OTRB Crashes Cited a Vehicle-Related Factor[2] 19%	BCCS Injury and Fatality Crashes Cited a Vehicle Failure[3] 12%

[1]U.S. DOT Motorcoach Safety Plan 2012.

[2]From 2007-2011 on roadways of 45mph or higher, 31-crash sample.

[3]2009 FMCSA/NHTSA *Bus Crash Causation Study.*

From FARS, one crash each in 2007, 2008, and 2011 cited tires as a vehicle-related or contributing factor. In three crashes that occurred in 2010, vehicle systems and equipment were cited as contributing factors in those crashes, with one case citing vehicle brakes, another citing suspension, and a third citing both brakes and suspension as contributors. It should be noted that post-crash investigations that include comprehensive vehicle system examinations may identify additional cases of vehicle-related crash factors that may not be reflected in the data above.

The 2010 Bus Crash Causation Study conducted by FMCSA and NHTSA evaluated a sample of 39 crashes in New Jersey that resulted in fatalities or incapacitating or non-incapacitating injuries.[12] Of the 39 crashes included within this study, only 3 were associated with vehicle or vehicle system failures. The investigations that occurred indicated two incidents that were the result of bus fires and one the result of failed brakes. A review of the data used in the report reveals that the three vehicle or vehicle system failures occurred in crashes on OTRBs and none of these occurred on transit buses (FMCSA-hosted data files). These three crashes resulted in five people who were emergency-transported for possible injuries.

The GES data represented in Figure 1-5 are taken from a sample of approximately 50,000 crashes annually. Brakes were the most commonly-identified vehicle-related or contributing factor in the sampled dataset. Tires were also a common vehicle-related defect cited in crash reports.[13] For commercial motor vehicles, tire deficiencies found during roadside inspections often resulted in citations for regulatory violations or caused vehicles to be taken out of service.[14]

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[11]Federal Motor Carrier Safety Administration, Office of Analysis Research and Technology, *Bus Crash Causation Study.* Publication No. FMCSA-RRA—10-003, January 2010.

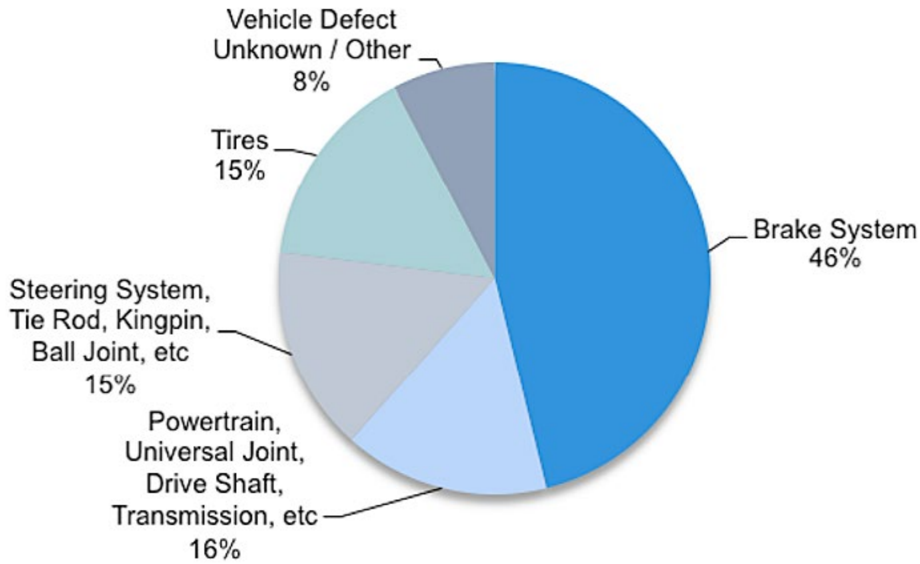
[12]*Ibid*.

[13]D. Freund and S. Brady, "Applications for Tire Pressure Monitoring and Management," Paper No. 09-0134, *Proceedings*, 21st International Technical Conference on the Enhanced Safety of Vehicles, Stuttgart, Germany, June 2009.

[14]*Ibid*.

Figure 1-5

GES Sample of OTRB Crashes with Vehicle-related/Contributing Factors[1]



[1]From NHTSA's General Estimates System (GES) 2007-2011, OTRB crashes only.

Motorcoach fires occur with an approximate frequency of 160 per year.[15] This number is relatively stable, neither trending substantially up or down during the study period through 2008. Fires originating in the engine compartment and wheel wells accounted for approximately 70 percent of all reported fires. Ninety-five percent of the reported fires from this study period resulted in no direct injuries or fatalities. Much like other motorcoach accidents, infrequent, individual events account for the majority of related injuries and fatalities.

Safety Comparisons – OTRB and Public Transit

Table 1-4 identifies the fatalities per units of service for OTRB and transit from 2007 through 2010. A limited OTRB and public transit comparison can be conducted when calculating the number of fatalities between the two services and standardizing for the amount of service provided by each industry. While not a comprehensive accounting of safety between the two bus and service types, these data can be taken forward into the evaluation of whether or not certain laws and regulation in the OTRB industry would be appropriate for public transit.

Fatalities occurring on OTRBs significantly outpace fatalities on transit buses when normalized for the amount of service provided by each industry annually. There were 80 OTRB and 11 transit bus fatalities for the entire 4-year period. A measure where OTRB and transit bus fatalities are somewhat similar is the number of fatalities per passenger trip. However, these values can be somewhat misleading. While the number of total revenue service miles provided by each of

[15]Federal Motor Carrier Safety Administration, *Motorcoach Fire Safety Analysis*, Volpe National Transportation Systems Center, July 2009.

the two modes is comparable, the number of passenger trips provided by transit greatly exceeds those provided by OTRB. This is primarily due to the average passenger trip length. For the year 2010, OTRB average passenger trip length was almost 110 miles; for transit, it was approximately 4 miles.

Table 1-4

Fatalities per Unit of Service in OTRB and Transit, 2007–2010

	2007		2008		2009		2010	
	OTRB[1]	Transit[2]	OTRB[1]	Transit[2]	OTRB[1]	Transit[2]	OTRB[1]	Transit[2]
Per 100 Million Passenger Trips[3]	2.40	0.11	4.99	0.07	1.24	0.02	2.16	0.00
Per 100 Million Passenger Miles[3]	0.03	0.03	0.06	0.02	0.02	0.004	0.02	0.00
Per 100 Million Revenue Service Miles[3]	1.00	0.31	2.08	0.20	0.52	0.05	0.67	0.00

[1]From FARS on all roadways national; does not include OTRBs providing public transit services.

[2]From NTD on all roadways nationally; includes OTRBs used in providing public transit services.

[3]From NTD and ABA Motorcoach Census Years 2007 through 2010.

When isolating the number of fatalities to include only those occurring on high speed roadways, the difference becomes more pronounced. Once again, infrequent, yet catastrophic events account for a significant number of fatalities in OTRB.

Table 1-5

Fatalities in Rollovers and Corresponding Passenger Ejections/Partial Ejections OTRB and Transit on High Speed Roadways, 2007–2011[1]

	OTRB	Transit Bus
Total Fatalities	108	1
Fatalities in Rollover Events	84	0
Fatalities in Rollovers Involving Ejections/Partial Ejections	41 (38 ejections & 3 partial ejections)	0

[1]Includes only those crashes that occurred on high-speed roadways and operating in service as defined in this study.

The near non-existent number of transit bus fatalities compared to OTRBs can be attributed to multiple reasons. The amount of service provided on high-speed roads by OTRB represents a far greater proportion of its total mileage than transit bus. Transit bus is likely to operate a majority of its overall high-speed roadway mileage in peak hour traffic, resulting in slower operating speeds. There are also issues not covered in this study regarding rollovers and the performance of low-floor transit buses and OTRBs: in OTRBs, the passenger compartment is raised above the baggage compartment. The higher center of gravity of these vehicles makes them more prone to rollovers compared to the low-floor, low center of gravity of public transit buses.

CHAPTER

2

Examination of the Safety of Public Transit Buses that Travel on Highway Routes

To establish the prevalence of public transit bus routes that operate on "highway routes," as defined in this study, the study team performed an initial scan of public transit agencies across the U.S. The scan included a review of transit agency webpages and route maps, as well as personal knowledge of various transit agencies by the study team. In addition, calculations were made using General Transit Feed Specifications (GTFS)[16] for those agencies that openly share this data.

Using U.S. Census TIGER line files and the GTFS data from U.S. transit agencies, the study team identified and calculated the distance that transit routes operate on highway segments. Using scheduled trip information from the GTFS files, the total route miles were calculated for each agency. Figure 2-1 identifies the locations of those public transit agencies that release GTFS data and are included in this analysis.

Figure 2-1

GTFS Reporting Agencies

[16]GTFS is an open transit schedule data format that is popularly provided to Google for inclusion on Google Transit. GTFS defines a common format for public transportation schedules and associated geographic information. Each transit agency is responsible for the maintenance of its GTFS. Participation in Google Transit is voluntary.

The study team identified 243 transit agencies with GTFS data. A total of 99 of the agencies were removed due to data inconsistencies and/or the fact that the GTFS represented non-roadway modes such as commuter rail or ferry. Others were eliminated due to long processing times resulting in a final total of 70 agencies for which calculations were made.

The MAP-21 study requirement specifies an analysis of public transit buses operating on highway routes. However, identification of a national road network with posted speed limits above 45 mph is not available, nor are national safety statistics regarding transit buses operating on highway routes. Multiple datasets were considered to identify high-speed roadways, including the Federal Highway Administration's (FHWA) Highway Performance Monitoring System (HPMS), which contains information on all public roads for arterial and collector functional systems; United States Census TIGER files, which contain all street centerlines with categories for primary and secondary roads; and the Bureau of Transportation Statistics Highway file. After close consideration, the study team chose to use the TIGER dataset and the MAF/TIGER Feature Class Code (MTFCC)[17] to identify high-speed roads.

The analysis used two separate codes and conducted two separate analyses. The first analysis was based on transit routes that traveled along all roads classified as primary and secondary (MTFCC Code S1100 and S1200); definitions of these categories are included in Table 2-1. This is a much broader definition of high-speed roads. A second analysis was conducted using only primary roads. These roads do not include all high-speed roads, however. In a spot evaluation in the Tampa Bay area, the toll roads within the region were not classified as primary and, consequently, were not represented in the analysis.

Table 2-1

Census MTFCC Code Definitions

MTFCC Code	Roadway Description	Full Description
S1100	Primary Road	Primary roads generally are divided, limited-access highways within the interstate highway system or under state management, and are distinguished by the presence of interchanges. These highways are accessible by ramps and may include some toll highways.
S1200	Secondary Road	Secondary roads are main arteries, usually in the U.S. Highway, State Highway or County Highway system. These roads have one or more lanes of traffic in each direction, may or may not be divided, and usually have at-grade intersections with many other roads and driveways. They often have both a local name and a route number.

Source: U.S. Bureau of the Census, TIGER MAF/TIGER Feature Class Codes.

In the initial analysis of the TIGER road files, 2,226 transit routes were evaluated, with more than 4,193,463 route miles operated by 69 agencies. A total of 385

[17]MAF/TIGER refers to US Bureau of the Census Master Address File/Topologically Integrated Geographic Encoding and Referencing

routes (17%) and more than 118,000 (3%) scheduled route miles operate on roads classified as primary by the U.S. Census TIGER center line files. The analysis using both primary and secondary roads (MTFCC Codes S1100 and S1200) resulted in an appreciable difference in the evaluation, with 1,686 routes (75%) operating on primary and secondary roads totaling more than 1,094,000 (26%) scheduled route miles.

It is likely that the actual proportion of transit routes that fit within the definition of highway routes more closely aligns with the calculations made for primary roads. While it is possible that some of these routes may actually be classified as secondary, consistent with the example above related to toll roads, the use of secondary roads would seem to exaggerate the prevalence of transit routes operating on high speed roads. This category includes roads that usually have at-grade intersections with other roads and driveways as well as US Highways traveling through congested, urbanized areas. As such, from a national perspective and for the purpose of this study, primary roads will be used as an indicator of high speed roads.

Identification of Study Corridors

This study focuses on the safety of OTRBs and public transit systems operating within nine specific corridors (i.e., interstate or other limited-access facilities). Researchers identified and studied bus accidents (those involving OTRBs and those involving public transit buses) occurring within these corridors that resulted in injuries or fatalities to the occupants of the motorcoaches or buses. For public transit systems, the report examines only those events that occurred on highway routes. The study corridors include the following (shown in Figure 2-2):

- I-95 in southeast Florida (services provided by Miami-Dade Transit, Broward County Transit, and Palm Tran)
- I-395 in the Washington, DC metro area (services provided by the Washington Metropolitan Area Transit Authority, WMATA)
- I-4 in the Orlando/Daytona corridor (services provided by LYNX, the Central Florida Regional Transportation Authority)
- I-5 through Portland, Oregon (services provided by Tri-Met)
- Interstate network in the Seattle area (including I-5, I-90, and I-405) (services provided by King County Metro)
- I-75, I-94, and I-96 in Detroit (services provided by the SMART system and the Detroit Department of Transportation)
- I-90, I-71, I-77, and I-480 in Cleveland (express services provided by Greater Cleveland Regional Transit)
- I-95 and I-287 between Stamford, CT and White Plains, NY (services operated by CT Transit)

- I-66 and I-95/I-395 in the Washington, DC metro area (services provided by the Potomac and Rappahannock Transportation Commission)

Using U.S. Census TIGER line files and available GTFS data from transit agencies operating within the study corridors, the study team identified and calculated the distance on which these agencies have transit routes operating on highway segments. Using scheduled trip information from the GTFS files, the total route miles were calculated for each agency.

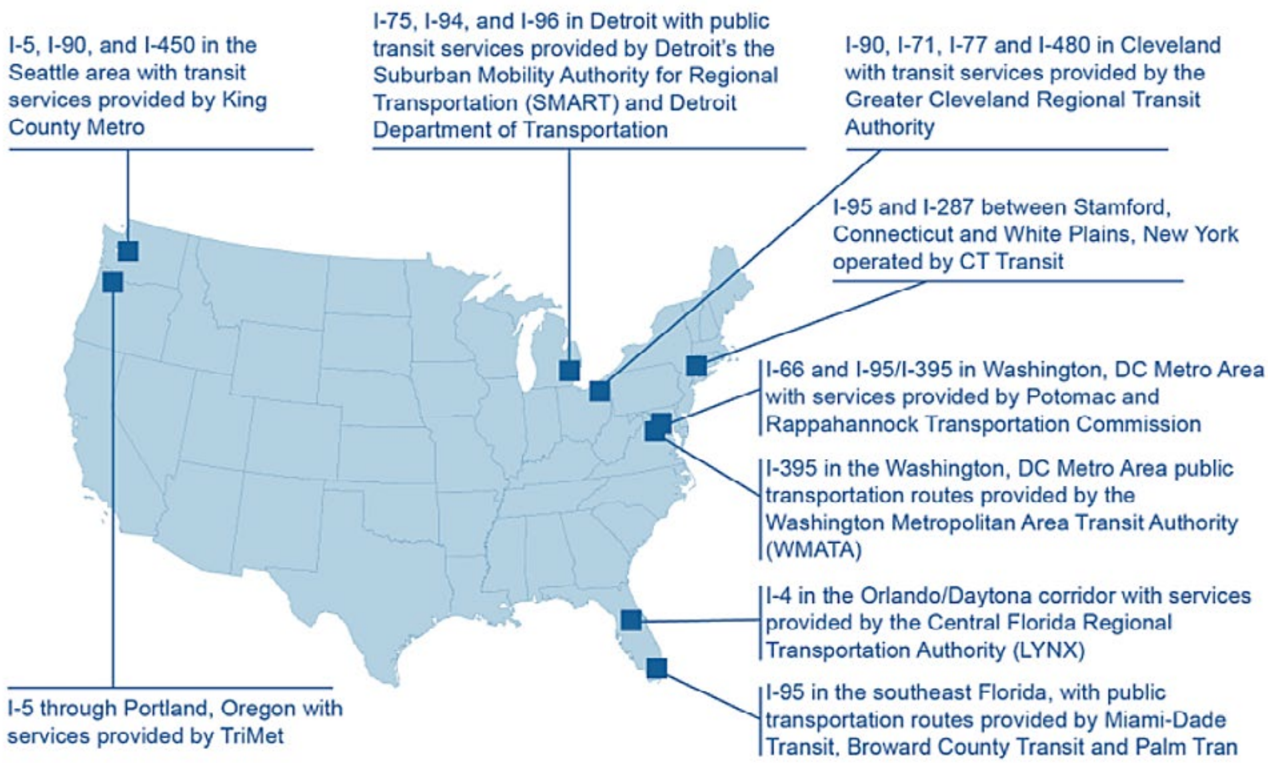


Figure 2-2
Study Corridors

A closer look at the transit agencies operating within these corridors illuminates the conditions and characteristics of high-speed transit services. It is important to note that GTFS-based analysis is only a reflection of an agency's GTFS data obtained directly from the agency or from the GTFS-Exchange, an unofficial inventory of agency GTFS files used by transit application developers. The scheduled route miles calculation is not intended to align with NTD Vehicle Revenue Miles. The analysis is based on scheduled route miles from the GTFS. Individual analysis reports are not intended to reflect any service characteristics but to serve as a broad analysis to illustrate the magnitude of the service that is scheduled to operate on "high-speed" roads. The following is an analysis of some of the transit agencies within the study corridors for which GTFS data was available. A summary of the findings is shown in Table 2-2.

Table 2-2

Summary of Analysis of Transit Agencies Operating with Study Corridors

Agency Name	Analysis	Total Routes	Routes Operating on Highway	Total Scheduled Route Miles	Total Scheduled Highway Route Miles
Broward County Transit	Primary and Secondary Roads	38	37	164,283	101,943
	Primary Roads Only		4		957
Miami-Dade Transit	Primary and Secondary Roads	100	94	219,572	87,966
	Primary Roads Only		5		3,247
Detroit Department of Transportation	Primary and Secondary Roads	74	64	136,101	30,094
	Primary Roads Only		19		409
Tri-Met	Primary and Secondary Roads	86	66	438,355	120,356
	Primary Roads Only		10		7,747

Miami-DadeTransit

Based on the analysis of Miami-Dade's GTFS file, there are 100 bus routes with 219,572 total scheduled routes miles. Only 5 of the 100 routes (5%) operate on 3,247 miles (1%) of primary roads. Using the broader analysis of primary and secondary roads, 94 of the 100 routes (94%) operated on 87,966 miles (40%) of primary and secondary roads.

Broward County Transit

Based on the analysis of the Broward County Transit GTFS file, there are 38 bus routes with 164,282 total scheduled route miles. The analysis based on Census' primary roads, resulted in 4 of the 38 routes (11%) operating on 957 miles (less than 1%) of primary roads. Based on the primary and secondary roads 37 of the 38 (97%) routes operate on 101,942 (62%) miles of primary and secondary roads.

Detroit Department of Transportation

The analysis of the Detroit Department of Transportation's GTFS file found that 74 routes provide 136,101 total scheduled route miles. The primary road analysis reveals that 19 of 74 routes (26%) operate on 409 miles (less than 1%) of highway and when the secondary roads are added to the analysis the total routes increase 64 (86%) and the total miles increases to 30,094 (22%).

Tri-Met

Based on the analysis of Tri-Met's GTFS file, there are 86 bus routes with 439,355 total scheduled route miles. The analysis of transit routes operating on primary roads indicate that 10 of the 86 routes (12%) and 7,747 miles (2%) of scheduled route service operate on primary roads. Findings from the analysis of the primary and secondary roads show that 66 (77%) of the routes operate on these facilities with a total of 120,356 miles (27%) of service.

Description of Transit Systems Operating within Study Corridors

Table 2-3 lists the modes operated by each of the transit systems included in this study. As shown, most of the agencies included are multimodal. WMATA, Miami-Dade Transit, and the Greater Cleveland RTA all provide heavy rail services, and Portland's Tri-Met and Cleveland RTA provide light rail services. Miami-Dade Transit also operates a peoplemover, known as Metromover, which is classified in NTD as MG (monorail or automated guideway), and Portland's Tri-Met operates a hybrid rail system (YR). Four of the agencies provide directly-operated motorbus services and also contract for additional motorbus services. The Potomac and Rappahannock Transportation Commission exclusively contracts for the motorbus services it provides. Until 2011, bus rapid transit (BRT) services were included under motorbus (MB), and, currently, those agencies that provide BRT service that meets the NTD definition can report that service as RB. King County Metro is the first agency to do so of those included in this study.

Table 2-3

Modes Operated in 2011 for Transit Systems Included in the Study[1]

Transit Agency Name	Modes Operated[2]
King County Department of Transportation (Seattle Metro)	MB-DO, MB-PT, RB-DO, TB-DO, SR-DO, VP-DO, DR-PT, DT-PT
Tri-County Metropolitan Transportation District of Oregon (Portland Tri-Met)	MB-DO, LR-DO, SR-DO, YR-PT, DR-PT, DT-PT
Connecticut Transit (CT Transit Hartford & Stamford Divisions)	MB-DO
Washington Metropolitan Area Transit Authority (WMATA)	MB-DO, MB-PT, HR-DO, DR-PT, DT-PT
Potomac & Rappahannock Transportation Commission	MB-PT, CB-PT[3]
Broward County Transit Division (& Community Bus)	MB-DO, MB-PT, DR-PT
Palm Tran (West Palm Beach, FL)	MB-DO, DR-PT
Miami-Dade Transit	MB-DO, HR-DO, MG-DO, DR-PT
Central Florida Regional Transportation Authority (LYNX)	MB-DO, DR-PT, VP-PT
Greater Cleveland Regional Transit Authority	MB-DO, LR-DO, HR-DO, DR-DO, DR-PT
Suburban Mobility Authority for Regional Transportation (SMART Detroit)	MB-DO, MB-PT, DR-DO, DR-PT
City of Detroit Department of Transportation	MB-DO, DR-PT, DT-PT

[1]As reported in the NTD for Report Year (RY) 2011.

[2]DO – directly-operated service; PT – purchased transportation service; MB – motorbus; RB – bus rapid transit; TB – trolleybus; SR – streetcar rail; LR – light rail; HR – heavy rail; YR – hybrid rail; MG – monorail or automated guideway; VP – vanpool; DR – demand-response; DT – demand-response taxi (See Appendix C for definitions).

[3]Potomac and Rappahannock operated the commuter bus (CB) mode, a new mode classification, in 2012.

Table 2-4 includes selected transit service statistics for these agencies using the most recent NTD available, for report year (RY) 2011. The data shown represent bus modes only and include the number of vehicles operated in maximum (peak) service, total annual revenue miles, total annual revenue hours, total annual unlinked passenger trips, and directional route miles (both on controlled or exclusive right-of-way and total). The definitions for these indicators are provided in Appendix D. The agencies range in size from 112 peak bus vehicles operated by Potomac and Rappahannock, which also operates OTRBs in public transit service, to WMATA's 1,303. For the other statistics, such as revenue miles, hours of service and ridership, Potomac and Rappahannock is the smallest system and WMATA is the largest.

Table 2-4

2011 NTD Bus Information for Transit Systems Included in the Study[1]

Transit Agency Name	Motorbus Data (MB)					
	Vehicles Operated in Maximum Service	Total Revenue Miles	Total Revenue Hours	Total Unlinked Passenger Trips	Directional Route Miles	
					Controlled-Access or Exclusive ROW	Total
King County Metro (Seattle)[2]	986	32,959,657	2,687,136	91,413,649	262	2,015
Portland Tri-Met	520	19,396,640	1,636,603	58,248,403	4	1,340
CT Transit (Hartford & Stamford)	234	7,985,798	632,298	17,308,909	29	1,127
Washington D.C. (WMATA)	1,303	39,459,432	3,771,390	130,732,652	75	2,614
Potomac & Rappahannock	112	3,080,485	163,301	3,326,699	125	504
Broward County Transit Division (& Community Bus)	309	15,799,243	1,153,339	38,279,640	37	1,686
Palm Tran (West Palm Beach, FL)	123	6,974,987	404,415	11,143,922	0	1,186
Miami-Dade Transit	694	28,860,941	2,424,028	75,723,805	92	1,891
Central Florida Regional Transportation Authority (LYNX)	225	14,714,555	1,029,676	26,996,158	3	1,382
Greater Cleveland RTA	310	12,616,043	1,096,531	37,198,763	17	1,494
Suburban Mobility Authority for Regional Transportation (SMART Detroit)	233	10,574,179	641,594	10,660,270	0	1,646
City of Detroit DOT	375	13,913,142	1,037,639	35,615,420	0	1,036

[1]Source: National Transit Database (NTD) data for bus modes, directly-operated and purchased. 2011 represents the most current data available.

[2]King County Metro's data for 2011 also include bus rapid transit (RB).

For a historical perspective, the data for the 12 transit agencies are totaled and presented in Table 2-5. The data are shown from 2008 to 2011 and are from the NTD. During this time, both motorbus service and ridership have decreased as a whole for these agencies, although the total number of directional route miles has increased.

Table 2-5

NTD Motorbus Information Totals for Transit Systems Included in the Study, 2008–2011[1]

Bus Totals[2]	2008	2009	2010	2011
Vehicles Operated in Maximum Service	5,874	5,557	5,563	5,424
Revenue Miles	222,656,969	219,448,699	208,087,562	206,335,102
Revenue Hours	17,885,927	17,572,415	16,787,930	16,677,950
Average Speed[3] (mph)	12.45	12.49	12.46	12.37
Unlinked Passenger Trips	574,698,837	554,328,216	525,045,760	536,648,290
Average Trip Length[4](miles)	4.46	4.36	4.43	4.33
Revenue Miles Between Collisions[5]	419,316	448,770	433,516	361,357
Revenue Miles Between Injuries[5]	360,870	312,605	290,625	228,247
Total Directional Route Miles	15,238	17,750	17,865	17,921
Directional Route Miles on Exclusive or Controlled-Access ROW	695	762	637	644

[1]Data from National Transit Database for years specified; includes directly-operated and purchased motorbus services. 2011 represents the most current data available.

[2]King County Metro's data for 2011 also include bus rapid transit (RB).

[3]Average speed equals revenue miles divided by revenue hours and is shown for all motorbus service.

[4]Average trip length equals passenger miles divided by unlinked passenger trips and is shown for all motorbus service.

[5]Revenue miles between collisions and between injuries are common measures of safety in the public transit industry and provide an estimate of incident frequency. They are computed by dividing revenue miles by collisions and incidents, respectively, and are show in this table for all motorbus service.

Public Transit Bus System Safety Data

Bus safety data for the 12 transit systems included in this study are summarized in Table 2-6. First, all safety incidents are listed that include collisions as described earlier, as well as fires, hazardous material spills, and weather/natural disaster related incidents (no security incidents are included in these data). Detailed information on the category of "Other Safety Occurrences Not Otherwise Classified" was not available by agency, and so is not presented here (see Appendix C). The number of safety incidents was then narrowed to include only collisions and, finally, only to those collisions occurring on the corridors identified for this study. The collisions that occurred on the selected corridors were identified by first narrowing the data files by agency, mode, and collision type, which reduced the number to a few hundred per year. Finally, from the smaller data set, the location field was manually searched to identify collisions occurring in the relevant corridors.

As shown in Table 2-6, among the 12 included transit systems, 10 collisions occurred on the identified corridors in 2008, 9 in 2009, 12 in 2010, 10 in 2011, and 7 in 2012 for a total of 48 collisions during this time. These 48 collisions represent 1.9 percent of all the collisions for these transit agencies occurring during this time frame. The number of injuries resulting from these collisions totaled 39 from 2008 to 2012. In 2011, there were only two injuries. The injuries noted in the table include only injuries to bus occupants, including the operator, and represent just 1.1 percent of all passenger and operator injuries for the selected transit systems during this period. Injuries to those in other affected vehicles, pedestrians, bicyclists, passersby, or others in the revenue facility (bus stop or shelter, for example) are not included in these totals. There were no fatalities associated with the collisions on the identified corridors.

Table 2-6

NTD Motorbus Safety Information Totals for Transit Systems Included in the Study, 2008–2012[1]

Bus Totals	2008	2009	2010	2011	2012
All Safety Incidents (less "Other Safety Occurrences")[2]	565	523	510	597	540
Collision Incidents	530	489	480	571	499
Collision Incidents per 1 Million Revenue Miles[3]	2.38	2.23	2.31	2.78	n/a
Injuries to Bus Occupants from Collision Incidents[4]	620	702	716	904	721
Injuries to Bus Occupants per 1 Million Revenue Miles[3]	2.78	3.20	3.44	4.38	n/a
Fatalities to Bus Occupants from Collision Incidents[4]	3	0	0	1	1
Fatalities to Bus Occupants per 1 Million Revenue Miles[3]	0.01	0	0	0.004	n/a
Collision Incidents on Identified Highway Corridors[5]	10	9	12	10	7
Injuries to Bus Occupants from Collisions on Identified Highway Corridors[4,5]	15	8	10	2	4
Fatalities to Bus Occupants from Collisions on Identified Highway Corridors[4,5]	0	0	0	0	0

[1]Data from NTD for years specified; includes directly-operated and purchased motorbus services.

[2]Safety incidents include collisions, fires, hazardous material spills, and weather/natural disaster-related incidents (no NTD security incidents, i.e., public safety incidents, are included in these data).

[3]NTD service supply data are not yet available for 2012.

[4]Injuries and fatalities to persons on the transit vehicle only, passengers and/or operator.

[5]Corridors identified for this study.

NOTE: Available data were not sufficient to estimate revenue miles for portions of routes operating on identified corridors.

Table 2-7

Motorbus Collision Information Totals for Transit Systems Included in the Study, 2008–2012[1]

NTD Collision Category	Number of Collisions	Injured Passengers	Injured Operators	Total Injuries
Angle	3	6	0	6
Head-On	1	0	0	0
Other Front Impact	12	5	3	8
Rear-Ended	7	3	3	6
Rear-Ending	18	14	1	15
Side Impact	1	0	0	0
Sideswipe	6	2	2	4
Total	**48**	**30**	**9**	**39**
Vehicle Problem or Defect[2]	0			

[1]Data from National Transit Database for years specified; includes directly-operated and purchased motorbus services, for collisions on identified corridors for this study.

[2]NTD does not specifically include this information, but it can be found in the open-ended incident description field. In addition, transit agencies involved were contacted for this information.

Of the 48 total collisions found on the identified highway corridors, more than half (27 collisions, or 56%) resulted in no injuries to the passengers or operator on the bus. Any injuries that occurred were to persons outside the transit bus or in other vehicles involved in the collisions. Nine of the collisions resulted in injuries to the bus operator only, with no passenger injuries. Further, 47 of the 48 collisions were with another motor vehicle. One collision was with an object that flew off a trailer from the vehicle in front of the transit bus and crashed through the windshield of the bus, injuring the operator. Two of the 48 collisions involved OTRBs operating in contracted public transit service; the remaining 46 involved regular transit buses in directly-operated public transit service.

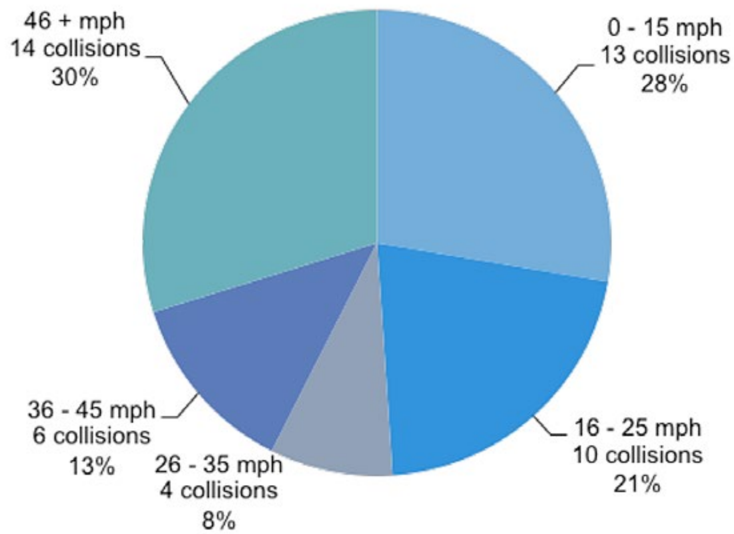
Table 2-7 summarizes information for the 48 relevant collisions identified by collision category as reported in the NTD. The most common type of collision is rear-ending, whereby the transit bus collides with the rear of the vehicle in front of it. Most of these occurred in stopped or slowing traffic, and some also occurred when another vehicle moved unexpectedly into the lane occupied by the bus. An additional 19 of the 48 collisions resulted from another vehicle changing lanes or merging into the path of the bus, or another vehicle losing control and hitting the bus. Table 2-7 also separates the injuries to passengers and operators. In total, 30 passengers and 9 operators were injured in these collisions. There were no fatalities.

Table 2-7 also indicates that there were no vehicle problems or defects associated with any of the 48 identified collisions. For many of the collisions, this information could be ascertained from the NTD Major Incident report open-ended description field. Nonetheless, contact was made with the selected transit agencies to confirm or gather additional information regarding any vehicle issues. For one rear-ending collision, the transit agency indicated that a brake issue was initially noted in the description, but no brake issue was found during the subsequent vehicle and tire tracks inspection. In that case, the operator was cited by the state patrol and also cited internally for not allowing enough following distance between the transit bus and the vehicle in front of it. For another collision, an operator reported a stuck accelerator, but several subsequent vehicle inspections found no problem; thus that collision was not attributed to any vehicle factor.

Figure 2-3 provides additional information on the 48 identified collisions by noting the estimated vehicle speeds at which the collisions occurred. Thirteen collisions occurred in stopped traffic or speeds of 15 miles per hour or less. However, 14 collisions occurred at speeds of 46 miles per hour or greater. Reports for one of the identified collisions did not indicate an estimated vehicle speed.

Figure 2-3

NTD Motorbus Collision Speed Information Totals (Transit Systems Included in the Study), 2008–2012[1]



[1]Data from NTD for years specified; includes directly-operated and purchased motorbus services, for collisions on identified corridors for this study. It should be noted that the speeds listed are estimated; one collision did not have estimated speed information in its reports.

Of the 14 collisions occurring at speeds of 46 miles per hour or greater, 4 were rear-ending, 2 were rear-ended, 3 were sideswipes, 2 were angle collisions, and 3 were the result of other front impact. Two of these collisions were the result of operator avoidance maneuvers where the bus ended up striking something else (concrete barrier, bridge support). A total of 3 operators and 15 passengers were injured in these collisions; 8 of the injuries were from one collision where the bus operator rear-ended the vehicle in front of it as traffic suddenly slowed.

OTRB Safety Study Corridor Data

Reports were requested from the crash record administrators in the nine states within which the study corridors are located. The criteria for inclusion in the analysis included crashes involving OTRBs commercially operating on identified high speed corridors shared with public transportation vehicles. Five years of data were requested; however, due to the variety of state policies and data maintenance methods, there was variance in the data returned. Therefore, all returned years of records were included, as described below.

- **Connecticut** – Crash records for years 2007 through 2009 were the only years available and were accessed through a publicly-available database query tool. The records returned were coded from PARs and absent narratives.
- **Florida** – Crash records for years 2007 through 2011 were provided. The records were original scanned PARs with narratives.
- **Michigan** – Crash records for 2007 through 2011 were accessed through the Southeastern Michigan Council of Government's (SEMCOG) Web-furnished tool. The records were original scanned PARs that had been sanitized by redacting personal information about the involved parties in the crash. Narratives were available for review.
- **Ohio** – Crash records were available only for 2008 through 2012 and were accessed through a publicly-accessible crash data extraction tool hosted by the Ohio Department of Public Safety. The crashes were output into a database and absent narratives.
- **Oregon** – Crash records for 2007 through 2011 were provided in a summary report from the Oregon Department of Transportation and absent narratives.
- **New York** – Crash records were not obtained in time for the release of this report.
- **Virginia** – Crash records from 2008 through 2012 were provided in a database from the Virginia Department of Motor Vehicles and absent narratives.
- **Washington, DC** – Crash records from 2010 through 2012 were provided in a spreadsheet with truncated narratives.
- **Washington State** – Crash records from 2007 through 2011 were provided in a spreadsheet and absent narratives.

Crashes and injuries were generally underreported for the following three states:

- Michigan maintains a "Commercial Truck/Bus" field that did not allow the study team to discern between truck and bus in every case and therefore all questionable crashes were excluded; only when the narrative described bus involvement were the crashes counted.
- Washington State maintains a "Bus or Motorstage" field that did not explicitly describe either public transit or commercial over the road bus in every case. Where possible, the study team used other means, such as newspaper archives to confirm OTRB involvement.
- New York had no crash records available for analysis.

The compiled data from the crash records are included in Table 2-8.

Table 2-8

OTRB State Crash Database Safety Information Totals for Corridors Included in the Study, 2007–2012[1]

Year	2007	2008	2009	2010	2011	2012
Total OTRB Crashes on Identified Highway Corridors	10	36	36	22	23	10
OTRB Injury Crashes on Identified Highway Corridors	1	4	5	3	2	1
OTRB Injuries from Crashes on Identified Highway Corridors	1	62[2]	23	3	2	1
OTRB Fatalities from Crashes on Identified Highway Corridors	0	0	0	0	0	0
OTRB Vehicle-related or Contributing Factor Crashes on Identified Highway Corridors	0	0	0	2	0	1
OTRB Vehicle-related or Contributing Factors Cited in Crashes	0	0	0	Vehicle Fire, Driveshaft	0	Motor Trouble

[1]Assembled from eight of the nine states that maintain crash records for the study corridors; not every state was able to provide five years of crash records.

[2]Includes one OTRB crash in Florida, with 42 injuries. The OTRB was not operating in public transit service.

One OTRB crash with vehicle-related or contributing factors contained a narrative that described the events that occurred in the crash. None of the vehicle-related crashes had an injury associated with the event.

> In August 2010, a motorcoach was traveling east on an Interstate in the outside center lane. A second vehicle was traveling behind the motorcoach. The drive shaft of the motorcoach detached from the undercarriage and fell onto the roadway. The drive shaft broke into several pieces that struck the left side of the trailing vehicle. Both vehicles were removed from the roadway. The first harmful event of this crash was identified as the detachment of the drive shaft and the fall of the driveshaft onto the roadway.

In summary, for the reporting period of 2008-2012 with data consistently available for public transit and OTRB, there were fewer reported collisions and injuries in public transit than in OTRB. There were three crashes in OTRB with vehicle-related factors and none in public transit. The records from the states also identified a single crash that resulted in nearly half of all OTRB injuries for the study period, reinforcing the role catastrophic events plan in passenger safety.

CHAPTER

3

Summary of Laws, Regulations, and Voluntary Industry Standards

Laws and regulations, for the purposes of this study, include all those under the purview of the USDOT Secretary. These include regulations that address both vehicle design (e.g., FMVSS) and vehicle operations (e.g., FMCSRs). Although governmental agencies, including public transportation agencies, are exempt from most of the FMCSRs, many of the FMVSSs do apply to both public transit buses, as well as OTRBs. Any laws or regulations from states within which our study corridors are located that establish standards or minimum operating criteria for either OTRBs or public transportation systems are included within this section. Also included are identification and a brief discussion of the voluntary bus safety standards developed by APTA.

This examination of laws and regulations does not include those related to motorcoach or public transit bus driver qualifications, on-duty or driving hours, substance abuse management, training, or other topics specific to motorcoach or bus drivers.

The following section identifies those laws and regulations that are applicable to the design and in-use operation of buses and provides a brief summary of applicability and content. Additional regulations found in 49 CFR, including Parts 391-395 and 397-399, which cover FMCSRs for transit buses not applicable to this study, are provided in Appendix F.

Federal Regulations

49 CFR Part 390

FMCSRs are contained within Parts 390-399 of Title 49 of the Code of Federal Regulations, Transportation. These regulations apply to commercial motor vehicles and their operators that transport property or passengers in interstate commerce. Public transit agencies may adopt these regulations, but they are not required to do so. The sections described below only include those FMCSRs that are relevant to the discussion points of this report.

The operational safety regulations of the FMCSRs (Parts 390-399) generally do not apply to the following (with the exception of Part 392 related to texting-handheld devices):

- School bus operations as defined in 49 CFR Section 390.5
- Transportation provided by federal, state, local governments or an agency established under a compact between states that has been approved by the United States Congress
- Occasional transportation of personal property by individuals not for compensation or commercial purposes
- Transportation of human corpses or sick and injured people
- The operation of fire trucks and rescue vehicles while involved in emergency and related operations
- Transportation provided by commercial motor vehicles transporting between 9 and 15 passengers (including the driver), not for direct compensation, except for the requirements to file the Motor Carrier Identification Report (MCS-150), maintain an accident register, and mark the vehicle with the motor carrier identification number.

49 CFR Part 393

Part 393 establishes minimum standards for parts and accessories for commercial motor vehicles, as defined in 49 CFR 390.5. Of relevance to this report, Part 393 includes requirements for brakes, Subpart C (393.40 – 393.55); glazing and window construction (including emergency exits), Subpart D (393.60-393.63); miscellaneous parts and accessories (which includes tires), Subpart G (393.75-393.94); and frames, cab and body components, wheels, steering, and suspension systems, Subpart J (393.201-393.209).

49 CFR Part 396

Part 396 contains the minimum requirements for the inspection, repair and maintenance of commercial motor vehicles, as defined in 49 CFR 390.5. This includes relevant sections that discuss inspection of vehicles while in operation (396.9); driver vehicle inspection reports (396.11); periodic inspections (393.17); and qualifications of brake inspectors (396.25).

49 CFR Part 571, Subpart B

Parts 571.101 through 571.500 provide the FMVSS. These standards are regulations for the manufacture and sale of new vehicles and equipment that reflect minimum safety performance requirements. They are organized under the general headings of "Crash Avoidance, "Crashworthiness," "Post-Crash Standards," and "Other Regulations." Those FMVSSs applicable to transit buses and OTRBs include the following:

- **FMVSS No. 101**, Controls and Displays—controls must be operable by driver with seat belt fastened, and includes requirements for telltales and warning indicators.

- **FMVSS No. 102**, Transmission shift lever sequence—vehicles equipped with automatic transmissions must have transmission braking at vehicle speeds below 40 km/h (25 mph).
- **FMVSS No. 103**, Defrosting and defogging systems—must have a system.
- **FMVSS No. 104**, Windshield wiping and washing—must meet wiper speed and windshield washing area per SAE J942.
- **FMVSS No. 106**, Brake hoses—air brake hoses must meet performance requirements.
- **FMVSS No. 108**, Lamps, reflective devices and associated equipment—must meet performance and location on vehicle requirements.
- **FMVSS No. 111**, Rearview mirror—must have unit magnification mirrors of specified size, may have additional mirrors, i.e., convex.
- **FMVSS No. 119**, Tires for vehicles with GVWR > 4,536 kg—tires on vehicle must meet performance and labeling requirements.
- **FMVSS No. 120**, Tire selection and rims and motor home/recreation vehicle trailer load carrying capacity information for motor vehicles with GVWR > 4,536 kg—sum of load ratings of tires must be equal to or greater than the gross axle weight ratings to prevent vehicle overloading.
- **FMVSS No. 121**, Air brake systems—specifies stopping distance performance and that vehicles be equipped with an antilock brake system.
- **FMVSS No. 124**, Accelerator control systems—removing force on accelerator requires return to idle in specified time.
- **FMVSS No. 205**, Glazing materials—glazing must meet performance requirements.
- **FMVSS No. 207**, Seating systems—driver's seat must meet performance requirements.
- **FMVSS No. 208**, Occupant crash protection—driver's seat must be equipped with Type 1 or Type 2 seat belt assembly.
- **FMVSS No. 209**, Seat belt assemblies—driver's belt must meet performance. requirements
- **FMVSS No. 210**, Seat belt assembly anchorages—for driver's belt, must meet strength requirements.
- **FMVSS No. 217**, Emergency exits and window retention—must have emergency exits meeting size and location requirements that meet performance and labeling requirements.
- **FMVSS No. 302**, Flammability of interior materials—must meet burn resistance performance requirements.

- **FMVSS Nos. 403 & 404**, Platform lift systems for motor vehicles and platform lift installations in motor vehicles—operational metrics for platform lifts and safety requirements for vehicles so equipped.

Current Rulemaking and Research Activities by NHTSA to enhance bus safety are provided in Table 3-1.

Table 3-1

Current Rulemaking and Research Activities by NHTSA

Activity	Description
Occupant Restraints	Notice of Proposed Rulemaking (NPRM) published on August 18, 2010. Final rule expected in 2013. Proposed lap/shoulder belts at all seating positions on applicable large buses, including OTRBs.
Stability Control	Published NPRM in May 23, 2012. Final rule being developed. Requires stability control systems in applicable buses to mitigate rollover and loss-of-control crashes.
Rollover Structural Integrity	Require structural integrity of applicable buses in rollover events to maintain occupant survival space and structural integrity around side windows.
Advanced Glazing and Window Retention	Considerations for advanced glazing and other portal improvements to prevent ejection of motorcoach occupants.
Emergency Egress	Considerations for enhancing emergency egress in applicable buses to ensure evacuation in adequate time under different emergency situations for various occupant groups, including children and older adults.
Heavy Vehicle Tires	NPRM to upgrade heavy vehicle tire performance requirements published on September 29, 2010. Analysis of additional tests in response to comments underway.
Fire Safety	Completed two year research program on propagation and penetration of wheel well fires. Conducting follow-up research to develop performance tests and requirements for exterior material and detection systems and evaluate suppression systems.
Crash Avoidance Systems	Research on forward collision avoidance and mitigation systems and lane departure warning systems for heavy vehicles, including buses.

State Laws and Regulations

A summary of state laws and regulations (for those states within which the study corridors are located) for motorcoaches and/or public transit buses is provided in Appendix G.

Additional information on existing state oversight transit bus standards and recommended practices was described in "Bus Transit Safety Standards and Recommended Practices" (FTA draft report, September 2012). These standards and recommended practices include those related to vehicle systems and equipment, inspection, maintenance, training, and accident reporting/review. Those included in the report are provided below with expanded narrative presented by the study team.

State Regulation of Transit Bus Safety

- The NYSDOT/Public Transportation Safety Board (PTSB) has broad, legislatively-mandated powers and duties that enable it to effectively improve public transportation safety for those bus transportation systems that receive, either directly or indirectly, any statewide mass transportation operating assistance. The PTSB is statutorily responsible for investigating and analyzing serious bus accidents, and recommending actions to be taken to reduce the possibility of similar accidents from occurring.
- The State of Florida Equipment and Operational Standards for Bus Transit Systems, Rule Chapter 14-90, Florida Administrative Code (FAC), provides state regulation of bus transit systems operating in the state.

Existence of Overall Transit Bus (or Public Transit) Safety Policy

- State of Florida Equipment and Operational Standards for Bus Transit Systems, Rule Chapter 14-90, FAC
  - Bus Transit System Operational Standards (Section 14-90.004, FAC)
  - Operational and Driving Requirements (Section 14-90.006, FAC)

Requirement for System Safety Program Plan (SSPP)

- NYSDOT/PTSB requires the development of system safety program plans for public transit agencies.

- State of Florida Equipment and Operational Standards for Bus Transit Systems, Rule Chapter 14-90, FAC

  - Section 14-90.004(1), FAC requires bus transit systems to develop and adopt a system safety program plan and provides minimum safety standards that must be addressed with the SSPP.
  - Section 14-90.004(1)(c), FAC requires annual inspections of all operable transit buses.
  - Section 14-90.004(2), FAC requires each bus transit system to develop a Security Program Plan (SPP) and provides minimum security requirements.
  - Section 14-90.004(1)(d), FAC requires each bus system to annually submit a safety certification to the Florida Department of Transportation verifying the adoption of and compliance with a SSPP and that annual inspections have been performed.

Requirement for Safety, Security and Emergency Preparedness Plan (SSEPP)

- Ohio DOT has developed a System Security and Emergency Preparedness Plan template for use by transit agencies operating within the state.

- State of Florida Equipment and Operational Standards for Bus Transit Systems, Rule Chapter 14-90, FAC, Section 14-90.004(2), requires bus transit systems to develop a Security Program Plan (SPP) that addresses the following:
  - Security policies, goals, and objectives
  - Organizational roles and responsibilities
  - Emergency management processes and procedures for mitigation, preparedness, response and recover
  - Procedures for the investigation of any event involving a bus or taking place on bus transit system controlled property resulting in a fatality, injury, or property damage within defined parameters
  - Procedures for interfacing with emergency response organizations
  - Procedures for interagency coordination with local law enforcement
  - Employee security and threat awareness training programs
  - Security data acquisition and analysis
  - Emergency preparedness drills and exercises
  - Security requirements for private contracted transit providers
  - Procedures for SPP maintenance and distribution

Safety and Security Inspections and Reviews

- NYSDOT/PTSB requires each on duty transit bus driver to complete and sign a vehicle inspection report at both the beginning and the end of the driver's shift, as well as any time the vehicle undergoes mechanical service during the day. An itemized record of each periodic maintenance "examination" of each vehicle is also required. All vehicles subject to inspection by NYSDOT are required to be inspected at least every six months. Operators of bus transit systems subject to these inspections must present vehicle maintenance files and driver records.
- State of Florida Equipment and Operational Standards for Bus Transit Systems, Rule Chapter 14-90, FAC
  - Section 14-90.004(1)(c), FAC requires annual inspections of all operable transit buses.
  - Section 14-90.004(3)(i), FAC requires that drivers submit a daily bus inspection report.
  - Section 14-90.006(7), FAC requires pre-operational or daily inspection and reporting of all defects and deficiencies likely to affect safe vehicle operation or cause mechanical malfunctions and provides a list of the parts and devices that must be inspected.

  - Section 14-90.009, FAC requires all buses operated by a bus transit system and buses operated by private contract providers be inspected at least annually according to the inspection procedures provided in the rule.
  - Section 14-90.012, FAC requires the FDOT to conduct inspections of bus transit systems to determine compliance with Rule Chapter 14-90, FAC. At a minimum, the reviews are conducted triennially, but may occur more frequently at the discretion of FDOT. It also authorizes FDOT to suspend bus transit system service if the failure to meet bus safety or security standards poses an immediate danger to public safety or if the bus transit system fails to correct deficiencies within a defined implementation schedule.

Requirement of Vehicle and Equipment Safety Standards

Most jurisdictions have vehicle codes providing the requirements for basic equipment and continued compliance.

- NYSDOT/PTSB has established minimum preventative maintenance intervals and requires a certification that this maintenance has been conducted and completed consistent with the requirements.
- State of Florida Equipment and Operational Standards for Bus Transit Systems, Rule Chapter 14-90, FAC
  - Section 14-90.007, F.A.C., establishes Vehicle Equipment Standards and Procurement Criteria for bus transit systems. Section 14-90.006(1)(c) of the rule incorporates the following FMVSS by reference: 49 C.F.R. Part 571, Sections 102, 103, 104, 105, 108, 207, 209, 210, 217, 220, 221, 225, 302, 403, and 404. Additional minimum equipment standards are provided in Section 14-90.007, FAC.

Requirement to Report/Investigate Accidents

Most jurisdictions require accident reporting for those incidents involving, at minimum, injuries or fatalities. There are states that actively investigate public transportation safety accidents, including:

- Since 2003, NYSDOT/PTSB bus staff has been providing BAITFISH training classes in bus accident investigation. There is no charge to attend the classes, which are held at locations throughout the State, given to fulfill the system safety program plan requirement of having at least one staff person certified in comprehensive accident investigation training program approved by the Safety Board. There are currently 12 in¬-state bus industry representatives to provide the BAITFISH training program on an ongoing basis throughout New York State.

- In addition, some states, such as Florida, require accident investigation, reporting, and tracking for transit bus systems. Section 14-90.004(5), FAC requires each bus transit system to investigate any event involving a bus or taking place on a bus transit system-controlled property that results in a fatality, injury, or property damage within established parameters. The Florida Department of Transportation (FDOT) developed a Bus Incident Reporting, Tracking, and Analysis System Database as a tool to help transit agencies in the state collect and analyze accident data. FDOT also developed a Bus Transit Incident Investigation Toolbox that provides transit systems with an overview of the procedures and guidelines needed to conduct transit incidents investigations.

Safety and Training Programs

FDOT has an extensive menu of transit training programs available to transit agencies within that state. It is actively involved in the delivery of training sessions, including e-learning platforms, the development of training curriculum and corresponding training tools and products, and ongoing information exchange through listservs and other e-mail communication. Example training products developed by FDOT include:

- Wireless Distractions Training Resource Program (CBT)
- Transit Emergencies: Validating Local Preparedness
- Threat and Vulnerability Assessment Course
- Clean, Sober and Safety Training Video
- REACT; Supervisor Training Package (DVD)

State Management Plans (SMPs)

The SMPs required of state DOTs often address transit safety and security. Many state DOTs have policies and procedures manuals that provide guidance to transit sub recipients and list policies for vehicle procurement and inspection, driver training, oversight responsibilities, compliance monitoring. Some DOTs list regulations and standards in these manuals. A number of states also pass these requirements to FTA subrecipients through annual grant application manuals and/or contracting agreements between those subrecipients and the state DOT.

APTA Voluntary Standards

APTA has a structured, ongoing industry consensus standard development program with separate committees that cover a series of public transit safety and security practices. According to APTA's Annual Report on the Standards Development Program, 500 transit industry professionals from across the country participate on 20 transit standards technical development committees. As of the last quarter of 2012, the organization established 305 individual safety standards and recommended practices or guidelines to assist their members in improving system safety. A list of APTA's voluntary standards and recommended practices is in Appendix H.

APTA currently has eight active standards programs including:

- Passenger Rail Equipment Safety Standards (PRESS)
- Rail Transit Standards
- Bus Transit Standards
- Universal Transit System Fare Collection Standards
- IT Standards
- Accessibility Standards
- Procurement Standards
- Security Standards
- Sustainability and Design Standards

There have been 29 standards developed in the area of Bus Safety. These standards are housed within four areas: Suspension Systems (Brakes and Chassis), Bus Maintenance Training, Bus Operations and Safety, and Fire Safety. APTA's *Manual of Standards and Recommended Practices for Bus Transit Systems* documents the standards developed for transit buses. Those standards related to vehicle systems and structural designs include:

- Bus Brake and Chassis Systems Recommended Practices
  - Transit Bus In-Service Brake System Performance Testing
  - Transit Bus Foundation Brake Lining Classification
  - Transit Bus Brake Shoe Rebuild
  - Transit Bus Front and Rear Axle S-Cam Brake Reline
  - Troubleshooting Common Transit Bus S-Cam and Air Brake Complaints
- Bus Safety Recommended Practices
  - Transit Bus Fire Safety Shutdown
  - Transit Bus Electrical System Requirements Related to Fire Safety
  - Installation of Transit Vehicle Fire Protection Systems
  - Transit Bus Fire/Thermal Incident Investigation
  - Reducing Driver-Controlled Distractions While Operating a Vehicle on Agency Time
  - Reducing Agency-Controlled Distractions While Operating a Vehicle on Agency Time

Standard Bus Procurement Guidelines

APTA's Bus Procurement Guidelines provide transit agencies with detailed instruction on conducting bus procurement activities for heavy duty 30-foot and longer transit buses. Included within these guidelines are minimum vehicle specifications, with allowances for various alternatives above these standards. A select sample of the standards that have relevance for this study include the following:

- Crashworthiness
  - The bus body and roof structure shall withstand a static load equal to 150 percent of the curb weight evenly distributed on the roof with no more than a 6 in. reduction in any interior dimension. Windows shall remain in place and shall not open under such a load. These requirements must be met without the roof-mounted equipment installed.
  - The bus shall withstand a 25 mph impact by a 4000-pound automobile at any side, excluding doorways, along either side of the bus with no more than 3 in. of permanent structural deformation at seated passenger hip height. This impact shall not result in sharp edges or protrusions in the bus interior.
  - Exterior panels below 35 inches from ground level shall withstand a static load of 2000 pounds applied perpendicular to the bus by a pad no larger than 5 square inches. This load shall not result in deformation that prevents installation of new exterior panels to restore the original appearance of the bus.
- Seat Belts
  - The belt assembly should be an auto-locking retractor (ALR). All seat belts should be stored in automatic retractors. The belts shall be mounted to the seat frame so that the driver may adjust the seat without resetting the seat belt.
  - The seat and seat belt assemblies as installed in the bus shall withstand static horizontal forces as required in FMVSS 207 and 210.
  - Default – lap seat belt only (driver); Alternative – lap and shoulder (three-point) seat belt (driver)

Standards Development Organizations (SDOs)

There are SDOs that have standards programs that provide recommendations to their respective industries on topics such as bus and other vehicle design and safety requirements; recommended practices for bus operators or other vehicle drivers; training; and vehicle maintenance-related procedures, standards, and practices. A few of those SDOs and professional association groups that issue standards, handbooks, manuals, and recommendations to support the development of safety design criteria applicable to bus transit systems, transit facilities, and vehicle manufacturers are listed below:[18]

- American Association of State Highway and Transportation Officials (AASHTO)
- American National Standards Institute (ANSI)
- American Society of Civil Engineers (ASCE)
- American Society of Mechanical Engineers (ASME)
- American Society of Testing and Materials (ASTM)
- National Institute for Automotive Service Excellence (ASE)
- Community Transportation Association of America (CTAA)
- Institute of Electrical and Electronics Engineers (IEEE)
- International Standards Organization (ISO)
- National Fire Protection Association (NFPA)
- National Institute of Standards and Technology (NIST)
- Occupational Safety and Health Administration (OSHA)
- Society of Automotive Engineers (SAE)
- Underwriters Laboratories, Inc. (UL)

[18]Federal Transit Administration, "Bus Transit Safety Standards and Recommended Practices," Draft Report, September 2012.

CHAPTER

4

Bus Safety Study Conclusions

Findings

This study includes an analysis of public transit buses and OTRB safety through a review of accidents that occurred for both modes that resulted in injuries and fatalities. The scope of this study was narrowly defined to reviewing injuries and fatalities that occurred when public transit buses were traveling on highway routes. The study did not evaluate human factor related events, such as those resulting from driver error or fatigue.

MAP-21 requires that this study include "… recommendations as to whether additional safety measures should be required for public transportation buses that travel on highway routes." **The analysis of information regarding injuries and fatalities of occupants of transit buses did not disclose any basis for requiring additional safety measures be observed when transit buses are carrying passengers over highway routes.**

NHTSA proposed regulations concerning crashworthiness and crash avoidance for motorcoaches place great emphasis on rollovers and corresponding passenger ejections. The review of data and associated literature (including NTSB and SCI reports) indicate that catastrophic OTRB accidents and associated injuries and fatalities are directly correlated with rollover events. These rollover events often result in passenger ejections and partial ejections or the reduction in survivable space within the vehicle due to roof collapse.

An analysis of FARS data conducted by NHTSA identified 54 OTRB bus crashes resulting in 186 fatalities. Of these fatal accidents, 24 were rollover events that accounted for 97 fatalities (53% of all occupant fatalities); 76 percent of the fatalities in rollover events were passengers who were ejected. Due to the operation of public transit vehicles primarily occurring with frequent stopping and within constrained, congested roadways, the average speeds and physical forces experienced by these vehicles do not generally provide the conditions necessary to generate rollover events. An analysis of the schedule data of 69 transit agencies showed that only 3 percent of all fixed-route miles were operated on the interstate system. A search of FARS data focused on those events that resulted in rollovers illustrated this difference in operating environments. Table 4-1 compares OTRB and transit bus in the areas of total fatalities, fatalities in rollover events, and fatalities that were a result of passenger ejections or partial ejections in those rollovers.

Table 4-1

Fatalities in Rollovers and Corresponding Passenger Ejections/ Partial Ejections OTRB and Transit, 2007–2011[1]

	OTRB	Transit Bus
Total Fatalities	108	1
Fatalities in Rollover Events	84	0
Fatalities in Rollovers Involving Ejections/Partial Ejections	41 (38 ejections & 3 partial ejections)	0

[1]Includes only those crashes that occurred on high speed roadways and operating in service as defined in this study.

Source: FARS

For those public transit systems that do operate highway routes there are no data to suggest that rollovers and passenger ejections are problematic.

The data compiled for this study present no direct correlation between the operation of public transit bus services on highway routes and an increase in injuries and fatalities of transit passengers. There is no evidence to suggest that public transit service operated on highway routes provides a higher level of risk that could lead to severe injuries or fatalities.

In summary, there are different operational characteristics of OTRBs and transit, including the percent of service operating on highway routes, average trip lengths, average vehicle speed, and vehicle chassis types. In addition, there are significant differences in fatalities and injuries, particularly those resulting from rollovers and ejections. As a result, the conclusions do not include safety improvements related to passenger restraints, electronic stability control, window glazing, or others that are designed to mitigate injuries and fatalities in rollover or loss-of-control events.

Also considered in this study were incidents in which vehicle systems or vehicle components were indicated as causal or contributing factors to the event. Vehicle contributing factors to crashes represented a small portion of overall crash contributing factors in OTRBs, representing less than 20 percent in each of three analyses cited in this report. The review of transit data revealed no collisions attributed to vehicle system or vehicle component failures.

Conclusions

The following conclusions are based on the collection and analysis of transit bus and OTRB safety data, the review of relevant regulations, standards, and industry recommended practices, and a review of available literature. The study conclusions are provided below.

Conclusion 1: Federal Regulations and Standards

The examination of the existing FMCSR and those FMVSS applicable to public transit buses, and the analysis conducted for this study do not provide sufficient evidence to suggest that the existing regulations

and standards be modified to require them for all public transit operating on highway routes. (Buses being used in transit service are typically not OTRBs.) However, NHTSA's rulemakings are considering upgraded FMVSSs for OTRBs used in transit services and that agency will be analyzing various factors in deciding how to move forward with its proposed modifications to the FMVSS. FMCSRs are contained within Parts 390-399 of Title 49 of the Code of Federal Regulations, Transportation. These regulations apply to commercial motor vehicles and their operators that transport property or passengers in interstate commerce. Public transit agencies may observe these regulations, but they are not required to do so. FMVSS are regulations for the manufacture and sale of new vehicles or equipment that reflect the minimum safety performance requirements for motor vehicles or items of motor vehicle equipment. NHTSA's rulemaking activities including the proposed revisions to FMVSSs, such as those regarding electronic stability control, and lap and shoulder belts for passenger seats in general exempt public transit.

Conclusion 2: State Laws and Regulations

Based on the examination of state laws and regulations, an expanded, comprehensive review of regulations and standards developed by all states is warranted. The findings of this examination should be used in the development of national transit bus safety standards and vehicle safety performance measures. The review of state laws and regulations for those states within which the study corridors are located resulted in the identification of a number of states that have developed standards related to vehicle systems and equipment, inspection, maintenance, training, and accident reporting and review. While there is variability in the application of state regulations and standards, some corridor states reviewed have comprehensive bus operational and safety standards.

Conclusion 3: Industry Standards and Recommended Practices

Based on the review of the standards and recommended practices, SDO or industry association developed standards should be used as resources in the development of national transit bus safety standards and vehicle performance measures. Accredited SDOs and industry associations have standards programs that provide recommended bus design and safety equipment requirements, and recommended practices for bus operator and maintenance training and vehicle system maintenance. Public transit agencies do apply some of these standards and practices, but there is variability in their use.

Conclusion 4: Research

Based on the data analysis and associated research conducted, further study is needed to address those incidents resulting in injuries or

fatalities for which human factors are indicated as probable causes or contributing factors. In the corridor analysis conducted for this study, vehicle contributing factors represented a small portion of overall crash contributing factors in OTRBs (less than 20%), with no vehicle-related factors reported in public transit. Documented public transit bus and OTRB incidents, including those included in NTSB HARs and NHTSA SCIs reviewed as part of this study, continue to focus on the human elements involved in these events. FMCSA/NHTSA's Bus Crash Causation Study concluded that human errors by bus drivers, other vehicle drivers, and pedestrians or bicyclists were the critical reasons for bus crashes in 90 percent of the cases examined.[19] While the review and documentation of human elements were not included within the scope of this study, during the data and literature reviews, the majority of those causal and contributing factors examined were related to driver error, fatigue, or other human factors.

[19]Federal Motor Carrier Safety Administration, Office of Analysis Research and Technology, Bus Crash Causation Study. Publication No. FMCSA-RRA—10-003, January 2010.

APPENDIX

A

MAP-21 Statutory Text

Section 20021 (b):

(b) Bus Safety Study-

(1) DEFINITION- In this subsection, the term ‘highway route’ means a route where 50 percent or more of the route is on roads having a speed limit of more than 45 miles per hour.

(2) STUDY- Not later than 180 days after the date of enactment of this Act, the Secretary of Transportation shall submit to the Committee on Banking, Housing, and Urban Affairs of the Senate and the Committee on Transportation and Infrastructure of the House of Representatives a report that--

(A) examines the safety of public transportation buses that travel on highway routes;

(B) examines laws and regulations that apply to commercial over-the-road buses; and

(C) makes recommendations as to whether additional safety measures should be required for public transportation buses that travel on highway routes.

APPENDIX

B

Synthesis Review of Existing Literature

Synthesis Review of Existing Literature

This study included a synthesis review of existing literature on OTRB safety for relevant discussion points. Included in this review were NTSB Highway Accident Reports (HARs), as well as research documents and other special reports. The section is organized by agency for which the reports were conducted (NTSB, NHTSA, and FMCSA), and reports are presented in reverse chronologic order. Specific reference will be made to conclusions or points of discussion that focus on the structural integrity of OTRBs, injury and fatality causal factors related to the structure of these vehicles, and issues related to maintenance. In addition, recommendations related to legislative or regulatory modifications, including performance standards, in the aforementioned topic areas will be noted. While many of the reports discussed do provide human factor-related points, including driver error, these will not be included as central topics in the synopses which follow.

National Transportation Safety Board

NTSB Highway Accident Reports

NTSB is an independent federal agency that investigates every civil aviation accident in the U.S. and "significant accidents" in other modes of transportation, including railroad, highway, marine, and pipeline accidents. NTSB investigations are designed to determine the probable cause of each accident, and the reports generated by these investigations provide safety recommendations aimed at preventing future accidents. NTSB does not have any authority to regulate the transportation industry, but the investigations conducted and recommendations provided are intended to improve transportation safety.

NTSB's HARs are the products of accident investigations for events that occur on the nation's highways. These reports provide significant detail related to an accident event and include detailed analyses to determine the probable cause of each event and the contributing factors in the injuries and fatalities sustained during the accident sequence. A narrative summary of the HARs that are relevant to this study are provided below.

Motorcoach Roadway Departure and Overturn on Interstate 95, Near Doswell, Virginia, May 31, 2011. NTSB/HAR-12-02, July 2012

This highway accident report documents the accident investigation of the Sky Express, Inc., motorcoach accident that occurred on May 31, 2011. At 4:55 AM

EDT, the motorcoach drifted off the interstate, struck a cable barrier, rotated counterclockwise, overturned, and rolled onto its roof. Of the 58 passengers in the motorcoach, 4 were killed, 14 received serious injuries, and 35 received minor injuries. The driver of the motorcoach sustained only minor injuries.

The investigation focused on driver fatigue, motorcoach design deficiencies specifically related to roof strength and occupant protection, and "the Federal Motor Carrier Safety Administration (FMCSA) failure to exercise adequate safety oversight of the accident motor carrier."[20]

The report identified the lack of a comprehensive occupant protection system, including systems providing passenger restraint and ensuring sufficient roof strength, as primary contributors to the fatalities and the severity of the injuries sustained. Of the four fatalities, all died as a result of crushing injuries sustained when the motorcoach rolled over and the roof collapsed. In addition, because passenger restraints were not available on this motorcoach, injuries occurred during the rollover when passengers were thrown from their seats and the survivable space decreased due to the substantial collapse of the roof structure.

As a result, the following recommendations were made to NHTSA:

- Develop performance standards for motorcoach occupant protection systems that account for frontal, side and rear impact collisions and rollovers.
- Once the performance measures have been developed, require newly-manufactured motorcoaches to have occupant crash protection systems that meet the performance standards and retains passengers.
  - Develop performance standards for motorcoach roof strength and require newly manufactured motorcoaches to meet those standards, and
  - Expand research on current advanced glazing to include its applicability to motorcoach occupant ejection prevention and revise window-glazing requirements for newly-manufactured motorcoaches based on the results of that research.[21]

Motorcoach Run-Off-the-Road and Collision with Vertical Highway Signpost, Interstate 95 Southbound, New York City, NY, March 12, 2011. NTSB/HAR-12-01, June 2012

This highway accident report documents the accident investigation of the World Wide Travel of Greater New York motorcoach accident that occurred on March 12, 2011. At 5:38 AM EDT, the motorcoach was traveling southbound on Interstate 95 from Uncasville, Connecticut to New York City. The motorcoach left the travel lanes of the interstate, crossed the rumble strips on the shoulder,

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[20]National Transportation Safety Board. 2012, *Motorcoach Roadway Departure and Overturn on Interstate 95 Near Doswell, Virginia, May 31, 2011*, Highway Accident Report NTSB/HAR-12/02, Washington, DC.

[21]Ibid.

crossed over the paved shoulder, and struck a guardrail. The vehicle then traveled along the guardrail and overturned, continuing until it collided with a vertical highway signpost that consisted of two vertical steel tubular poles that were linked by a cross-beam of diagonal metal supports. The support structure's steel poles entered the passenger compartment along the base of the passenger windows and, as the vehicle slid forward, tore the roof panel from the bus body for almost the entire length of the motorcoach. Of the 32 passengers in the motorcoach, 15 passengers were killed and 17 received serious to minor injuries. The driver of the motorcoach sustained only minor injuries. NTSB determined that the primary cause of the accident was the driver's failure to control the motorcoach due to fatigue.

Major safety issues identified in this investigation included the driver's fatigue and onboard monitoring systems, commercial driver license history, heavy vehicle speed limiters, safety management systems and motor carrier safety ratings, roadside barriers for heavy commercial passenger vehicles, and occupant injuries and motorcoach crashworthiness.[22]

This motorcoach experienced three impacts during the collision. The greatest factor in the fatalities and injuries that resulted from the accident occurred with the third stage of the accident when the coach struck the highway signpost and slid on its side along the guardrail. Once the roof of the vehicle separated from the body of the coach, several occupants were either completely or partially ejected. In addition, with the considerable destruction of the motorcoach interior and the shearing of the roof, the survival space was compromised. The intrusion of the signpost was established to have been the cause of most of the injuries sustained and all the fatalities, whether through the ejection from the vehicle or bodily impact with the signpost. It was concluded that passenger restraint systems may have mitigated the fatalities and serious injuries for some of the occupants in the rollover and collision. In addition, design changes that result in safer spacing of vehicle passenger seats and armrest configurations were also noted as potential avenues for decreasing the risks to passengers.

As a result of the accident review, the following recommendation was made to NHTSA:

- Evaluate the effects of seat spacing and armrests as factors for potential occupant injury and, if safer spacing or armrest configurations are identified, develop and implement appropriate guidelines.[23]

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[22]National Transportation Safety Board. 2012, *Motorcoach Run-Off-The-Road and Collision with Vertical Highway Signpost, Interstate 95 Southbound, New York City, NY, March 12, 2011*, Highway Accident Report NTSB/HAR-12/01, Washington, DC.

[23]*Ibid*.

The following recommendations, previously issued by NTSB, were reiterated to NHTSA:

- Develop performance standards for motorcoach occupant protection systems that account for frontal impact collisions, side impact collisions, rear impact collisions, and rollovers.
- Once pertinent standards have been developed for motorcoach occupant protection systems, require newly-manufactured motorcoaches to have an occupant crash protection system that meets the newly-developed performance standards and retains passengers, including those in child safety restraint systems, within the seating compartment throughout the accident sequence for all accident scenarios.[24]

Bus Loss of Control and Rollover, Dolan Springs, AZ, January 30, 2009. NTSB/HAB-10/01, April 2010

This HAR documents the investigation of the DW Tour and Charter accident that occurred on January 30, 2009. At 4:06 PM MST, the 2007 Chevrolet/ Starcraft 29 passenger body-on-chassis bus was traveling northbound in the right lane of U.S. Highway 93 near Dolan Springs, Arizona. As the bus approached milepost 28 at an estimated speed of 70 mph, it moved to the left and out of its travel lane. The driver steered sharply back to the right, crossing both northbound lanes, and entered the right shoulder. The driver overcorrected to the left, causing the bus to cross both northbound lanes. The bus entered the median and overturned before resting on its right side across both southbound lanes. Of the 17 occupants and driver on board, 15 were either fully or partially ejected from the bus. There were 7 fatalities (6 of whom were ejected from the vehicle) and 10 injured, including the driver.

NTSB determined that the probable cause of the accident was the bus driver's inadvertent drift from the driving lane due to distraction caused by his manipulation of the driver's side door and subsequent abrupt steering maneuver, which led to losing directional control of the vehicle. Contributing to the severity of the accident was the lack of both occupant protection and advance window-glazing standards for medium-size buses.[25]

The passenger fatalities that resulted from the accident were primarily a result of being ejected from the vehicle. Six of the seven fatalities were due to multiple head injuries and bilateral rib fractures. The serious injuries were primarily related to fractures of extremities. The primary causal element indicated in the injuries and fatalities was the lack of an occupant restraint system.

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[24] *Ibid*.

[25] National Transportation Safety Board, *Bus Loss of Control and Rollover, Dolan Springs, AZ, January 30, 2009,* NTSB/HAB-10/01, April 2010.

As a result of the accident review, the following recommendations were made to NHTSA:

- Require new commercial motor vehicles with a gross vehicle weight rating above 10,000 pounds to be equipped with lane departure warning systems.
- Develop regulatory definitions and classifications for each of the different bus body types that would apply to all USDOT agencies and promote use of the definitions among bus industry and state governments.
- Develop performance standards for all newly-manufactured buses with a gross vehicle weight rating above 10,000 pounds to require that overhead luggage racks are constructed and installed to prevent head and neck injuries and remain anchored during an accident sequence.
- Develop stability control system performance standards applicable to newly-manufactured buses with a gross vehicle rating above 10,000 pounds.
- Once performance standards have been developed, require the installation of stability control systems in all newly-manufactured buses in which this technology could have a safety benefit.
- Require that all buses above 10,000 pounds gross vehicle weight rating be equipped with on-board recording systems.[26]

Motorcoach Run off Roadway and Rollover, Interstate 87, New Westport, NY, August 28, 2006. NTSB/HAB-10/02, April 2010

This HAR documents the investigation of the Greyhound motorcoach accident that occurred on August 28, 2006. At 6:40 PM EDT, the motorcoach was traveling northbound on Interstate 87 near Westport, NY. The motorcoach was traveling down a five percent grade at a speed that increased to 78 mph. The left steer axle tire of the motorcoach experienced failure and sudden deflation, causing the motorcoach to depart the travel lane, continue across the shoulder, and strike a three-strand cable barrier. The motorcoach continued through the barrier and into the median. The motorcoach rotated clockwise, striking a large boulder with its left rear wheels, causing it to roll over before coming to rest on its roof. Of the 52 passengers on board, 4 were killed. The driver of the motorcoach was also among the fatalities.

Driver error or condition was not indicated as causal in the accident investigation. The NTSB determined that the probable cause of the accident was the failure of the left-steer-axle tire due to an extended period of low-pressure operation, which resulted in overheating and tread separation, leading to loss of vehicle control. Contributing to the accident were the imbalanced brakes, which enhanced the vehicle's counterclockwise rotation and loss of control when applied by the driver.[27]

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[26]*Ibid.*

[27]National Transportation Safety Board, *Motorcoach Run Off Roadway and Rollover, Interstate 87, New Westport, NY, August 28, 2006*, NTSB/HAB-10/02, April 2010.

The motorcoach vehicle systems that were identified as contributors to the accident include the tires and the braking system. An examination of the tires off-site demonstrated significant uneven wear for both steer axle tires. In addition, despite Greyhound's standard operating procedure requiring rotation from the steer to the tag axle when uneven wear is present, there was no evidence that rotation occurred during the most recent service. In addition, the most recent entry on the "Coach Tire Record" showed that the left- and right-rear tires were underinflated by five to six pounds per square inch. There was no notation by the tire service technician that air had been added to either tire. However, driver daily inspection reports did not denote any issue with tire pressure or wear.

The inspection of the braking system indicated uneven brake balance that was due to an inoperative antilock braking system (ABS) sensor on the left drive axle and an out of adjustment brake. It was determined that because the ABS on the left drive axle was inoperable, when the motorcoach driver applied the brakes it was likely that left drive axle brakes locked, while other brakes did not. The left side of the motorcoach would have generated a greater braking force than the right, resulting in the rotation of the vehicle to the left when braking occurred.

The passenger fatalities that resulted from the accident were primarily a result of compression of the vehicle passenger and driver compartment when the vehicle rolled. One of the fatalities was due to the partial ejection of a passenger who was crushed between the motorcoach and the ground when the motorcoach rolled. Causal elements indicated in the injuries included both the collapse of the roof during the rollover and the lack of an occupant restraint system. Of the 52 passengers, 23 were ejected from the motorcoach. Many of the serious injuries of those remaining onboard were also tied to the lack of passenger restraint.

As a result of the accident review (and review of the Sherman, TX accident summarized below), the following recommendation was reiterated to the FMCSA:

- Require that tire pressure be checked with a tire pressure gauge during pre-trip inspections, vehicle inspections, and roadside inspections of motor vehicles.[28]

The following recommendations, previously issued by NTSB (Safety Recommendations H-99-47, -48, -50, and -51), were reiterated to NHTSA:

- Develop performance standards for motorcoach occupant protection systems that account for frontal-impact collisions, side-impact collisions, rear-impact collisions, and rollovers.

[28]*Ibid.*

- Once pertinent standards have been developed for motorcoach occupant protection systems, require newly-manufactured motorcoaches to have an occupant crash protection system that meets the newly-developed performance standards and retains passengers, including those in child safety restraint systems, within the seating compartment throughout the accident sequence for all accident scenarios.
- In two years, develop performance standards for motorcoach roof strength that provide maximum survival space for all seating positions and that take into account current typical motorcoach window dimensions.
- Once performance standards have been developed for motorcoach roof strength, require newly-manufactured motorcoaches to meet those standards.[29]

The following recommendations, previously issued by NTSB, were reiterated to the American Association of Motor Vehicle Administrators:

- Revise the model *Commercial Driver's License Manual* to stipulate that tire pressure be checked with a tire gauge during pre-trip inspections, vehicle inspections, and roadside inspections of motor vehicles.[30]

Motorcoach Run-Off-the-Road and Rollover, U.S. Route 163, Mexican Hat, UT, January 6, 2008. NTSB/HAR-09-01, April 2009

This HAR documents the investigation of the Arrow Stage Lines motorcoach accident that occurred on January 6, 2008. At about 3:15 PM MST, the motorcoach was traveling southbound and descending a 5.6 percent grade that led into a curve to the left. After entering the curve, the vehicle left the right side of the roadway, struck the guardrail, traveled 350 feet along the side of the road sloping away from the roadway, and lost traction. The motorcoach rotated, descended an embankment, and overturned, striking several rocks at the bottom of the embankment. Of the 53 motorcoach occupants, there were 9 fatalities and 43 with minor to serious injuries.

Roof structural design and the lack of an occupant restraint system were identified as contributors to the serious injuries and fatalities that resulted from the accident. During the rollover, the right side of the motorcoach's roof, at the lower edge of the window sill and vertical support posts for the window, became separated from the body of the vehicle. In addition, the windshield glazing and all windows along both sides of the motorcoach were displaced.

During the accident, the majority of the passengers was ejected from the top of the motorcoach as the roof became separated. Of the 52 passengers and driver on board the motorcoach, 50 were ejected from the vehicle. The 9 fatally-wounded passengers died of blunt-force trauma to their heads and torsos. There

[29] *Ibid.*

[30] *Ibid.*

were 35 seriously-injured passengers, with 13 of those sustaining combination fractures to the spine, torso, and extremities. The remaining 12 passengers sustained serious head and internal chest injuries.

The NTSB determined that the probable cause of the accident was the driver's diminished alertness due to inadequate sleep resulting from a combination of head congestion, problems acclimating to high altitude, and his sporadic use of a continuous positive airway pressure sleeping device during the accident trip. The driver's state of fatigue affected his awareness of his vehicle's excessive speed and lane position on a downhill mountain grade of a rural secondary road. Contributing to the accident's severity was the lack of an adequate motorcoach occupant protection system.[31]

Motorcoach Run-Off-the-Bridge and Rollover, Sherman, Texas, August 8, 2008. NTSB/HAR-09-02, October 2009

This HAR documents the investigation of the Iguala BusMex, Inc., motorcoach accident that occurred on August 8, 2008. At 12:45 AM CDT, the motorcoach was traveling northbound on U.S. Highway 75 near Sherman, Texas. As the motorcoach approached the Post Oak Creek bridge at a speed of about 68 mph, its right steer axle tire failed. The motorcoach departed the roadway on an angle to the right, overrode a 7-inch-high, 18-inch-wide concrete curb, and struck the metal bridge railing. After riding against the bridge railing for about 120 feet and displacing approximately 136 feet of railing, the motorcoach went through the bridge railing and off the bridge. It fell about 8 feet and slid approximately 24 feet on its right side before coming to rest on the inclined earthen bridge abutment adjacent to Post Oak Creek. Of the 55 passengers and bus driver on board, 17 died, and 38 passengers and the driver sustained minor to serious injuries.[32]

An examination of the motorcoach right steer axle tire, conducted through an independent inspection by Bridgestone, indicated that the failure of the tire was due to "damage caused by over-deflection operation. In this case, the most probable cause of over-deflection is underinflation due to an un-repaired puncture to the tire which led to inflation pressure loss and damaging stress/strain and heat buildup…."[33]

The majority of the fatalities and serious injuries were due to blunt force trauma to the head, neck, chest and spine. Some of these injuries were due to the luggage rack on the right side of the vehicle detaching during the accident event and falling on the top of the passenger seats. The investigators were able to

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[31]National Transportation Safety Board, *Motorcoach Run-Off-the-Road and Rollover, U.S. Route 163, Mexican Hat, UT, January 6, 2008, NTSB/HAR-09-01, April 2009.*

[32]National Transportation Safety Board, Motorcoach Run-Off-the-Bridge and Rollover, Sherman, Texas, August 8, 2008, NTSB/HAR-09-02, October 2009.

[33]*Ibid.*

confirm that the detached luggage rack made passenger contact along its length. Other injuries and fatalities were due to passengers being ejected or partially ejected from the vehicle. The accident investigators were able to confirm that at least four passengers were either fully or partially ejected. The exact number of passengers ejected from the vehicle could not be confirmed because many of the injured were moved away from the motorcoach by first responders and a number of those who had been partially ejected were trapped under the vehicle. None of the passenger seating positions was equipped with occupant restraints. While the driver's seat was equipped with a 2-point lap seat belt, the driver was not using it at the time of the crash. The investigators examined the lap belt mechanism and found it to be inoperative.

The NTSB determined that the probable cause of the accident was the failure of the right-steer-axle tire due to an extended period of low-pressure operation, which resulted in sidewall, belting, and body-ply separation within the tire, leading to loss of vehicle control. In addition, the lack of an adequate occupant protection system contributed to the severity of the passenger injuries.[34]

As a result of the accident review, the following recommendations were made to the FMCSA:

- Establish a regulatory requirement that provides the NTSB, in the exercise of its statutory authority, access to all positive drug and alcohol test results and refusal determinations that are conducted under the USDOT testing requirements.
- Require that tire pressure be checked with a tire pressure gauge during pre-trip inspections, vehicle inspections, and roadside inspections of motor vehicles.
- Require those states that allow private garages to conduct FMCSA inspections of motor vehicles to have a quality assurance and oversight program that evaluates the effectiveness and thoroughness of those inspections.
- Develop an evaluation component to determine the effectiveness of the New Applicant Screening Program.[35]

The following recommendations were made to the NHTSA:

- Require all new motor vehicles weighing over 10,000 pounds to be equipped with direct tire pressure monitoring systems to inform drivers of the actual tire pressures on their vehicles.

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[34] *Ibid.*

[35] *Ibid.*

- Develop performance standards for newly-manufactured motorcoaches to require that overhead luggage racks remain anchored during an accident sequence.
- Develop performance standards for newly-manufactured motorcoaches to prevent head and neck injuries from overhead luggage racks.[36]

The following recommendations were reiterated to NHTSA:

- Develop performance standards for motorcoach occupant protection systems that account for frontal impact collisions, side impact collisions, rear impact collisions, and rollovers.
- Once pertinent standards have been developed for motorcoach occupant protection systems, require newly-manufactured motorcoaches to have an occupant crash protection system that meets the newly-developed performance standards and retains passengers, including those in child safety restraint systems, within the seating compartment throughout the accident sequence for all accident scenarios.
- In two years, develop performance standards for motorcoach roof strength that provide maximum survival space for all seating positions and that take into account current typical motorcoach window dimensions.
- Once performance standards have been developed for motorcoach roof strength, require newly-manufactured motorcoaches to meet those standards.[37]

The following recommendations were made to the American Association of Motor Vehicle Administrators:

- Revise the model Commercial Driver's License Manual to stipulate that tire pressure be checked with a tire pressure gauge during pre-trip inspections, vehicle inspections, and roadside inspections of motor vehicles.

Motorcoach Rollover on US Highway 59 near Victoria, Texas, January 2, 2008. NTSB/HAR-09-03, December 2009

This HAR documents the investigation of the Capricorn Bus Lines, Inc. / International Charter Services, Inc., accident that occurred on January 2, 2008. At approximately 4:13 AM CDT, the motorcoach was traveling northbound on U.S. Highway 59 approximately five miles south of Victoria, Texas. The motorcoach driver partially drifted off the right edge of the roadway and oversteered to the left to avoid leaving the roadway, resulting in the motorcoach coming back across both lanes, departing the left edge of the roadway and partially entering the median. The driver oversteered again to the right, and a final oversteer to the left caused the motorcoach to yaw to the left, rotate

[36] *Ibid.*

[37] *Ibid.*

counterclockwise, and overturn onto its right side. The motorcoach's right rear struck a guardrail as the motorcoach slid on it right side approximately 112 feet before coming to rest across the roadway. Within approximately five minutes of the accident event, and before emergency responders arrived at the scene, a pickup truck struck the exposed underside of the motorcoach forward the rear axle. Of the 47 passengers on board, 1 was fatally injured. Other occupants of the vehicle, including the driver, sustained minor to serious injuries. NTSB was unable to determine the extent to which the secondary collision contributed to passengers' injuries.

The fatally-injured passenger of the vehicle had been partially ejected from the vehicle and pinned beneath the motorcoach. Those passengers who sustained severe upper-extremity injuries were primarily those who were partially ejected out the right-side windows of the motorcoach. While the motorcoach was equipped with 2-point lap belts, it was determined that few passengers actually used them.

NTSB determined that the probable cause of the accident was the driver falling asleep which caused him to drift off the road, resulting in oversteer corrections when he regained awareness and subsequent vehicle loss of control and overturn. Contributing to the severity of the unrestrained passenger injuries was their striking objects and other passengers inside the motorcoach, as well as the partial ejections that occurred when the motorcoach overturned.[38]

The following recommendation related to the accident event and the injuries and fatalities that occurred as a result of the accident were provided to the FMCSA:

- Update and redistribute the "Driver Fatigue Video" to include current information on fatigue and fatigue countermeasures and make the video available electronically.

Additional recommendations were provided related to motor carriers that are operating non-FMVSS-compliant motorcoaches or other passenger-carrying commercial motor vehicles and the inspection of those vehicles. These included recommendations for NHTSA, FMCSA, the U.S. Customs and Border Protection Agency, the American Association of Motor Vehicle Administrators, the International Registration Plan, Inc., and the Commercial Vehicle Safety Alliance.

Table B-1 identifies each HAR examined and documents the probable cause of each event, as well as contributing factors to injuries and fatalities.

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[38]National Transportation Safety Board, *Motorcoach Rollover on US Highway 59 Near Victoria, Texas, January 2, 2008, NTSB/HAR-09-03, December 2009.*

Table B-1

NTSB Highway Accident Reports (HARs) Summary

HAR	Accident	Probable Cause	Contributing Factors Injuries/Fatalities[1]	Fatalities
HAR-12-02	Motorcoach Roadway Departure and Overturn on I-95, Near Doswell, VA – May 31, 2011	Driver Fatigue	• Roof collapse/structural integrity • Lack of passenger restraint system	4
HAR-12-01	Motorcoach Run-off-the-Road and Collision with Vertical Highway Signpost, I-95 Southbound, New York City, NY – March 12, 2011	Driver Fatigue	• Intrusion of outside structure • Lack of passenger restraint system	15
HAR-10-02	Motorcoach Run-off-Roadway and Rollover, I-87, New Westport, NY – August 28, 2006	Tire failure and sudden deflation due to an extended period of low pressure; Imbalance brakes contributed to loss of control	• Crushing and shifting of roof structure • Passenger ejection or partial ejection due to lack of occupant protection system (passenger restraint)	5
HAR-10-01	Bus Loss of Control and Rollover, Dolan Springs, AZ – January 30, 2009	Driver Distraction	• Lack of occupant protection • Lack of advance window glazing standards for medium-size buses	7
HAR-09-03	Motorcoach Rollover, US Highway 59, Near Victoria, TX – January 2, 2008	Driver Fatigue	• Lack of passenger restraint system – led to injuries on board and injuries and fatalities of those partially ejected	1
HAR-09-02	Motorcoach Run-off-the-Bridge and Rollover, Sherman, TX – August 8, 2008	Tire failure and sudden deflation due to underinflation; the failure to repair tire puncture	• Blunt force trauma due to collapsed roof mounted luggage rack • Passenger ejection or partial ejection due to lack of passenger restraint system	17
HAR-09-01	Motorcoach Run-Off-the-Road and Rollover, U.S. Highway 163, Mexican Hat, UT – January 6, 2008	Driver Fatigue (driver had been diagnosed with sleep apnea)	• Roof structural design • Lack of an occupant restraint system • Both resulted in ejection of passengers from vehicle	9

[1]Only includes contributors to fatalities and injuries for motorcoach occupants and driver. Does not include factors for victims in other vehicles in multi-vehicle accidents.

National Transportation Safety Board, Report on Curbside Motorcoach Safety, Special Report NTSB/SR-11/01

The NTSB conducted this special report in response to several high profile accidents that occurred in 2011. NTSB investigated motorcoach safety with a focus on curbside operations. The report describes the interstate motorcoach carrier curbside business model; describes the safety record of interstate motorcoach carriers, including those that use this model; and evaluates the adequacy of safety oversight for interstate motorcoach carriers using the curbside business model.[39]

At the time of the study, there were 4,172 active interstate motorcoach carriers operating within the U.S., 71 of which were identified as carriers providing curbside service. While accidents involving interstate motorcoach carriers are uncommon, the report did indicate that curbside carriers have higher fatal accident and out-of-service rates resulting from driver violations. The study also reported that these carriers have higher driver fitness violation rates. There is variation in the safety records of these carriers with some characterized as having very good safety records and others with safety records that are less than exemplary.

The oversight of these carriers was characterized as problematic. Conducting the volume of inspections and compliance reviews is challenging for FMCSA and state investigators. In summary, the reported noted that "the prohibition of routine en route inspections, the minimal requirements for obtaining new operating authority, the inconsistent enforcement of the requirement to submit mileage and other essential information to the FMCSA, and language barriers all indicate that oversight of curbside carriers is more challenging than that for other segments of the motorcoach industry."[40]

NTSB Report Conclusions, Recommendations and Agency Updates

Occupant crash protection and bus rollover/structural integrity are the focus areas documented in the summaries provided, drawn from the conclusions and recommendations made to various federal agencies by NTSB in response to the accident investigations documented in the Highway Accident Reports (HARs). Included below, as well as noted in Chapter 3, is the progress made by each of these agencies to address these areas and NTSB recommendations. This may include regulatory modifications recently enacted, currently underway, or proposed. This includes the Motorcoach Enhanced Safety Act (MESA) of 2012 and relevant priorities listed in NHTSA's *Vehicle Safety and Fuel Economy Rulemaking and Research Priority Plan, 2011-2013*, as well as the milestones established for these priorities.

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[39]National Transportation Safety Board, *Report on Curbside Motorcoach Safety, Special Report* NTSB/SR-11/01, Washington, DC, 2011.

[40]*Ibid.*

The Motorcoach Enhanced Safety Act (MESA) of 2012 was incorporated in MAP-21 as Subtitle G and directs the Secretary of Transportation to pursue rulemaking on occupant crash protection. The range of subjects includes improved roof support standards, advanced glazing standards, and other portal improvements to prevent partial and complete ejection of motorcoach passengers, rollover stability enhancing technology, and tire pressure monitoring systems and tire performance standards. The efforts made by USDOT in addressing these safety topics, as well as the status of these activities are discussed below.

National Highway Traffic Safety Administration

USDOT and NHTSA have long recognized the potential impact of stability control technology. Stability control helps to reduce motorcoach rollover events by applying selective braking to the slow the vehicle down. NHTSA conducted an extensive research program to focus on these vehicles to understand the performance limits of stability control systems. The agency found ESC to be most effective in reducing a vehicle's propensity to rollover or lose control. A Notice of Proposed Rulemaking requiring ESC on motorcoaches and other large buses was published on May 23, 2012. NHTSA is in the process of developing the final rule.

On August 18, 2010, NHTSA published a Notice of Proposed Rulemaking to propose to require lap/shoulder seat belts for each passenger seating position on new OTRBs and other large buses with a GVWR of 11,793 kg or greater. These vehicles were defined as motorcoaches. NHTSA's safety research on motorcoach seat belts, completed in 2009, shows that the installation of lap/shoulder seat belts on motorcoaches is practicable and effective in reducing the likelihood of ejection and in mitigating crash forces in frontal impacts. The final rule is under development and review.

In 2008, NHTSA conducted roof crush/rollover test on two older motorcoach models to evaluate two existing roof crush/rollover test procedures—one for school buses and the other specified in European regulations. The objective of these tests was to determine the feasibility of their application to motorcoaches sold in the United States. In 2009, NHTSA tested a newer motorcoach using the European test protocol and determined appropriate performance requirements for rollover structural integrity to maintain the occupant survival space. NHTSA expects to issue a notice of proposed rulemaking to establish a new safety standard to enhance the rollover structural integrity of large buses in 2013.

In 2006, NHTSA completed a joint research program with Canada, to examine advanced glazing and window retention. Preliminary results indicated that preventing ejection would involve not only glazing, but also the structural integrity of the motorcoach to ensure that the glazing would not detach in the event the structure of the vehicle is twisted.

National Highway Traffic Safety Administration

NHTSA Special Crash Investigations

The following section provides a summary of Special Crash Investigations (SCIs) performed for the National Highway Traffic Safety Administration. The summary of the SCI reports below only includes those crashes that resulted in injuries or fatalities of the vehicle occupants, including the driver.

Calspan On-Site Motorcoach Rollover Investigation, New York, July 2011. SCI Case No. CA11020

This SCI, performed by Calspan for the NHTSA Office of Defects Investigation, documents the rollover of a 2007 Motor Coach Industries motorcoach. The specific date of the crash and the time of day within which the crash occurred were not indicated in the report. In July 2011, the motorcoach was traveling northbound and experienced a right front tire failure, shredding, and separation. The driver lost control of the vehicle, crossed the right shoulder, and traveled into a ditch, causing the vehicle to roll onto its left side. The vehicle continued moving forward on its side through the tree line adjacent to the roadway. Of the 35 passengers on board, 2 were fatally injured. All other occupants of the vehicle were transported to area hospitals, with 19 of those, including the driver, admitted for treatment.

The fatally-injured passengers included one female who was ejected from the vehicle and a second female who remained on the coach during the crash, but died of injuries sustained during the event. No additional information was provided within the report to indicate the specific injuries that resulted in the fatality. The report indicated that all passengers were thrown out of their seats and forward when the vehicle impacted the bank of the ditch and were then thrown to the left side of the bus when the vehicle rolled onto its side. A number of those injured sustained various fractures as a result of these movements. Head injuries were also noted due to contact with the vehicle's overhead luggage compartment. The report did not discuss the existence or use of passenger restraints. The driver was using a lap belt.

The local police investigation determined that the failure of the right front tire was a "probable contributory factor to the crash."[41] Contributing to the severity of the unrestrained passengers' injuries was their striking objects and other passengers inside the motorcoach, ejections that occurred when the vehicle hit the ditch embankment and turn on its side (two ejections occurred, one fatal), and the deformation of the passenger compartment.

[41] *Calspan On-Site Motorcoach Rollover Crash Investigation, SCI Case No.: CA11020, New York*, Calspan Corporation, National Highway Traffic Safety Administration, February 2012.

Calspan On-Site Motorcoach Fire Investigation, Texas, July 2010. SCI Case No. CA10032

This SCI, performed by Calspan for the NHTSA Office of Defects Investigation, documents the fire occurring on a 2007 Motor Coach Industries motorcoach. The specific date of the crash and the time of day within which the crash occurred were not indicated in the report. In July 2010, the motorcoach was traveling from Mexico to the United States along a limited-access highway in rural Texas when passengers noticed smoke entering the passenger compartment through the floor and air conditioning vents and notified the driver. The driver exited the highway and entered an off-ramp, pulled the vehicle over and opened the right front access door, instructing passengers to evacuate. The fire quickly spread through the vehicle compartment. Of the 38 passengers on board, 6 were transported to local hospitals, with 2 of them treated for smoke inhalation; the remaining 4 were evaluated and released. All other occupants of the vehicle, including the driver, were uninjured.

The investigation determined that the origin of the fire was in the vehicle undercarriage, forward of the drive axle. The fire investigators report, provided as an appendix to the SCI, established that "this fire is consistent with an electrical fire of undetermined cause."[42] The contributing factor to the injuries sustained by passengers was smoke inhalation.

Calspan On-Site Motorcoach Rollover Investigation, New York, June 2010. SCI Case No. CA10020

This SCI, performed by Calspan for the NHTSA Office of Defects Investigation, documents the rollover of a 1997 Motor Coach Industries motorcoach. The specific date on which the crash occurred was not indicated in the report. The report did indicate that the event occurred in during early morning, approximately 5:30 AM. In June 2010, the motorcoach was traveling from New Jersey to New York when the driver veered off the travel lane, crossed the shoulder, and traveled into the grassed roadside running adjacent to the travel lane. The vehicle rotated clockwise, slid into three small trees, and tipped approximately one quarter of a turn onto its right side (described as a "soft rollover event"[43]). Of the 20 passengers on board, 6 sustained minor injuries and were transported to area hospitals. There were no serious injuries or fatalities.

The probable cause indicated in the report was driver fatigue. The report did not provide any conclusions about the contributing factors for the injuries. However, the vehicle was not equipped with occupant restraints and, therefore, unrestricted movement within the vehicle during the event sequence may have contributed to those injuries.

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[42]*Calspan On-Site Motorcoach Fire Crash Investigation, SCI Case No.: CA10032, Texas*, Calspan Corporation, National Highway Traffic Safety Administration, November 2010.

[43]*Calspan On-Site Motorcoach Rollover Crash Investigation, SCI Case No.: CA10020, New Jersey*, Calspan Corporation, National Highway Traffic Safety Administration, November 2010.

On-Site Tour Bus Investigation, Nevada, August 2008. Case No. DS08026, Dynamic Science, Inc.

This onsite tour bus investigation, performed by Dynamic Science, Inc., for NHTSA, documents the crash of a 2007 BCI Falcon 45 tour bus. The specific date on which the crash occurred was not indicated in the report. The report did indicate that the event occurred at approximately 6:50 PM. In August 2008, the vehicle was traveling northbound, in the center lane of a three-lane divided highway and experience a left front tire failure and tread separation. The vehicle veered sharply to the left, crossed the adjacent travel lane, and struck a metal guardrail with the left front bumper. The bus continued moving forward and struck a concrete barrier, finally coming to rest. Of the 37 passengers and the driver, all sustained injuries ranging from lacerations and contusions to fractures. Thirty passengers were transported to trauma centers and local hospitals; 7 passengers were injured, but were not transported. There were no fatalities.

The report indicated that the majority of the injuries were due to the occupants being displaced from their seats and making contact with seat backs, with some lacerations the result of broken glass. The vehicle was not equipped with occupant restraints, although one position, adjacent to the driver, was equipped with a lap belt. The driver position did have a lap belt, but it was not in use at the time of the crash.

Table B-2 provides a brief summary of the SCI reports.

Table B-2

NHTSA Special Crash Investigation (SCI) Summary

SCI Case #	Investigation	Determination of Origin	Probable Cause	Injuries / Fatalities[1]
CA11020	Roadside departure and motorcoach rollover, New York Interstate, July 2011	Right front tire	Tire blowout	2 fatalities
CA10032	In-transit motorcoach fire, Texas, July 2010	Center of rear-most luggage compartment, forward of the drive axle	Electrical fire of undetermined cause	2 injuries
CA10020	Roadside departure motorcoach rollover, New Jersey Interstate, June 2010	Driver fatigue	Driver steering input, brake application & roadway slope	6 injuries
DS08026	Motorcoach shuttle tread separation, Nevada Interstate, August 2008	Left front tire	Tread separation	37 injuries

[1]Includes only injuries or fatalities for motorcoach occupants and driver.

NHTSA Vehicle Safety and Fuel Economy Rulemaking and Research Priority Plan, 2011–2013, March 2011

This identifies projects and safety focus areas which NHTSA intends to include within rulemaking processes or the research agenda through 2013. NHTSA's priority projects within the "Heavy Vehicle" program area for 2011-2013 include:

- Truck Tractor and Motorcoach Stability Control
- Medium Truck and Bus Stability Control
- Motorcoach Lap/Shoulder Belts
- Motorcoach Fire Safety
- Motorcoach Emergency Evacuation
- Motorcoach Rollover Structural Integrity

Federal Motor Carrier Safety Administration

U.S. Department of Transportation 2012 Motorcoach Safety Action Plan (MSAP), Federal Motor Carrier Safety Administration/National Highway Traffic Safety Administration, December 2012

The 2012 MSAP updates the 2009 plan, providing the status of "priority action items" and updates the accomplishments that occurred in prior years. It reflects the commitment across the Department's modal administrations to improve motorcoach safety through their representation in the update of the Plan and their ongoing commitment to share and coordinate with FMCSA. It also includes the feedback received from motorcoach stakeholders who participated in the 2011 Motorcoach Safety Summit. The Plan expands the safety provisions included in the prior report and emphasizes the following on-going target areas:

- Driver Fatigue
- Driver Behavior
- Vehicle Maintenance
- Operator Oversight
- Data Collection and Analysis
- Crash Avoidance Measures
- Occupant Protection

Bus Crash Causation Study, Federal Motor Carrier Safety Administration, FMCSA-RRA-10-003, January 2010

The Bus Crash Causation Study was conducted by FMCSA and NHTSA and included the review, evaluation, and on-site data collection of 39 fatal and injury crashes that occurred in New Jersey in 2005 and 2006. New Jersey was selected as the data collection site due to the high volume and variety of bus traffic; a high level of interest in bus crashes expressed by federal, state, and local New Jersey government officials; and a strong state bus safety program.[44]

The on-site data collection activities included interviews with the bus driver, passengers, and any witnesses. In addition, crash forms were used for each crash that captured the following information:

- Location, date, time, and sequence of the crash event and collision measurements
- Bus and bus driver inspection results
- Roadway, weather and traffic conditions
- Pre-crash events
- Driver age, sex, physical characteristics, and injury severity
- Driver's use of drugs or alcohol[45]

The study concluded that human errors by bus drivers, other vehicle drivers, and pedestrians or bicyclists were the critical reasons for bus crashes in 90 percent of the cases examined. Only four of the crashes examined were related to other factors. Two of these events were related to bus fires, one related to brake failure, and one that was the result of ice on the roadway.

Many of the bus driver errors were not characterized as activities that violated laws or regulations. The authors did indicate that in many instances these human errors were accompanied by other federal violations, such as failure to comply with hours-of-service regulations or vehicle safety standards.[46]

[44]Federal Motor Carrier Safety Administration, Office of Analysis Research and Technology, *Bus Crash Causation Study,* Publication No. FMCSA-RRA-10-003, January 2010.

[45]*Ibid.*

[46]*Ibid.*

APPENDIX

C

Limitations of Study

Bus Safety Study data used in this report are maintained by several agencies (predominantly FTA, FMCSA and NHTSA), each with unique departmental priorities that are reflected in the types of data collected. Comparison could not be conducted between each dataset for each mode.

OTRB crash data from the study corridors are sourced from Police Accident Reports (PARs) from nine states, among which, data collection and maintenance methods vary. The completeness of crash records from PARs is somewhat inconsistent. In some cases, the state's scanned multi-page PARs were available for analysis, while for other states, findings were extrapolated from coded database records. In both situations, intermittent problems existed in determination of public or private bus ownership and discerning semi-truck from bus accidents.

OTRB injury statistics are presented from the MCMIS and are maintained as total number of injured persons in the crash among all vehicles involved in the crash. This does not allow for comparing injuries sustained by occupants of the OTRB to the injuries sustained by the transit vehicle occupants. This level of data for OTRB is unavailable.

One of the nine states, within which the study corridors are located, did not present data to the study team. Two other states were only able to provide three of the five years of crash records requested for the analysis.

Regarding the NTD data, the reporting form for the major safety occurrences includes information on fatalities and those injured, such as whether they were passengers, employees, inside or outside the transit vehicle, an occupant of another involved vehicle or a pedestrian/ passerby. Information on any other vehicles involved is provided, as well as the estimated vehicle speed and the type of collision (head-on, side-swipe, rear-end, etc.). Also provided is the type of roadway on which the collision occurred and the address or location. This makes it possible to identify the relevant collisions that occurred on the corridors identified for this study. It should be noted, however, that the location field is open-ended and information can be entered in any number of formats (e.g., Interstate 90, I-90, Route 90, East 90, EB 90, etc., all refer to the same roadway).

While in the NTD, it was straightforward to closely examine the location and other information for the relevant collisions for the study's identified corridors, it was not possible to read through the thousands of open-ended location information when compiling data at the national level. As such, data were filtered according to roadway configuration, primarily "limited-access highway." However, some relevant collisions on interstate highways were also found classified under the roadway configurations of “divided highway” and “ramp.” These additional relevant incidents were discovered when previously identified incidents were not found in the “limited-access highway” filter, thus encouraging the study team to search under additional roadway configurations. It must also be noted that not all roadways classified as limited-access highways are high-speed, for purposes of this study. Still, the use of collisions on limited-access highways, as well as select collisions from the classifications of “divided highway” and “ramp,” are considered to be a sufficient proxy for estimating the amount of collisions that occur nationwide in public transit vehicles on high-speed roadways.

In addition, the NTD reporting form does not provide information on where in the transit vehicle an affected passenger was located or whether that passenger was sitting or standing, and it does not provide information on the total number of passengers on board a vehicle during the collision. Also missing from the NTD reporting form is whether a vehicle problem or defect was a factor in the collision. There is an open-ended field where the person completing the form provides a description, and some of this additional information is included in that narrative. However, there is no standard format for entering such information and different individuals among different agencies provide widely varying levels of details in their descriptions. It is for this reason that, with relevant collisions or other safety occurrences identified, the project staff contacted the affected transit agencies to access the agencies’ internal accident reports and/or other relevant information, which may contain more detailed information that can be useful for this study. Again, for the national presentation of public transportation data, it was not possible to read through thousands of open-ended collision descriptions. Some of the collisions on the study’s identified corridors turned out to have occurred in non-revenue service, such as deadheading, and thus are not relevant for this study. It is possible that some of the collisions nationally occurred in non-revenue service.

An additional comment on the NTD data is that “other safety occurrences not otherwise classified” are not included. These “non-major” incidents are not collisions but include occurrences such as when individuals on the bus are injured due to evasive action by the operator, fast starts or stops by the operator, or other factors. The vast majority of these types of incidents is related to boarding and alighting at transit stops and is not relevant for this study. While there may be some of these incidents that are relevant, the manner in which these data are reported by the transit agencies (tallied by month; no detail provided) makes it impossible to collect this information within the time frame of this study.

Other annual NTD data for the transit agencies, such as service consumed and supplied, is only available through 2011 (for many agencies, the first submission of their annual NTD reports was due January 31, 2013, yet there are usually several rounds of submissions until the reports are "closed out" by FTA, usually in the late spring or summer).

APPENDIX

D

National Transit Database Glossary

(Includes only terms relevant to this study)

A

AB

Vehicle Type: Articulated Buses

Angle

A collision type involving an impact to anywhere on the side of a vehicle with the exception of a sideswipe. Can be found in: S&S-40

Average Trip Length

The average distance ridden for an unlinked passenger trip (UPT) by time period (weekday, Saturday, Sunday) computed as passenger miles traveled (PMT) divided by unlinked passenger trips (UPT). Can be found in: S-10

B

BR

Vehicle type: Over-the Road Buses

Bus (MB)

A transit mode comprised of rubber-tired passenger vehicles operating on fixed routes and schedules over roadways. Vehicles are powered by:

- Diesel
- Gasoline
- Battery
- Alternative fuel engines contained within the vehicle.

Can be found in: B-10, MR-10, S&S Introduction, S&S-10, RU-20

Bus Rapid Transit (RB)

Fixed-route bus systems that either (1) operate their routes predominantly on fixed-guideways (other than on highway HOV or shoulder lanes, such as for commuter bus service) or (2) that operate routes of high-frequency service with the following elements: Substantial transit stations, traffic signal priority or pre-emption, low-floor vehicles or level-platform boarding, and separate branding of the service. High-frequency service is defined as 10-minute peak and 15-minute off-peak headways for at least 14 hours of service operations per day. This mode may include portions of service that are fixed-guideway and non-fixed-guideway. Can be found in: B-10, MR-10, S&S Introduction, S&S-10

Bus Stop

Pre-defined location for passengers to board and/or alight the transit vehicle, typically on-street, at the curb, or in a median, sometimes with a shelter, sign, or lighting. Can be found in: S&S-40

Buses (BU)

Vehicle type: Rubber-tired passenger vehicles powered by diesel, gasoline, battery or alternative fuel engines contained within the vehicle. Vehicles in this category do not include articulated, double-decked, or school buses. Can be found in: A-30

C

Collision

A vehicle accident in which there is an impact of a transit vehicle with:

- Another transit vehicle
- A non-transit vehicle
- An object
- A person(s) (suicide excluded)
- An animal
- A rail vehicle
- A vessel
- A dock

Can be found in: S&S-40

Commuter Bus (CB)

Fixed-route bus systems that are primarily connecting outlying areas with a central city through bus service that operates with at least five miles of continuous closed-door service. This service typically operates using motorcoaches (aka over-the-road buses), and usually features peak scheduling, multiple-trip tickets, and multiple stops in outlying areas with limited stops in the central city. Can be found in: B-10, MR-10, S&S Introduction, S&S-10

Controlled Access Right-of-way (ROW)

Lanes restricted for at least a portion of the day for use by transit vehicles and other high occupancy vehicles (HOV). Use of controlled access lanes may also be permitted for vehicles preparing to turn. The restriction must be sufficiently enforced so that 95 percent of the vehicles using the lanes during the restricted period are authorized to use them. Can be found in: A-20, S-10, FFA-10

D

Deadhead (Miles and Hours)

The miles and hours that a vehicle travels when out of revenue service. Deadhead includes:

- Leaving or returning to the garage or yard facility
- Changing routes
- When there is no expectation of carrying revenue passengers.

However, deadhead does not include:

- Charter service
- School bus service
- Operator training
- Maintenance training

Can be found in: Internet Reporting, S-10, R-20, MR Internet Reporting, MR-20

Demand Response (DR)

A transit mode comprised of passenger cars, vans or small buses operating in response to calls from passengers or their agents to the transit operator, who then dispatches a vehicle to pick up the passengers and transport them to their destinations. A demand response (DR) operation is characterized by the following:

a) The vehicles do not operate over a fixed route or on a fixed schedule except, perhaps, on a temporary basis to satisfy a special need, and

b) Typically, the vehicle may be dispatched to pick up several passengers at different pick-up points before taking them to their respective destinations and may even be interrupted en route to these destinations to pick up other passengers. The following types of operations fall under the above definitions provided they are not on a scheduled fixed route basis:

    - Many origins - many destinations
    - Many origins - one destination
    - One origin - many destinations
    - One origin - one destination

Can be found in: B-10, MR-10, S&S Introduction, S&S-10, RU-10

Demand Response-Taxi (DT)

A special form of the demand response mode operated through taxicab providers. The mode is always purchased transportation type of service. Can be found in:B-10, MR-10, S&S Introduction, S&S-10

Directional Route Miles (DRM)

The mileage in each direction over which public transportation vehicles travel while in revenue service. Directional route miles (DRM) are: A measure of the route path over a facility or roadway, not the service carried on the facility; e.g., number of routes, vehicles, or vehicle revenue miles. Computed with regard to direction of service, but without regard to the number of traffic lanes or rail tracks existing in the right-of-way (ROW).

Directional route miles (DRM) do not include staging or storage areas at the beginning or end of a route. Can be found in: A-20, S-10, S-20, FFA-10, Declarations

Directly Operated (DO)

Transportation service provided directly by a transit agency, using their employees to supply the necessary labor to operate the revenue vehicles. This includes instances where an agency's employees provide purchased transportation (PT) services to the agency through a contractual agreement. Can be found in: Introduction, B-10, F-10, F-20, A-10, R-10, R-20, R-30, FFA-10, Declarations, MR Introduction, MR-10, S&S Introduction, S&S-10, S&S-40, S&S-50, RU-10

Divided Highway

A highway divided down the middle by a barrier that separates traffic going in different directions. Can be found in: S&S-40

E

Evacuation

A condition requiring all passengers/customers and employees to depart a transit vehicle or transit property due to the presence of imminent danger. This condition does not include transfer from one vehicle to another due to the mechanical failure of a vehicle. Can be found in: S&S Introduction, S&S-40 RU-20

Exclusive right-of-way (Safety and Security Reporting)

Transit right-of-way (ROW) from which all other motor vehicle and pedestrian traffic, mixed and cross, is excluded. Can be found in: S&S-40

Exclusive Right-of-Way (ROW)

Roadway or other right-of-way (ROW) reserved at all times for transit use and / or other high occupancy vehicles (HOV). The restriction must be sufficiently enforced so that 95 percent of vehicles using the right-of-way (ROW) are authorized to use it. Can be found in: A-20, S-10, FFA-10, Declarations

F

Fatality

A death or suicide confirmed within 30 days of a reported incident. Does not include deaths in or on transit property that are a result of illness or other natural causes. Can be found in: S&S Introduction, S&S-40, RU-20

Fire

Uncontrolled combustion made evident by flame and / or smoke that requires suppression by equipment or personnel. Can be found in: S&S-40, S&S-50

Fixed Route Services

Services provided on a repetitive, fixed schedule basis along a specific route with vehicles stopping to pickup and deliver passengers to specific locations; each fixed route trip serves the same origins and destinations, such as rail and bus (MB); unlike demand responsive (DR) and vanpool (VP) services. Can be found in: A-10, A-20, S-10

FTA

Federal Transit Administration

FYE

Fiscal Year End

H

Hazardous Materials Spill

The spill or release of any amount of hazardous material that creates an imminent danger to life, health, or the environment and requires special attention be given to clean up the material. Can be found in: S&S-40

Head-on

A collision type where two vehicles coming from opposite directions impact each other straight on in the front; or in a T-bone or broadside collision, where the front of a vehicle (head-on) impacts the side (angle) of another vehicle. Can be found in: S&S-40

Heavy Rail (HR)

A transit mode that is an electric railway with the capacity for a heavy volume of traffic. It is characterized by:

- High speed and rapid acceleration passenger rail cars operating singly or in multi-car trains on fixed rails
- Separate rights-of-way (ROW) from which all other vehicular and foot traffic are excluded
- Sophisticated signaling
- High platform loading

Can be found in: B-10, MR-10, S&S Introduction, S&S-10, RU-10

Hybrid Rail (YR)

Rail System Primarily operating routes on the National system of railroads, but not operating with the characteristics of commuter rail. This service typically operates light rail-type vehicles as diesel multiple-unit trains (DMU's). These trains do not meet Federal Railroad Administration standards, and so must operate with temporal separation from freight rail traffic. Can be found in: B-10, MR-10, S&S Introduction, S&S-10

I

Injury

Any physical damage or harm to persons as a result of an incident that requires immediate medical attention away from the scene. Can be found in: S&S Introduction, S&S-40, S&S-50, RU-20

L

Light Rail (LR)

A transit mode that typically is an electric railway with a light volume traffic capacity compared to heavy rail (HR). It is characterized by:

- Passenger rail cars operating singly (or in short, usually two car, trains) on fixed rails in shared or exclusive right-of-way (ROW)
- Low or high platform loading
- Vehicle power drawn from an overhead electric line via a trolley or a pantograph

Can be found in: B-10, MR-10, S&S Introduction, S&S-10, RU-10

Limited-access Highway

A controlled-access road to which access from adjacent properties is limited in some way. It can mean anything from a city street to which the maintaining authority limits driveway access to a freeway (or other equivalent terms). The precise definition may vary by jurisdiction. Often, on these kinds of road, low-speed vehicles and non-motorized uses including pedestrians, bicycles, and horses, are not permitted. Can be found in: S&S-40

M

MB

Mode: Bus

Mode

A system for carrying transit passengers described by specific right-of-way (ROW), technology and operational features. Can be found in: Introduction, Internet Reporting, B-10, F-20, F-30, F-40, A-10, A-20, A-30, S-10, S-20, R-10, R-20, R-30, FFA-10, Declarations, MR Introduction, MR-10, MR-20, S&S Introduction, S&S-10, S&S-30, S&S-40, RU-10

Monorail/Automated Guideway (MG)

Monorail and Automated Guideway modes on exclusive guideway without using steel wheels on rails.

N

Non-Revenue Facility

A facility or an area that is not used to enable individuals to board or alight transit vehicles, and that is primarily staffed by transit employees. Can be found in: S&S-40, S&S-50

NTD

National Transit Database

NTD Identification Number (NTD ID)

A unique FTA-assigned number (NTD ID) that each transit agency must have before filing a report. Can be found in: Introduction, B-10, MR Introduction, S&S Introduction

O

Occurrences

The number of events or incidents experienced. Can be found in: S&S-50

Operators

The personnel (other than security agents) scheduled to be aboard vehicles in revenue operations, including: Vehicle operators; Conductors; Ticket collectors. Operators may also include: Attendants who are transit agency employees that are aboard vehicles to assist riders in boarding and alighting, securing wheelchairs, etc., typically the elderly and persons with disabilities. Can be found in: Introduction, F-30, MR Introduction, S&S Introduction

Other Front Impact

Any collision type that impacts the front of the vehicle and that would not be described as head-on. Can be found in: S&S-40

Other Motor Vehicle

Encompasses multiple types of motorized passenger vehicles such as automobiles, minivans, pickup trucks, motorcycles, rail cars, and buses intended for roadway or rail travel. Can be found in: S&S-40

Other Safety Occurrences not Otherwise Classified (OSONOC)

Includes incidents such as: slips, trips, falls, electric shock, yard derailments, smoke or the odor of smoke/chemicals noticed in a transit vehicle or facility, or other safety events not specifically listed as a Reportable Incident but which meet a reportable incident threshold.

Can be found in S&S-40, S&S-50

Over-the-Road Bus

A bus characterized by an elevated passenger deck located over a baggage compartment. Can be found in: MR Introduction, RU-10

P

Passenger

An individual on board, boarding, or alighting from a revenue transit vehicle. Excludes operators, transit employees and contractors. Can be found in: S&S-40

Passenger Miles Traveled (PMT)

The cumulative sum of the distances ridden by each passenger. Can be found in: Internet Reporting, F-10, S-10, FFA-10, Declarations, MR Internet Reporting

Property Damage

The estimated dollar value of all property that is damaged in a Reportable Incident. This includes transit-owned property and other vehicles and property involved in the incident that are not owned by the transit agency (excludes personal property such as cell phones and computers). Property damage also includes the cost of clearing wreckage. Can be found in: S&S Introduction, S&S-40, RU-20

Public Agency or Transit System

A public entity that provides public transportation services. It may be a state or local government, or any department, special purpose district (e.g. transit or transportation district), authority or other instrumentality of one or more state or local governments (e.g., joint powers agency). Can be found in: Introduction, B-30, F-10, A-10, MR Introduction, S&S Introduction

Public Transportation

As defined in the Federal Transit Act, "transportation by a conveyance that provides regular and continuing general or special transportation to the public, but does not include school bus, charter, or intercity bus transportation or intercity passenger rail transportation provided by the entity described in chapter 243 (or a successor to such entity)."

Notes: (1) Passenger rail transportation refers to Amtrak. (2) This definition does not affect the eligibility of intercity bus service under the Section 5311 Other Than Urbanized Area (Rural) Formula Program. (3) The intercity bus and intercity rail (Amtrak) portion of Intermodal terminals is however an eligible capital cost. Can be found in: Introduction, B-10, A-10, A-20, A-30, MR-10, S&S Introduction, RU Introduction

Purchased Transportation (PT)

Transportation service provided to a public transit agency or governmental unit from a public or private transportation provider based on a written contract. The provider is obligated in advance to operate public transportation services for a public transit agency or governmental unit for a specific monetary consideration, using its own employees to operate revenue vehicles. Purchased transportation (PT) does not include:

- Franchising
- Licensing operations
- Management services
- Cooperative agreements
- Private conventional bus service

Can be found in: Introduction, B-10, B-30, F-10, F-20, F-30, A-10, A-20, A-30, R-30, FFA-10, Declarations, MR Introduction, MR-10, MR-20, S&S Introduction, S&S-10, S&S-40, S&S-50, RU-10

R

RB

Mode: Bus Rapid Transit

Rear-ended

A collision type where a vehicle is impacted on its back end by the front of another vehicle. Can be found in: S&S-40

Rear-ending

A collision type where the front of a vehicle impacts the back end of another vehicle. Can be found in: S&S-40

Reportable Incident

A safety or security incident occurring on transit property or otherwise affecting revenue service that results in one or more of the following conditions: A fatality confirmed within 30 days of the incident; An injury requiring immediate medical attention away from the scene for one or more persons; Property damage equal to or exceeding $25,000; An evacuation for life safety reasons; orA mainline derailment.

Can be found in: S&S Introduction, S&S-40

Reporting Waiver

Relief from filing an NTD report. Can be found in: Introduction, Internet Reporting, S&S Introduction

Revenue Service (Miles, Hours, and Trips)

The time when a vehicle is available to the general public and there is an expectation of carrying passengers. These passengers either: Directly pay fares; Are subsidized by public policy, or Provide payment through some contractual arrangement; Vehicles operated in fare free service are considered in revenue service. Revenue service includes: Layover / recovery time; Revenue service excludes: Deadhead, Vehicle maintenance testing, School bus service, and Charter service.

Can be found in: A-10, A-30, S-10, R-20, FFA-10, Declarations

Revenue Vehicle

The floating and rolling stock used to provide revenue service for passengers. Can be found in: Introduction, B-10, F-20, F-30, A-10, S-10, R-10, R-20, R-30, Declarations, MR Introduction, MR-10, S&S Introduction, S&S-40

Right-of-way

The area through which a train travels; a train's dynamic envelope. Can be found in: S&S-40

S

Safe Operation

Concept that applies to priority lanes on freeways, expressways and other /high-speed facilities used by bus (MB) mode and other high occupancy vehicles (HOV), i.e., vanpools (VP) and carpools, to ensure safe travel. For these lanes, there must be some indication of separation to ensure safe access between free flowing high occupancy vehicle (HOV) lanes and the congested, unrestricted lanes. Separation can be accomplished at least two ways:

1. Physical barriers such as cones, concrete dividers, medians
2. Pavement markings such as a double solid wide line, a single solid wide line, a single broken wide line, or a diagonally striped area between lanes.

Can be found in: S-20

Safety

Component activities include: Providing supervision and clerical support for a system safety program; Providing safety-first and other campaigns among employees or the public for the purpose of preventing accidents and damages; Compiling and maintaining safety statistics.

Can be found in: F-30

Safety Incidents

A collision, derailment, fire, hazardous material spill, act of nature (Act of God), evacuation, or OSONOC occurring on transit-controlled property and meeting established NTD thresholds. Can be found in: S&S Introduction, S&S-40, S&S-50, RU-20

Security Incident

An occurrence of a bomb threat, bombing, arson, hijacking, sabotage, cyber security event, assault, robbery, rape, burglary, suicide, attempted suicide, larceny, theft, vandalism, homicide, fare evasion, trespassing, nonviolent civil disturbance, or CBR (chemical/biological/radiological) or nuclear release. Can be found in: S&S Introduction, S&S-40, S&S-50

Service Consumed

The amount of service actually used by passengers and which is measured by unlinked passenger trips and passenger miles traveled. Can be found in: S-10

Service Supplied

The amount of service scheduled or actually operated. Service supplied is measured in vehicles, miles and / or hours that were operated. Can be found in: S-10

Sideswipe

A collision type in which two vehicles traveling in the same direction or opposite directions contact each other along the side in a scraping-type action, or a moving vehicle scraping its side against a stationery object. Can be found in: S&S-40

Sideswipe

A collision type in which two vehicles traveling in the same direction or opposite directions contact each other along the side in a scraping-type action, or a moving vehicle scraping its side against a stationery object. Can be found in: S&S-40

Small System Waiver (30 or Fewer Vehicles)

Relief from filing a complete NTD report if the transit agency operates nine or fewer vehicles in annual maximum service across all modes and types of service (TOS), and all service operates on non-fixed guideway (NFG) (mixed traffic right-of-way (ROW)). Can be found in: Introduction, Internet Reporting, B-10, Declarations, MR Introduction, MR-10, S&S Introduction

Streetcar Rail (SR)

This mode is for rail transit systems operating entire routes predominantly on streets in mixed-traffic. This service typically operates with single-car trains powered by overhead catenaries and with frequent stops.

T

Transit

Synonymous term with public transportation. Can be found in: B-10

Transit Passenger

A person who is: On board, Boarding, Alighting from a transit vehicle for the purpose of travel.

Excludes operators, transit employees, and contractors. Can be found in: S&S Introduction, S&S-40, S&S-50

Trolleybuses (TB)

Vehicle Type: Rubber-tired, electrically powered passenger vehicles operated on city streets drawing power from overhead lines with trolleys. Reporting manual reference: A-30, S&S-40

U

Unlinked Passenger Trips (UPT)

The number of passengers who board public transportation vehicles. Passengers are counted each time they board vehicles no matter how many vehicles they use to travel from their origin to their destination. Can be found in: Internet Reporting, F-10, S-10, FFA-10, Declarations, MR-20

UZA

Urbanized Area

V

Vanpool (VP)

A transit mode comprised of vans, small buses and other vehicles operating as a ride sharing arrangement, providing transportation to a group of individuals traveling directly between their homes and a regular destination within the same geographical area. The vehicles shall have a minimum seating capacity of seven persons, including the driver. For inclusion in the NTD, it is considered mass transit service if it meets the requirements for public mass transportation and is publicly sponsored.

Vehicle Revenue Hours (VRH)

The hours that vehicles are scheduled to or actually travel while in revenue service. Vehicle revenue hours include Layover / recovery time, but exclude: Deadhead, Operator training, and Vehicle maintenance testing, as well as School bus and charter services.

Can be found in: S-10

Vehicle Revenue Miles (VRM)

The miles that vehicles are scheduled to or actually travel while in revenue service. Vehicle revenue miles include Layover / recovery time, but exclude: Deadhead, Operator training, and Vehicle maintenance testing, as well as School bus and charter services.

Can be found in: F-10

Vehicle Type

The form of passenger conveyance used for revenue operations. Can be found in: A-30, S&S-40, RU-20

Vehicles Operated in Annual Maximum Service (VOMS)

The number of revenue vehicles operated to meet the annual maximum service requirement. This is the revenue vehicle count during the peak season of the year, on the week and day that maximum service is provided. Vehicles operated in maximum service (VOMS) exclude: Atypical days, or One-time special events.

Can be found in: Introduction, Internet Reporting, B-10, B-30, A-30, S-10, Declarations, MR Introduction, MR-10, MR-20

Y

YR

Mode: Hybrid Rail

APPENDIX

E

Acronyms

AASHTO	American Association of State Highway and Transportation Officials
ABA	American Bus Association
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASE	National Institute for Automotive Service Excellence
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AOBRD	Automatic On-board Recording Device
APTA	American Public Transportation Association
BASIC	Behavioral Analysis Safety Improvement Category
BCCS	Bus Crash Causation Study
BMI	Body Mass Index
BRT	Bus Rapid Transit
CAPRI	Compliance Analysis and Performance Review Information [system]
CB	Commuter Bus
CDL	Commercial Driver's License
CDLIS	Commercial Driver's License Information System
CFR	*Code of Federal Regulations*
CG	Center of Gravity
CID	Client Identification Number
CMV	Commercial Motor Vehicle
CSA	Compliance, Safety, Accountability [program]
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
CUTR	Center for Urban Transportation Research
CVSA	Commercial Vehicle Safety Alliance
DDWS	Drowsy Driver Warning System
DMV	Department of Motor Vehicles
DVIR	Driver Vehicle Inspection Report
ECM	Electronic Control Module
EMS	Emergency Medical Service

FAC	Florida Administrative Code
FARS	Fatality Analysis Reporting System
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FMCSRs	Federal Motor Carrier Safety Regulations
FMP	Fatigue Management Program
FMVSS	Federal Motor Vehicle Safety Standards
FR	Federal Register
FTA	Federal Transit Administration
GES	General Estimates System
GPS	Global Positioning System
GTFS	General Transit Feed Specification
GVWR	Gross Vehicle Weight Rating
HAR	Highway Accident Report
HMR	Hazardous Materials Regulations
HOV	High Occupancy Vehicle Lanes
HPMS	Highway Performance Monitoring System
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Standards Organization
LENS	License Event Notification System
LDWS	Lane Departure Warning System
MAP-21	Moving Ahead for Progress for the 21st Century
MB	Motorbus
MCMIS	Motor Carrier Management Information System
MCSAC	Motor Carrier Safety Advisory Committee
MCSAP	Motor Carrier Safety Assistance Program
MCSIA	Motor Carrier Safety Improvement Act of 1999
MG	Monorail or Fixed Guideway
MRB	Medical Review Board
MTFCC	MAF/TIGER Feature Class Code
MVR	Motor Vehicle Record
NAFMP	North American Fatigue Management Program
NASS	National Automotive Sampling System
NCHRP	National Cooperative Highway Research Program
NCTR	National Center for Transit Research

NDR	National Driver Register
NHTSA	National Highway Traffic Safety Administration
NIST	National Institute of Standards and Technology
NFPA	National Fire Protection Association
NPRM	Notice of Proposed Rulemaking
NTD	National Transit Database
NTSB	National Transportation Safety Board
NYSDOT	New York State Department of Transportation
NYSDOT/PTSB	New York State Department of Transportation/Public Transportation Safety Board
OBMS	Onboard Monitoring Systems
OOS	Out of Service
OSA	Obstructive Sleep Apnea
OSHA	Occupational Safety and Health Administration
OSONOC	Other Safety Occurrences Not Otherwise Classified
OTRB	Over-the-Road Bus
RSAP	Roadside Safety Analysis Program
RY	Reporting Year
SAE	Society of Automotive Engineers
SAFER	Safety and Fitness Electronic Records
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SCI	Special Crash Investigations
SDO	Standards Development Organization
SEMCOG	Southeastern Michigan Council of Government
SPP	Security Program Plan
S&S	Safety and Security (refers to NTD reporting forms)
SSEPP	Safety, Security and Emergency Preparedness Plan
SSPP	System Safety Program Plan
TRB	Transportation Research Board
TxDOT	Texas Department of Transportation
UL	Underwriters Laboratories, Inc.
US	United States
USC	United States Code
USDOT	U.S. Department of Transportation
UTC	University Transportation Center
UZA	Urbanized Area

WMATA	Washington Metropolitan Area Transit Authority
YR	Hybrid Rail System

APPENDIX

F

Federal Motor Carrier Safety Regulations for Bus Transit

	Regulation	Link
374.317	Identification—bus and driver	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=374.317
390.40	What responsibilities do intermodal equipment providers have under the Federal Motor Carrier Safety Regulations (49 CFR parts 350-399)?	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=390.40
392.3	Ill or fatigued operator	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=392.3
392.7	Equipment, inspection and use	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=392.7
393.95	Emergency equipment	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=393.95
392.10	Railroad grade crossings; stopping required	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=392.10
392.11	Railroad grade crossings; slowing down required	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=392.11
392.14	Hazardous conditions; extreme caution.	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=392.14
392.16	Use of seat belts	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=392.16
392.22	Emergency signals; stopped commercial motor vehicles	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=392.22
392.24	Emergency signals; flame-producing	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=392.24
392.25	Flame producing devices	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=392.25
392.33	Obscured lamps or reflective devices/material	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=392.33
392.50	Ignition of fuel; prevention	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=392.50
392.62	Safe operation, buses	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=392.62
392.64	Riding within closed commercial motor vehicles without proper exits	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=392.64
392.66	Carbon monoxide; use of commercial motor vehicle when detected	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=392.66

	Regulation	Link
392.80	Prohibition against texting	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=392.80
392.82	Using a hand-held mobile telephone	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=392.82
393	Parts and accessories necessary for safe operation	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/FmcsrGuideDetails.aspx?menukey=393
396	Inspection, repair, and maintenance	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/FmcsrGuideDetails.aspx?menukey=396
App G	Minimum periodic inspection standards	http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/Fmcsrruletext.aspx?contentid=3702

APPENDIX

G

State Laws and Regulations – Private Intercity/Intrastate Carriers and Public Transportation within Nine Study Corridors

State	Laws	Vehicles	Inspection	Maintenance
Connecticut	Connecticut State Statute, Title 14, Chapter 246, Section 14-163(c) ...allows the Commissioner of Motor Vehicles to adopt regulations which incorporate by reference the provisions of FMCSR from 49 CFR Parts 382 to 397 and the provisions relative to maximum hours of service for drivers as set forth in 49 CFR 395; Section 14-163(d) allows any state or municipal officer or motor vehicle inspector to inspect any motor vehicle. Sections 14-96 through 14-99 provide minimum requirements for vehicle components including tires, headlamps, windshields, mirrors, and other equipment.	CT Transit normally takes the lead on vehicle procurements. All agencies meet, address their needs and RFPs are issued including all options.	Each agency develops their own inspection criteria and forms, primarily very similar and standard	Connecticut follows the FTA requirements for preventative maintenance and plans are approved by FTA during triennials.
Florida	Chapter 14-90, Florida Administrative Code, establishes equipment and operational safety standards for public bus transit systems operating in the state	Provides vehicle equipment standards and procurement criteria and includes compliance with FVMSS	Requires annual bus safety inspections and identifies what is to be included within those inspections	Requires public transportation agencies to develop a maintenance plan and procedures for preventative and routine maintenance; requires a recording and tracking system for annual inspections, maintenance and lubrication intervals

State	Laws	Vehicles	Inspection	Maintenance
Maryland	Laws of the State of Maryland – Title 22, Equipment of Vehicles and Title 23, Vehicle Inspections; Code of Maryland Regulations (COMAR) adopt FMCSA regulations in several sections. These are contained in Title 11 – Department of Transportation, Subtitle 04 – State Highway Administration: 11.04.01; Subtitle 07, Maryland Transportation Authority, 11.07.02; Subtitle 14, Motor Vehicle Administration – Vehicle Inspections, and Subtitle 21, Motor Vehicle Administration – Commercial Motor Vehicles	State Highway Administration - Maryland Motor Carrier Handbook - covers over the road vehicles, refers to compliance with FMVSS	Maryland DOT has inspection criteria for commercial motor vehicles	COMAR, Title 11, Section 11.22.01.03 addresses types of items to be maintained. Maryland DOT has developed a preventative maintenance program handbook that is available for purchase. The form for preventative maintenance of passenger buses is available online from www.mdot.maryland.gov
Michigan	Michigan Law, Section 474.105 – requires motor carriers of passengers to comply with the Motor Bus Transportation Act 474.131 – adopts 49 CFR, Parts 356, 365, 374, 382, 387, 390-393, and 395-397	Does not address vehicle design standards	Section 474.116 requires motor buses to be inspected at least annually	Does not address the maintenance of motor carriers of passengers – only indicates that vehicles must be maintained in order to meet inspection requirements
New Jersey	New Jersey Statutes, Title 39, Motor Vehicles and Traffic Regulations, Chapter 3, Section: 39:3-79.19(10) a. addresses violations of 49 CFR Parts 393 and 396; Chapter 5B, Section: 39:5B-32, directs the Superintendent of the State Police to adopt, in consultation with the New Jersey Motor Vehicle Commission and the Department of Transportation, provisions to conform with FMCSRs and FMVSS. Chapter 8: Motor vehicle inspections, includes emission inspections of diesel buses or diesel powered motor vehicles		Title 39, Motor Vehicles and Traffic Regulations, Chapter 3, requires commercial vehicle inspections and standards imposing requirement that carriers inspect chassis on a routine basis.	Chapter 3, Section: 39:3-79.12 requires systematic maintenance check program refers to consistency with 49 CFR Parts 393 and 396 and establishes minimum components to be reviewed and reporting data

State	Laws	Vehicles	Inspection	Maintenance
New York	New York Transportation Law Article 7, Section 140, Safety Requirements, establishes the state commission's power to adopt rules and regulations governing the safe operation of vehicles, including commercial carriers. Provides the authority to examine vehicles, facilities and records. Allows for the issuance of equipment violations and requires proof of repair. Also establishes that it is unlawful for intercity or suburban bus carriers when the trip is more than 25 miles to allow passengers to stand in the aisle while in motion. Article 9B, creates the State Public Transportation Safety Board	NY DOT Bus and Passenger Carrying Vehicle Regulations, Title 17, effective 1999; Section 720.4 establishes the vehicle safety requirements for vehicles	New York State Department of Transportation Office of Modal Safety & Security - Bus & Passenger Carrier Safety. New York State DOT Bus & Passenger Vehicle Regulations. 720.2 - includes pre and post trip requirements. The regulations also refer to compliance with FMVSS	New York State Department of Transportation Office of Modal Safety & Security - Bus & Passenger Carrier Safety. New York State DOT Bus & Passenger Vehicle Regulations. 721.2 Maintenance / Driver
Ohio	ODOT Guide to Compliance with Interstate Passenger Transportation Regulations developed for interstate carriers and delineates FMVSS and FMCSR requirements; Title 55, Section 5501.56, requires transit agencies to develop system safety program plans, allows onsite inspections of transit agencies by Ohio DOT. Title 55, Chapter 4921 establishes motor carrier authority and permitting, Chapter 4923 establishes regulations for private motor carrier operations. Chapter 4901:2 of the Ohio Administrative Code provides motor carrier regulations – references FMCSRs and FMVSS by 49 CFR references.	Specialized Transportation Program FY 2010 - 2011 Vehicle Catalog and Selection Guide - addresses capacity needs, client needs, purchase price, type of service, operating environment and cost, safety and comfort, weight capacity and future needs. Mostly generic, does include spreadsheet with length, width, height, average cost, vehicle weight, standard features, primarily relative to paratransit type vehicles. Also establishes minimum standards for small public transportation vehicles – primarily vans and cutaways. Ohio Administrative Code, Section 4901:2-5-02 indicates consistency with 49 CFR Part 393 and 49 CFR Parts 571-101 to 471-304 (FMVSS) Ohio DOT provides link to FTA's Best Practices Procurement Manual	Section 4513.51 and 4513.52 of the Ohio Revised Code establishes mandatory bus inspections – directs the Ohio State Patrol to conduct inspections on at least an annual basis (vehicles owned or leased by a governmental agency or political subdivision are exempt). Only for those vehicles transporting more than 15 passengers and/or a gross vehicle weight rating of greater than 10,000 pounds. Motor carrier inspection is covered under Title 55, Section 4923.06 of the Ohio Revised Code.	ODOT Office of Transit has developed A Guide to Preventative Maintenance – it does not provide any minimum standards or references to state regs/ statutes

State	Laws	Vehicles	Inspection	Maintenance
Oregon	Oregon Revised Statutes Chapter 825, Motor Carriers. Addresses all sections of inter/intra city and public transit requirements, including, but not limited to, safety, taxes, greenhouse gas emissions, rules/regulations and penalties. Section 825.252 establishes safety regulations that relate to drivers or operators and uniformity with federal regulations.	Special Provisions for certain vehicles - Oregon Revised Statues Sections 811.520, 816.300, 811.155, 820.030. Design - general language regarding mechanical equipment, coupling devices, lighting devices and reflectors, motor exhaust system, rear-vision mirrors, service and parking lights and brakes, steering mechanism, tires, warning and signaling devices and windshield wipers. Draft specifications will be developed by interested parties in compliance with minimum standards	In compliance with ORS Section 820.030. If requested the Superintendent of State Police shall assist the department of transportation in these inspections.	Special needs maintenance plan which includes, by vehicle type, an extensive outline of what is to be inspected and maintained.
Virginia	State statute 46.2-2072. "No nonprofit/tax exempt passenger carrier shall operate over the same or an adjacent route and on a similar schedule as a public transportation authority or a common carrier holding a certificate of public convenience and necessity issued pursuant to this chapter." 67-501. Use of biodiesel and other alternative fuels in vehicles providing public transportation. The Commonwealth Transportation Board shall encourage the use of biodiesel fuel and other alternative fuels, to the extent practicable, in buses and other vehicles used to provide public transportation in the Commonwealth."	Department of Rail and Public Transit, primarily geared towards rail	The Virginia DOT website provides a sample pre-trip inspection form from Iowa DOT.	Using FTA Bus Safety Program

State	Laws	Vehicles	Inspection	Maintenance
Washington	Title 46 Revised Code of Washington (RCW) - Motor Vehicles, includes vehicle inspections, accidents, enforcement, transportation of passengers in for-hire vehicles, as well as other topics. Title 480, Section 480-30-221, Washington Administrative Code (WAC) establishes vehicle and driver safety requirements and includes adoption of parts of 49 CFR, including parts 40, 382, 383, 379, 380, 385, 390 – 393, and 395 – 397.		Inspection guide and form, including but not limited to requirements, best practices, time lines, plan requirements	Washington State guide to preparing your vehicle maintenance plan

APPENDIX

H

APTA Voluntary Standards and Recommended Practices for Bus Transit Systems

American Public Transportation Association (APTA) voluntary bus transit system standards, guidelines, and recommended practices include the following:

Bus Brake and Chassis Systems

- APTA BT-RP-001-05 Recommended Practice for Transit Bus In-Service Brake System Performance Testing
- APTA BT-RP-002-05 Recommended Practice for Transit Bus Foundation Brake Lining Classification
- APTA BTS-BC-RP-003-07 Recommended Practice for Transit Bus Brake Shoe Rebuild
- APTA BTS-BC-RP-004-07 Recommended Practice for Transit Bus Front and Rear Axle S-Cam Brake Reline
- APTA BTS-SS-RP-005-10 Troubleshooting Common Transit Bus S-Cam and Air Brake Complaints

Bus Safety

- APTA BTS-BS-RP-005-09 RP: Reducing Driver-Controlled Distractions While Operating…on Agency Time
- APTA BTS-BS-RP-006-09 RP: Reducing Agency-Controlled Distractions While Operating … on Agency Time

Standard Bus Procurement Guidelines

- Standard Bus Procurement Guidelines
- Bus In-Plant Inspection
- APTA BTS-II-RP-001-11 Recommended Practice: In-Plant Inspection for Bus Procurements

System Safety Program Plan

APTA developed the *Manual for the Development of Bus Transit System Safety Program Plans* for agencies to use as a primer and guideline for both new start and established bus systems to define the elements of a System Safety Program Plan. The following link to the FTA Bus Safety and Security website leads to the APTA manual: http://bussafety.fta.dot.gov/show_resource.php?id=2951

Bus Operations

- APTA BTS-BO-RP-001-07 Recommended Practice for Transit Bus Operator Training
- APTA BTS-BO-RP-002-07 Recommended Practice for Transit Supervisor Training
- APTA BTS-BO-RP-003-09 Recommended Practice: Recruiting and Retaining Bus Operations Employees
- APTA BTS-BO-RP-004-09 Recommended Practice: Developing and Maintaining a Customer Service Culture

Bus Rapid Transit

- APTA BTS-BRT-RP-001-10 Recommended Practice for BRT Branding, Imaging and Marketing
- APTA BTS-BRT-RP-002-10 Recommended Practice for Bus Rapid Transit Stations and Stops
- APTA BTS-BRT-RP-003-10 Recommended Practice for Designing Bus Rapid Transit Running Ways
- APTA BTS-BRT-RP-004-10 Recommended Practice for Bus Rapid Transit Service Design
- APTA BTS-BRT-RP-005-10 Recommended Practice for Implementing BRT Intelligent Transportation Systems
- APTA BTS-BRT-RP-007-10 Recommended Practice for Operating a Bus Rapid Transit System

Bus Maintenance Training

- APTA RP-BMT-001-10 Training Syllabus to Instruct/Prepare for the ASE Transit Bus HVAC Test
- APTA RP-BMT-002-10 Training Syllabus to Instruct for Transit Bus Transmission and Drivetrain Test
- APTA RP-BMT-003-10 Training Syllabus Instructions for ASE Transit Bus Air Brake Systems Test
- APTA RP-BMT-004-10 Training Syllabus Instructions for ASE Transit Bus Electrical/Electronics Test
- APTA RP-BMT-005-10 Training Syllabus to Instruct/Prepare for the ASE Transit Bus Diesel Engines Test

Fire Life Safety Standards for Bus Transit

- APTA BTS-BS-RP-001-05 Recommended Practice for Transit Bus Rapid Fire Safety Shutdown
- APTA BTS-BS-RP-002-07 Recommended Practice for Transit Bus Electrical System Requirements Related to Fire Safety
- APTA BTS-BS-RP-003-08 Recommended Practice for Installation of Transit Vehicle Fire Protection Systems
- APTA BTS-BS-RP-004-08 Recommended Practice for Transit Bus Fire/ Thermal Incident Investigation

Fixed Structures

- RT-S-FS-001-02 Standard for Transit Structure Inspection and Maintenance
- RT-S-FS-003-02 Standard for Station, Shop and Yard Inspection and Maintenance

Bus Maintenance Facility Design

- APTA RP-BT-BMF-001-11 A&E Design for a Transit Operating and Maintenance Facility

APPENDIX

I

Topics for Further Review

The recommendations contained in Chapter 4 include the identification of safety areas relevant to the topics covered within this study that require further evaluation. Further examination may uncover safety issues that appear to be problematic, but for which sufficient data and related analyses are inconclusive or unavailable. This examination was outside the scope of this study but should be considered for review. These topics include the following:

- It is understandable that FTA would wish to maximize the amount of safety (and security) data collected from transit agencies in NTD while also striving to minimize the reporting burden on these agencies. The following data collection related suggestions are provided.
  - Re-examine some categories and fields in the Major Incident Reporting Form (S&S-40) to include additional information that may be helpful to future studies of bus safety. For example, some collisions on interstates were reported as being on a "divided highway" while others were classified as "limited-access highway." Adding checkboxes for clarification (e.g., "interstate highway," changing "limited-access highway" to "other limited-access highway") would add useful information while not adding burden to the agencies.
  - Add a field in which the speed limit on the roadway where a collision occurred could be entered.
  - Add a data field as a checkbox to indicate whether injuries or fatalities on the transit vehicle occurred to individuals who were sitting or standing.
  - Expand the checkboxes for the type of non-major incident, particularly the "Other – Not a Securement Issue" category to add more usefulness to the summaries of non-major incidents (S&S-50). A category to capture an "avoidance maneuver" might be helpful to future studies of bus safety. It would not be logical to add a location field in the summaries of non-major incidents; however, slightly more information available (through checkboxes or menus that will add minimal reporting burden to the agencies) will allow users of the data to better narrow the incidents of interest to be further examined with the assistance of the transit agencies

APPENDIX

J

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