[NHTSA notes: The Associate Administrator for Rulemaking has signed the following document, and we are submitting it for publication in the Federal Register. While we have taken steps to ensure the accuracy of this version of the document, it is not the official version. Please refer to the official version in a forthcoming Federal Register publication or on GPO's Web Site. You can access the Federal Register at http://www.archives.gov/federal-register/index.html]

DEPARTMENT OF TRANSPORTATION

National Highway Traffic Safety Administration

49 CFR Part 571

Docket No. NHTSA-2016-0052

RIN 2127-AL36

Federal Motor Vehicle Safety Standards; Bus Emergency Exits and Window Retention and Release, Anti-Ejection Glazing for Bus Portals

AGENCY: National Highway Traffic Safety Administration (NHTSA), Department of Transportation (DOT).

ACTION: Notice of proposed rulemaking (NPRM).

SUMMARY: This NPRM proposes a new Federal Motor Vehicle Safety Standard (FMVSS) No. 217a, "Anti-ejection glazing for bus portals," to drive the installation of advanced glazing in high-occupancy buses (generally, over-the-road buses (of any weight) and non-over-the-road buses with a gross vehicle weight rating greater than 11,793 kilograms (26,000 pounds). The new standard would specify impactor testing of glazing material. In the tests, a 26 kilogram (57 pound) impactor would be propelled from inside a test vehicle toward the window glazing at 21.6 kilometers/hour (13.4 miles per hour). The impactor and impact speed would simulate the loading from an average size unrestrained adult male impacting a window on the opposite side of

a large bus in a rollover. Performance requirements would apply to side and rear windows, and to glass panels and windows on the roof to mitigate partial and complete ejection of passengers from these windows and to ensure that emergency exits remain operable after a rollover crash. NHTSA also proposes to limit the protrusions of emergency exit latches into emergency exit openings of windows to ensure they do not unduly hinder emergency egress.

This NPRM is among the rulemakings issued pursuant to NHTSA's 2007 Approach to Motorcoach Safety and DOT's Departmental Motorcoach Safety Action Plan. In addition, to the extent warranted under the National Traffic and Motor Vehicle Safety Act, establishing advanced glazing standards for the side and rear portals of the subject buses would fulfill a statutory provision of the Motorcoach Enhanced Safety Act of 2012 (incorporated and passed as part of the Moving Ahead for Progress in the 21st Century Act).

DATES: Comments must be received on or before **[INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

ADDRESSES: You may submit comments to the docket number identified in the heading of this document by any of the following methods:

- Federal eRulemaking Portal: go to http://www.regulations.gov. Follow the online instructions for submitting comments.
- Mail: Docket Management Facility, M-30, U.S. Department of Transportation, West Building, Ground Floor, Rm. W12-140, 1200 New Jersey Avenue, S.E., Washington, D.C. 20590.
- Hand Delivery or Courier: West Building Ground Floor, Room W12-140, 1200 New Jersey Avenue, S.E., between 9 am and 5 pm Eastern Time, Monday through Friday, except Federal holidays.

- Fax: (202) 493-2251.

Regardless of how you submit your comments, please mention the docket number of this document.

You may also call the Docket at 202-366-9324.

Instructions*:* For detailed instructions on submitting comments and additional information on the rulemaking process, see the Public Participation heading of the Supplementary Information section of this document. Note that all comments received will be posted without change to http://www.regulations.gov, including any personal information provided.

Privacy Act*:* Please see the Privacy Act heading under Rulemaking Analyses and Notices.

FOR FURTHER INFORMATION CONTACT:

For non-legal issues: Ms. Shashi Kuppa, Office of Crashworthiness Standards (telephone: 202-366-3827) (fax: 202-493-2990). For legal issues: Ms. Deirdre Fujita, Office of the Chief Counsel (telephone: 202-366-2992) (fax: 202-366-3820). The mailing address for these officials is: National Highway Traffic Safety Administration, 1200 New Jersey Avenue, S.E., Washington, DC 20590.

SUPPLEMENTARY INFORMATION:

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I. Executive Summary

One of the factors NHTSA considers in determining the priorities of our rulemaking projects is to ensure the protection of passengers in high-occupancy vehicles. In 2007, NHTSA

published a comprehensive plan pertaining to improvements in motorcoach safety.[1] NHTSA developed this plan in response to several National Transportation Safety Board (NTSB) recommendations, and also to focus agency resources and research on improving the safety of these vehicles. NHTSA's motorcoach safety plan identified four specific areas where we could most effectively address open NTSB recommendations and most expeditiously achieve our goals. The four priority areas were: requiring seat belts (minimizing passenger and driver ejection from the motorcoach), improved roof strength, emergency evacuation, and fire safety.[2]

Work on NHTSA's safety plan is ongoing. In 2013, the agency published a final rule[3] requiring seat belts for each passenger seating position in all new over-the-road buses (OTRBs)[4] regardless of bus GVWR, and in new "other" buses (i.e., large buses other than OTRBs[5]) with GVWRs greater than 11,793 kilograms (kg) (26,000 pounds (lb)). In 2014, NHTSA published an NPRM proposing that these buses, and prison buses, meet increased structural integrity requirements to protect both restrained and unrestrained occupants in rollover crashes.[6] NHTSA also has issued a final rule on electronic stability control[7] and has completed research studies on improved motorcoach emergency evacuation and fire safety.[8]

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[1] Docket No. NHTSA-2007-28793, NHTSA's Approach to Motorcoach Safety. In NHTSA's plan, "motorcoach" referred to inter-city transport buses.
[2] Motorcoach safety was also the focus of a DOT-wide action plan. DOT issued a Departmental Motorcoach Safety Action Plan in 2009 which addressed additional factors such as driver fatigue and operator maintenance schedules. An update to the 2009 plan was published in December 2012, see http://www.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/Motorcoach-Safety-Action-Plan-2012.pdf
[3] 78 FR 70416; November 25, 2013.
[4] An over-the-road bus is a bus characterized by an elevated passenger deck located over a baggage compartment. Excluded from the seat belt requirement are school buses and prison buses.
[5] Some buses are also excluded from this latter category, such as transit and school buses, prison buses, and perimeter seating buses.
[6] 79 FR 46090; August 6, 2014.
[7] 80 FR 36050; June 23, 2015.
[8] For research reports on emergency evacuation, see Docket No. NHTSA-2007-28793-22 and -24. For fire safety, Docket No. NHTSA-2007-28793-0027.

Today's NPRM complements the 2014 rollover structural integrity NPRM to further minimize passenger and driver ejection from motorcoaches and other large buses. It also enhances emergency evacuation from the vehicle.

This advanced glazing NPRM also fulfills a statutory mandate on motorcoach safety set forth in the "Moving Ahead for Progress in the 21st Century Act" (MAP-21). On July 6, 2012, President Obama signed MAP-21, which incorporated the "Motorcoach Enhanced Safety Act of 2012" in Subtitle G (§§ 32701 et seq.). Among other matters, the Motorcoach Enhanced Safety Act requires the DOT to "prescribe regulations that address the following commercial motor vehicle standards," if the Secretary determines that such standards meet the requirements and considerations set forth in subsections (a) and (b) of section 30111 of title 49, United States Code (§ 32703(b)). Section 32703(b)(2) of MAP-21 states that the DOT "shall consider requiring advanced glazing standards for each motorcoach portal and shall consider other portal improvements to prevent partial and complete ejection of motorcoach passengers, including children."[9] Under MAP-21 (§ 32702), "advanced glazing" means glazing installed in a portal on the side or the roof of a motorcoach that is designed to be highly resistant to partial or complete occupant ejection in all types of motor vehicle crashes.

This NPRM proposes new requirements, in an FMVSS No. 217a, to drive the installation of advanced glazing in portals[10] of covered buses (buses subject to the proposed rollover structural integrity requirements, except for prison buses).[11] The tests are based on procedures

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[9] Under MAP-21 (§ 32702), "motorcoach" means an over-the-road bus, but does not include a bus used in public transportation provided by, or on behalf of, a public transportation agency, or a school bus. "Portal" is also defined in § 32702. The definitions are discussed further later in this preamble.

[10] A portal is an opening that could permit partial or complete ejection of an occupant from the vehicle in the event of a crash involving the vehicle.

[11] We have proposed these requirements by way of a newly proposed FMVSS No. 217a. If a final rule is issued, we may keep the requirements in Standard No. 217a or we may incorporate them into FMVSS No. 217.

developed by NHTSA and Transport Canada to improve motorcoach glazing and bonding techniques to prevent ejections. ("Motor Coach Glazing Retention Test Development for Occupant Impact During a Rollover," Martec Technical Report # TR-06-16, Rev 4, August 2006 ("Martec study").) The proposed test procedures are also based on a follow-on NHTSA research study.[12]

The glazing types currently used in the motorcoach industry for side windows are single-pane laminated glass, single-pane tempered (or "toughened") glass, or a double-pane of either laminated or tempered glass or a combination of both. A single-pane laminated glass actually contains two thin glass layers held together by an interlayer, typically of polyvinyl butyral (PVB). The interlayer works to keep the outer layers of glass bonded together in the event they break or crack, and prevents the formation of large shards of sharp glass. Laminated glass may crack or splinter upon impact with the ground, but can still provide a means of keeping passengers within the occupant compartment of the bus if the glazing is retained within the window frame, the PVB interlayer is not excessively torn or punctured, and the window latch remains closed. We believe that laminated glass could meet the requirements proposed in this NPRM. We consider glass meeting the requirements to be "advanced glazing."

Tempered glass is glass processed with controlled thermal or chemical treatments. These treatments increase the strength of the glass, and also create balanced internal stresses so that when the glass does break, it breaks or crumbles into smaller granular chunks instead of large jagged shards. Tempered glass is stronger than laminated glass, but with tempered glass, occupant loading to the window during the rollover event and the bus impact with the ground can

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[12] "Motorcoach Side Glazing Retention Research, "NHTSA Report DOT HS 811 862, http://www.nhtsa.gov/Research/ci.Defects+Analysis+and+Crashworthiness+Division.print, Last accessed on December 23, 2015.

potentially shatter tempered glass, causing the glazing to vacate the window frame and create an ejection portal.

NHTSA is proposing performance requirements that covered buses would have to meet by way of anti-ejection safety countermeasures to prevent partial and complete ejection of passengers. We would adopt a new FMVSS No. 217a that specifies impactor testing of glazing material. In the tests, a 26 kg (57 lb) impactor would be propelled from inside the test vehicle toward the window glazing at 21.6 kilometers per hour (km/h) (13.4 miles per hour (mph)). Each side and rear window and glass panel/window on the roof would be subject to any one of three impacts, as selected by NHTSA in a compliance test: (a) an impact near a latching mechanism of an intact window[13]; (b) an impact at the center of the daylight opening[14] of an intact window; and (c) an impact at the center of the daylight opening of a pre-broken window. The impactor and impact speed in these proposed tests, developed in the Martec study, simulate the loading from an average size adult male impacting a window on the opposite side of a large bus in a rollover.

The proposed performance requirements are as follows:

- In tests described in (a) and (b) in the previous paragraph, the window would have to prevent passage of a 102 millimeter (mm) (4 inch) diameter sphere during the impact, and after the test. The agency would assess the window during the impact by determining whether any part of the window passes a reference plane defined during a pre-test set up procedure. These requirements would ensure that glazing

[13] For non-emergency exit fixed side and rear windows and fixed glass panels on the roof, the proposed test would be conducted at the location of one of the fixed latches or discrete attachment points. For fully rubber bonded or glued windows with no latch mechanisms, the test would be conducted along the center of the lower window edge one inch above the daylight opening periphery.

[14] Center of daylight opening is the center of the total unobstructed window opening that would result from the removal of the glazing.

is securely bonded to window frames, no potential ejection portals are created due to breaking of the glass, and the windows remain closed when impacted.

- In the test of (c) above, the maximum displacement of the impactor at the center of daylight opening would be limited to 175 mm (6.9 inches) for pre-broken glazing. This requirement in particular would drive the installation of advanced glazing. The requirement would also help ensure the advanced glazing reasonably retains occupants within the structural sidewall of the bus even when the glass surrounding the PVB interlayer is broken. It also ensures that no potential ejection portals are created during and after impact.
- Emergency exit latch protrusions may not extend more than one inch into the emergency exit opening of the window when the window is opened to the minimum emergency egress opening (allowing passage of an ellipsoid 500 mm (19.7 inches) wide by 300 mm (11.8 inches) high). This requirement would minimize the potential for the latch plate protrusions (or other projections) to hinder the emergency egress of passengers.
- Latches would have to be functional following the impact test to ensure that occupants can open the emergency exits to egress the vehicle after the crash.

The Motorcoach Enhanced Safety Act emphasizes anti-ejection safety countermeasures, particularly advanced glazing (§ 32703(b)(2)). With regard to advanced glazing standards, NHTSA's strategy has been first to seek improvements to the rollover structural integrity of motorcoaches (roof strength and crush resistance) and then to pursue measures that would drive use of advanced glazing. This ordered approach is based on findings from the Martec study that found the integrity of the bus structure has a profound impact on the effectiveness of glazing as

an anti-ejection safety countermeasure. That is, in the absence of a threshold of requisite performance for bus structural integrity, a twisting motion of a bus in a rollover could simply pop out any advanced glazing used in the windows and negate the potential benefits of the glazing in mitigating occupant ejection.

To better ensure that the full benefits of anti-ejection countermeasures such as advanced glazing could be realized, we adopted a holistic approach. We first focused on improving bus structural integrity and the strength of side window mountings. The 2014 NPRM on large bus structural integrity proposed requirements that would increase the likelihood that bus glazing will be retained in their mountings in a rollover.[15] Next in our strategy is issuance of today's NPRM, which has performance requirements that would increase use of advanced glazing that prevent partial or complete ejection of motorcoach passengers and further ensure the integrity of glazing mounting. Today's NPRM directly addresses the directive in §32703(b)(2) of the Motorcoach Enhanced Safety Act that NHTSA consider requiring advanced glazing standards for each motorcoach portal.

We have designed this NPRM in furtherance of NHTSA's goal to enhance the safety of all heavy buses used in intercity bus transportation, while attending to the Motorcoach Enhanced Safety Act's focus on over-the-road buses (motorcoaches). Since today's NPRM builds on the

[15] The 2014 rollover structural integrity NPRM proposes performance requirements that must be met when the bus is tipped over from an 800 mm (31.5 inch) raised platform onto a hard level surface. Among other requirements, the proposed standard would require that the occupant "survival space" (space around occupant seating positions) be maintained during and after the dynamic test, and that side window glazing opposite the impacted side of the vehicle remain attached to its mounting such that there is no opening that will allow the passage of a 102 mm (4 inch) diameter sphere. These proposed requirements would help ensure glazing is retained in the windows by limiting the twisting motion of a bus and strengthening window mountings.

2014 rollover structural integrity NPRM, we propose to apply today's advanced glazing proposal to the vehicles subject to the 2014 NPRM.[16, 17]

NHTSA estimates that this rulemaking would be cost beneficial.[18]

The agency estimates an annual incremental material cost for all new buses covered by this proposed rule to be $0.19 million (see Table 1 below). The countermeasures would likely be advanced glazing and improved emergency exit latches, resulting in an average incremental material cost per bus of $87 for buses covered under today's proposed rule. We estimate the testing cost of $8,700 per bus model. We estimate there would be no weight increase due to the proposed requirements; in fact, there could be a weight reduction of approximately 10.5-15 kg (23-33 lb) per window (125.5-180 kg (276-396 lb) per bus) as glazing designs change from a double-glazed tempered/tempered configuration to a single-glazed laminated configuration. We estimate that the proposal would result in fuel saving of $2.18 million to $2.9 million. This exceeds the material costs of $0.19 million for the proposal.

Beyond the benefits attributable to the agency's final rules on seat belts and ESC and a potential final rule on rollover structural integrity that also may apply to the subject buses, we estimate that requiring new subject buses to meet the proposed performance criteria would save 1.54 lives and prevent 0.4 serious to critical injuries annually if 15 percent of occupants use seat belts, and save 0.33 lives and prevent 0.08 serious to critical injuries annually if 84 percent of

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[16] With the exception of prison buses. We have tentatively determined that an advanced glazing standard would not be appropriate for prison buses since these buses typically have bars over the windows.

[17] Note that this NPRM proposes requirements limiting how far emergency exit latches may protrude into the exit space. We propose applying the requirement to the buses to which NHTSA proposed would be subject to the 2014 structural integrity NPRM, except prison buses. We are also proposing to apply the requirement to school buses, and are considering applying the proposed maximum emergency exit latch protrusion requirements to all buses governed under FMVSS No. 217. Comments are requested on this issue.

[18] NHTSA has developed a Preliminary Regulatory Evaluation (PRE) that discusses issues relating to the potential costs, benefits and other impacts of this regulatory action. The PRE is available in the docket for this NPRM and may be obtained by downloading it or by contacting the Docket at the address or telephone number provided at the beginning of this document.

occupants use seat belts. Thus, we estimate that this proposal would save 1.6 equivalent lives annually (undiscounted) if 15 percent of occupants use seat belts, and 0.34 equivalent lives annually (undiscounted) if 84 percent of occupants use seat belts (see Table 2, below).[19]

Since the fuel savings from the proposed rule would be far greater than the material costs of this proposal, we did not estimate cost per equivalent lives saved. The estimated net cost/benefit impact ranges from a net benefit of $5.87 million to $17.52 million at the 3 percent discount rate and a net benefit of $4.37 million to $13.15 million at the 7 percent discount rate (see Table 3, below).

Table 1: Estimated Annual Costs (2013 dollars)

Potential Costs	
Material Costs Per Vehicle	$87
Material Costs, Total New Fleet	$0.19 Million

Table 2: Estimated Annual Benefits (Undiscounted Equivalent Lives Saved)

15 percent belt usage	1.6
84 percent belt usage	0.34

Table 3: Annualized Net Benefits in Millions of 2013 Dollars

Discount Rate	Benefits	Net Costs	Net Benefits
3%	$13.22 - $2.82	($4.30 - $3.05)	$17.52 - $5.87
7%	$9.95 - $2.12	($3.20 - $ 2.25)	$13.15 - $4.37

[19] NHTSA used the same low seat belt usage rate estimate of 15 percent from the November 25, 2013 final rule requiring seat belts on motorcoaches and other large buses (78 FR 70416). The agency also utilized the same source of information to establish the high seat belt usage rate estimate (the National Occupant Protection Use Survey). Today's NPRM uses the 2009 data which estimates seat belt use of passenger vehicles to be 84 percent. *See* 2009 National Occupant Protection Use Survey. More information at: http://www-nrd.nhtsa.dot.gov/pubs/811100.pdf.

NHTSA has considered retrofit requirements and has made the following tentative conclusions. The agency does not believe it would be sensible to apply the requirements proposed today to buses that do not have sufficient structural integrity to retain the advanced glazing in a rollover. If the advanced glazing were to pop out in a rollover, the benefits of the glazing would not be achieved. Yet, Congress was particularly interested in a possible retrofit requirement for advanced glazing. Section 32703(e)(2)(A) of MAP-21 states that the Secretary may assess the feasibility, benefits, and costs with respect to the application of any requirement established under § 32703(b)(2), regarding advanced glazing, to motorcoaches manufactured before the date on which the requirement applies to new motorcoaches. Thus, NHTSA is requesting comments on the feasibility, benefits, and costs of any potential requirement to retrofit existing buses with advanced glazing.

II. Background

a. NHTSA's Statutory Authority

NHTSA is proposing today's NPRM pursuant to and in accordance with its authority under the National Traffic and Motor Vehicle Safety Act and the relevant provisions of MAP-21.

National Traffic and Motor Vehicle Safety Act (Vehicle Safety Act)

Under 49 United States Code (U.S.C.) Chapter 301, Motor Vehicle Safety (49 U.S.C. 30101 et seq.), the Secretary of Transportation is responsible for prescribing motor vehicle safety standards that are practicable, meet the need for motor vehicle safety, and are stated in objective terms (§ 30111(a)). "Motor vehicle safety" is defined in the Vehicle Safety Act (§ 30102(a)(8)) as "the performance of a motor vehicle or motor vehicle equipment in a way that protects the public against unreasonable risk of accidents occurring because of the design, construction, or performance of a motor vehicle, and against unreasonable risk of death or injury in an accident,

and includes nonoperational safety of a motor vehicle." "Motor vehicle safety standard" means a minimum standard for motor vehicles or motor vehicle equipment performance (§ 30102(a)(9)). When prescribing such standards, the Secretary must consider all relevant available motor vehicle safety information (§ 30111(b)(1)). The Secretary must also consider whether a proposed standard is reasonable, practicable, and appropriate for the particular type of motor vehicle or motor vehicle equipment for which it is prescribed (§ 30111(b)(3)) and the extent to which the standard will further the statutory purpose of reducing traffic accidents and associated deaths and injuries (§ 30111(b)(4)). The responsibility for promulgation of FMVSSs is delegated to NHTSA (49 CFR 1.95).

MAP-21 (Incorporating the Motorcoach Enhanced Safety Act of 2012)

On July 6, 2012, President Obama signed MAP-21, which incorporated the "Motorcoach Enhanced Safety Act of 2012" into Subtitle G. Section 32703(b) of MAP-21 requires the Secretary to prescribe regulations that would address certain aspects of motorcoach crash performance within two years if the Secretary determines that the standards would meet the requirements and considerations of §§ 30111(a) and (b) of the Vehicle Safety Act.

Section 32703(b)(2) of MAP-21 directs the Secretary to consider requiring advanced glazing standards for each motorcoach portal and to consider other portal improvements to prevent partial and complete ejection of motorcoach passengers, including children. Under § 32702, "portal" means any opening on the front, side, rear, or roof of a motorcoach that could, in the event of a crash involving the motorcoach, permit the partial or complete ejection of any occupant from the motorcoach, including a young child. Section 32703(b)(2) also states that in prescribing such standards, the Secretary shall consider the impact of such standards on the use of motorcoach portals as a means of emergency egress.

MAP-21 contains various other provisions that are relevant to this rulemaking. Section 32702 states that "motorcoach" has the meaning given to the term "over-the-road bus" in section 3038(a)(3) of the Transportation Equity Act for the 21st Century (TEA-21).[20] Section 32702 of MAP-21 excludes transit buses and school buses from the "motorcoach" definition.

MAP-21 sets forth compliance dates. It directs the Secretary to apply any regulation prescribed in accordance with § 32703(b) (and several other subsections) to all motorcoaches manufactured more than 3 years after the date on which the regulation is published (§ 32703(e)(1)). In addition, the Secretary may assess the feasibility, benefits, and costs of applying any requirement established under § 32703(b)(2) to "motorcoaches manufactured before the date on which the requirement applies to new motorcoaches" (retrofit) (§ 32703(e)(2)).

Finally, MAP-21 also authorizes the Secretary to combine the required rulemaking actions as the Secretary deems appropriate (§ 32706(b)).

b. NHTSA's 2007 Approach to Motorcoach Safety

In 2007, NHTSA undertook a comprehensive review of motorcoach safety issues and the course of action that the agency could pursue to address them. The agency considered various prevention, mitigation, and evacuation approaches in developing the course of action. Many considerations were factored into determining the priorities, including: cost and duration of testing, development, and analysis required; likelihood that the effort would lead to the desired and successful conclusion; target population and possible benefits that might be realized; and anticipated cost of implementing the ensuing requirements into the motorcoach fleet.

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[20] Section 3038(a)(3) of TEA-21 (see 49 U.S.C. 5310 note) defines "over-the-road bus" as "a bus characterized by an elevated passenger deck located over a baggage compartment."

The result was NHTSA's 2007 plan, "NHTSA's Approach to Motorcoach Safety,"[21] in which we identified the following areas as the highest priorities for possible near term regulatory action to enhance motorcoach safety: (1) seat belts; (2) improved roof strength; (3) emergency evacuation; and (4) fire safety. For addressing passenger ejection (action (1) above), we first pursued the incorporation of passenger seat belts as the most expeditious way to mitigate ejection. The agency's seat belt rulemaking, discussed further in subsection (e) below, began NHTSA's implementation of our Motorcoach Safety Plan. Today's NPRM further advances the implementation of the plan.

c. DOT's 2009 Task Force Action Plan and 2012 Update

In 2009, DOT issued a Departmental "Motorcoach Safety Action Plan," which outlined a Department-wide strategy to enhance motorcoach safety.[22] An update of the plan was issued in December 2012.[23] In addition to the four priority action items specified in NHTSA's 2007 plan, the DOT plan discussed additional factors for enhancing motorcoach safety, such as electronic stability control systems, event data recorders, and driver fatigue and operator maintenance issues. Departmental agencies continue to work on the motorcoach safety initiatives related to their administrations.

d. NTSB Recommendations

This NPRM addresses the following NTSB recommendations pertaining to window glazing and emergency exits.

H-99-049

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[21] Docket No. NHTSA-2007-28793-001.
[22] https://www.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/MotorcoachSafetyActionPlan_final2009report-508.pdf
[23] http://www.fmcsa.dot.gov/safety/passenger-safety/motorcoach-safety-action-plan-2012

NTSB initiated a special investigation reviewing 36 motorcoach crashes that were investigated from 1968 through 1997.[24] It found that of the 168 occupant fatalities, 106 occurred in crashes involving a rollover. Of those 106 fatalities, 64 were ejected from the bus.

NTSB also found that glazing composition may mitigate injury during a rollover event. In one investigation of a 1988 crash,[25] a 1987 Motor Coach Industries, Inc., intercity-type coach overturned on its right side and slid 220 feet across the highway before coming to rest. There was no intrusion into the occupant compartment and no fatalities. Forty-nine passengers and the driver sustained minor to severe injuries such as fractured ribs, lacerations, abrasions, and contusions. The 27 passengers on the left side were thrown from their seats and fell on top of the 22 right side passengers during the overturn sequence; however, all of the passengers were contained within the coach through the event. NTSB determined that because the bus's abrasive-resistant, coated acrylic windows did not break, the passengers may have been afforded protection from contacting the road surface and possibly sustaining more serious or even fatal injuries. NTSB concluded that buses equipped with advanced glazing may decrease the number of ejections of unrestrained passengers and reduce the risk of serious injury to restrained passengers during bus crashes, particularly rollover events. NTSB issued the following recommendation to NHTSA:

"H-99-049: Expand your 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 this research."

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[24] NTSB/SIR-99/04 PB98-917006; Highway Special Investigation Report: Bus Crashworthiness Issues; September, 1999.

[25] NTSB/HAR-89/01/SUM PB89-916201; Highway Accident Summary Report: Intercity-Type Buses Chartered for Service to Atlantic City; April 1989.

H-11-037

On August 5, 2010, a multi-vehicle accident occurred in Gray Summit, Missouri, involving a 2007 Volvo tractor, a 2007 GMC Sierra extended cab pickup truck, a 2003 Blue Bird 71-passenger bus ("lead school bus"), and a 2001 Blue Bird 72-passenger bus ("following school bus"). This multi-vehicle crash was investigated by NTSB in 2011.[26] In the collision, the lead school bus sustained moderate front-end damage from colliding into the back of the Sierra pickup and the rear of the Volvo tractor. Additionally, the rear of the lead school bus was severely damaged as a result of being impacted and overridden by the following school bus.

The only emergency exits available for egress on the lead school bus were the rear two emergency exit windows. All but one of the occupants in the lead bus exited the bus through the left rear emergency exit window. The remaining entrapped passenger was extricated by emergency responders and placed on a backboard before being removed through the right rear emergency exit window.

Several passengers in the lead school bus, and a witness who assisted in the evacuation, stated in post-crash interviews that emergency egress was hindered by the design of the emergency exit window. Particularly, the 4 inch by 3 inch emergency release latch plate for the emergency exit window was elevated about 1 inch from the window base and snagged the clothing of several passengers as they were exiting through the window opening. In addition, because of the failure of the emergency exit window to independently remain in the open position, one individual had to hold the hinged emergency exit window open so that other individuals could exit the bus unimpeded.

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[26] NTSB/HAR-11/03 PB2011-916203; Multivehicle Collision Interstate 44 Eastbound Gray Summit, Missouri, August 5, 2010; December 2011.

NTSB made three safety recommendations, including the following:

"H-11-037: Modify Federal Motor Vehicle Safety Standard 217 or the corresponding laboratory test procedure to eliminate the potential for objects such as latch plates to protrude into the emergency exit window space even when that protrusion still allows the exit window to meet the opening size requirements."

e. NHTSA's Previous Work on Motorcoach Crashworthiness Standards

1. Seat belt final rule

Section 32703(a) of MAP-21 directs the Secretary to require seat belts for each designated seating position in motorcoaches. NHTSA fulfilled this mandate in 2013, issuing a final rule amending FMVSS No. 208, "Occupant crash protection" to require lap/shoulder seat belts for each passenger seating position in: (a) all new OTRBs (except school buses and prison buses); and (b) in new buses other than OTRBs,[27] with a GVWR greater than 11,793 kg (26,000 lb).[28] The final rule significantly reduces the risk of fatality and serious injury in frontal crashes and the risk of occupant ejection in rollovers, thus considerably enhancing the safety of these vehicles.

2. Rollover Structural integrity NPRM

Section 32703(b)(1) of MAP-21 specifies that the Secretary is to establish improved roof and roof support standards that "substantially improve the resistance of motorcoach roofs to deformation and intrusion to prevent serious occupant injury in rollover crashes involving motorcoaches" if such standards meet the requirement and considerations of § 30111(a) and (b) of the Vehicle Safety Act. In 2014, NHTSA published an NPRM proposing that OTRBs (except

[27] Except school buses, transit buses, perimeter seating buses, and prison buses.
[28] 78 FR 70416; November 25, 2013.

school buses) and buses other than OTRBs[29] with a GVWR greater than 11,793 kg (26,000 lb) meet increased structural integrity requirements to protect both restrained and unrestrained occupants in rollover crashes. The NPRM was based on a rollover test set forth in the Economic Commission for Europe (ECE) Regulation No. 66, "Uniform Technical Prescriptions Concerning the Approval of Large Passenger Vehicles with Regard to the Strength of their Superstructure," (ECE R.66).[30]

NHTSA proposed performance requirements that each bus must meet when subjected to a dynamic rollover test. The bus is placed on a tilting platform that is 800 mm above a smooth and level concrete surface. One side of the platform is raised at a steady rate until the vehicle becomes unstable, rolls off the platform, and impacts the concrete surface below.

The proposed rollover structural integrity test is illustrated below in Figure1.

[29] Exceptions are transit buses, and perimeter seating buses.
[30] Supra. 79 FR 46090; August 6, 2014.

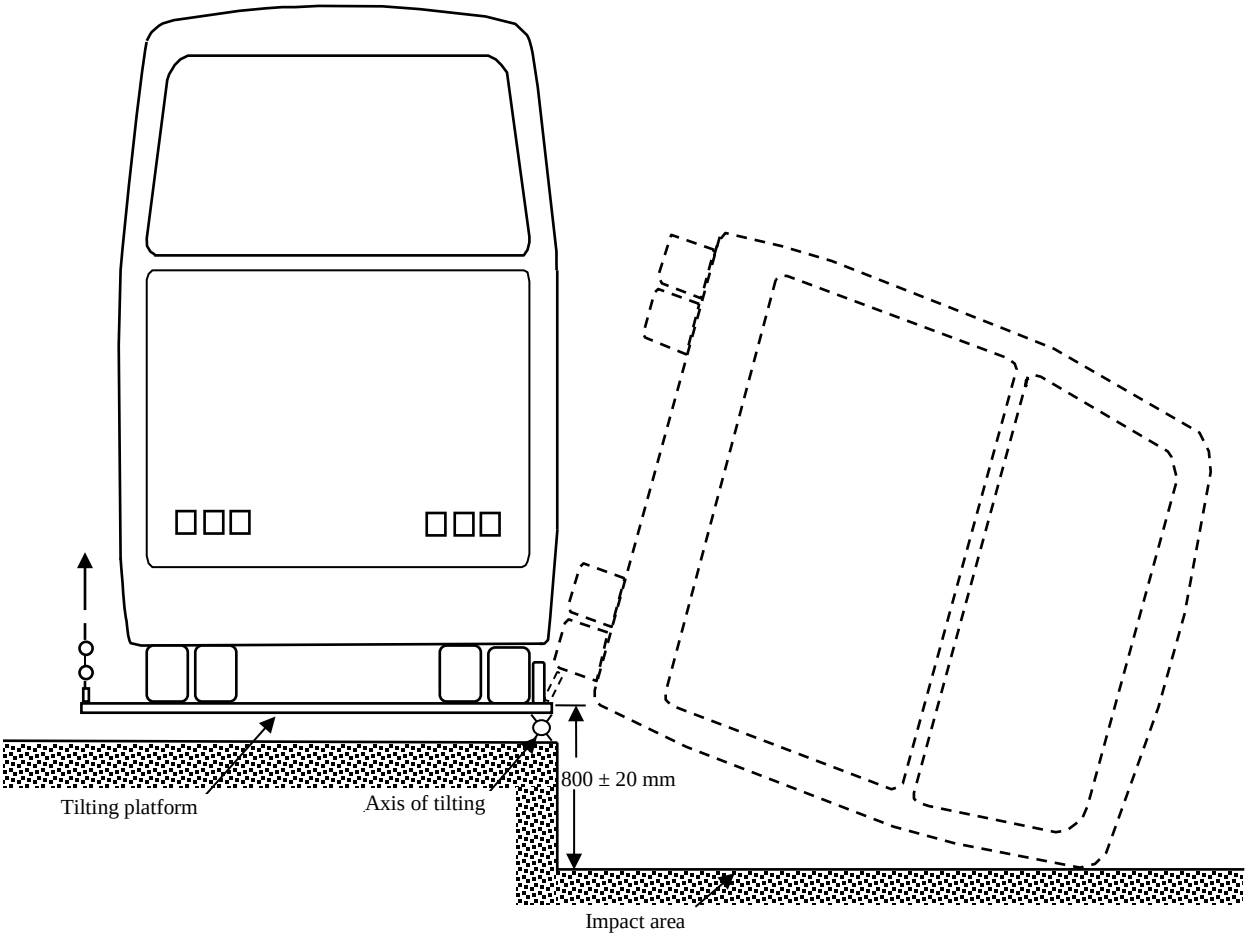

Figure 1: Vehicle on Tilting Platform

The following are the main proposed performance requirements that buses would have to meet when subjected to the rollover structural integrity test:

(1) intrusion into the "occupant survival space," demarcated in the vehicle interior, by any part of the vehicle outside the survival space is prohibited;

(2) each anchorage of the seats and overhead luggage racks must not completely separate from its mounting structure;

(3) emergency exits must remain shut during the test and must be operable in the manner required under FMVSS No. 217 after the test; and,

(4) each side window glazing opposite the impacted side of the vehicle must remain attached to its mounting such that there is no opening that will allow the passage of a 102 mm (4 inch) diameter sphere.

III. Safety Need

a. Background

Each year, the commercial bus industry transports millions of people between and in cities, for long and short distance tours, school field trips, commuting, and entertainment-related trips. According to a census published by the American Bus Association (ABA) in 2008, there were approximately 3,400 motorcoach[31] carriers in the United States and Canada in 2007.[32] These motorcoach carriers operated over 33,000 motorcoaches, logged nearly 750 million passenger trips, and traveled over 1.8 billion miles yearly. Approximately 3,100 of the carriers were chartered U.S. carriers that operated about 29,000 motorcoaches.

In an updated 2011 motorcoach census,[33] the motorcoach industry had grown to 4,478 carriers and 42,960 motorcoaches in the United States and Canada by the year 2010. In the U.S. alone, 4,088 carriers operated 39,324 motorcoaches. Although the number of motorcoaches on the road increased from 2007, the actual number of passenger trips logged dropped to 694 million trips, while the amount of vehicle miles traveled increased to 2.4 billion miles and passenger miles traveled increased to over 76.1 billion. In essence, the data indicated that the frequency of passenger trips may have decreased from 2007 to 2010, but the length or distance of each trip increased.

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[31] As used in the ABA census report, "motorcoach" refers to an OTRB. When we discuss this report and use the term motorcoach, we mean an OTRB.

[32] "Motorcoach Census 2008, A Benchmarking Study of the Size and Activity of the Motorcoach Industry in the United States and Canada in 2007," Paul Bourquin, December 18, 2008.

[33] "Motorcoach Census 2011, A Benchmarking of the Study of the Size and Activity of the Motorcoach Industry in the Unites States and Canada in 2010," John Dunham & Associates, June 18, 2012.

Carriers with a small fleet size (less than 10 motorcoaches) have older average motorcoach fleet age than carriers with a large fleet size (more than 50 motorcoaches). In 2007, the small carriers had an average motorcoach fleet age of 9 years, whereas the large carriers had an average fleet age of 6 years. In 2010, the small carrier's average fleet age increased to 10 years, whereas the large carrier's average fleet age remained the same at 6 years old.

b. FARS Data

NHTSA's Fatality Analysis Reporting System (FARS)[34] was analyzed for a 10 year period from 2004 to 2013 to look at fatal bus crashes within the United States.[35] During this period there were 85 fatal crashes involving all OTRBs regardless of GVWR and other covered non-OTRBs with a GVWR>11,793 kg (26,000 lb) resulting in a total of 212 occupant fatalities (an average of 21.2 total occupant fatalities per year). Tables 4 and 5 show the breakdown of the number of crashes and fatalities by bus body type, GVWR, and crash type, respectively.[36] Fatalities resulting from other events such as fires or occupants jumping from a bus were not included.

There were 59 OTRB and 26 large bus crashes. Among these 85 OTRB and large bus crashes, 40 were rollovers, 41 were frontal crashes, and 4 were side crashes. About 70 percent of the fatal bus crashes involved OTRBs among which 90 percent had a GVWR greater than 11,793 kg (26,000 lb).

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[34] NHTSA's FARS contains data on a census of fatal traffic crashes in the United States and Puerto Rico. Crashes in FARS involve a motor vehicle traveling on a road customarily open to the public resulting in a fatality within 30 days of the crash.

[35] Over-the-Road Bus (Motorcoach) in the FARS database is identified by the bus body type category, "cross-country/intercity bus," and large bus is identified by the bus body categories: "other bus," "unknown bus," and "van-based bus," and by the vehicle's GVWR greater than 11,793 kg (26,000 lb).

[36] The other two bus body types in the FARS database, transit bus and school bus, were also examined and the safety problem due to ejections in rollover accidents was found to be significantly lower than that in OTRBs and large buses. For the 10-year period from 2004 to 2013, 6 passengers (or 0.81 passengers annually on average) were ejected in rollover crashes of school buses and transit buses with GVWR>11,793 kg (26,000 lb), but the ejection path was not known.

Table 4: Over-the-road bus and large bus fatal crashes (FARS 2004-2013)

	rollover	front	side	rear	total
Over-the-road bus	33	25	1	0	59
Large bus GVWR > 11,793 kg (26,000 lb)	7	16	3	0	26
Total	40	41	4	0	85

Table 5: Over-the road bus and other large bus occupant fatalities in crashes (FARS 2004-2013)

Body type	Over-the-road bus		Large bus GVWR>11,793 kg (26,000 lb)		Total		
Crash Type	Driver	Passenger	Driver	Passenger	Driver	Passenger	All
Rollover	6	133	1	7	7	140	147
Front	19	19	8	11	27	30	57
Side	1	1	0	6	1	7	8
Rear	0	0	0	0	0	0	0
Total	26	153	9	24	35	177	212

The OTRB and large bus fatalities were broken down by separating the fatalities for drivers and passengers (Table 5). Passenger fatalities were significantly higher than driver fatalities, accounting for over 83 percent of the total fatalities, and were particularly prevalent in the OTRB category. Rollover events accounted for 79 percent of OTRB and large bus passenger fatalities (compared to 21 percent for driver fatalities).

With the focus on passenger fatalities only, the passenger fatalities were further broken down based on ejection status (Table 6). Of the 79 percent of OTRB and large bus passenger fatalities that were from rollover events, 57 percent of those passenger fatalities were ejected. One in eight of the passenger ejections had a documented known ejection portal through the side window of the bus. Rollovers remain the largest cause of passenger fatalities, for both ejected and non-ejected, in OTRB and large bus crashes.

Table 6: OTRB and large bus passenger fatalities by ejection status (FARS 2004-2013)

Crash Type	OTRB		Large bus GVWR>26,000 lb		Total	
	Eject	No Eject	Eject	No Eject	Eject	No Eject
Rollover	74	59	6	1	80	60
Front	5	14	2	9	7	23
Side	1	0	0	6	1	6
Rear	0	0	0	0	0	0
Total	80	73	8	16	88	89

The agency is proposing the requirements in today's NPRM to improve rollover safety in high-capacity buses. The aforementioned data show that crashes involving rollovers and ejections present the greatest risk of death to the occupants of these buses. The majority of fatalities occur in rollovers, and nearly 60 percent of rollover passenger fatalities are associated with occupant ejection.

In nearly all the recent OTRB and large bus fatal rollover events, there was a significant amount of structural damage to the roof and side structure of the vehicles, as well as open window portals. Hence, NHTSA tentatively believes that the prevention of occupant ejection through portals is a critical part of mitigating the OTRB and large bus fatality and injury rate.

IV. Research

The test procedure and test device proposed in this NPRM were developed from the findings of several NHTSA research programs described in this section.

a. Joint NHTSA and Transport Canada Motorcoach Program (Martec Study)

In 2003, NHTSA and Transport Canada entered into a joint program that focused on improving glazing and window retention on OTRBs to prevent occupant ejection. ("Motor Coach Glazing Retention Test Development For Occupant Impact During a Rollover," August

2006.)[37] Using a combination of crash investigations and numerical simulations, the study provided the important first steps necessary to develop a test procedure that realistically represented the impact loads from an unrestrained occupant on motorcoach glazing during a rollover event. The program also established the basis of a dynamic test device that could be used to test glazing materials and bonding techniques to evaluate their effectiveness in preventing ejections.

In the Martec study, the event chosen for simulation was a motorcoach rollover with a yaw speed of 30 km/h (18.6 mph) onto a flat surface, with an unrestrained occupant seated on the far side of the roll. Through these simulations, the Martec study determined that the impact velocity of an occupant striking the glazing was as much as 6.0 meters/second (m/s) (21.6 km/h or 13.4 mph). The analysis used a 50^{th} percentile adult male side impact test dummy (US-SID) numerical model to determine peak loading and duration. The Martec simulations (involving a bus rolling over on its side) showed the impact area between the bus occupant and window glazing was primarily along the side of the dummy and that the largest load on the glazing was due to the torso impact. It was this impact that was used as the target load or load profile in the dynamic impact test device development.

The impact test device consisted of a guided piston secured to a platform structure along with an accumulator tank used for powering the guided piston (Figure 2). The mass of the impactor was 26 kg (57 lb), representing the effective mass measurements from the numerical analysis. A spring with the appropriate stiffness (258 N/m) was used to replicate compression of the thorax and a shoulder foam part from the SID was affixed to the impactor face to replicate

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[37] Motor Coach Glazing Retention Test Development for Occupant Impact During a Rollover, Final Report published on August 2006, Docket No. NHTSA-2002-11876-15.

the compression of the dummy's shoulder and the contact area between the dummy's shoulder and the glazing during impact (Figure 3).

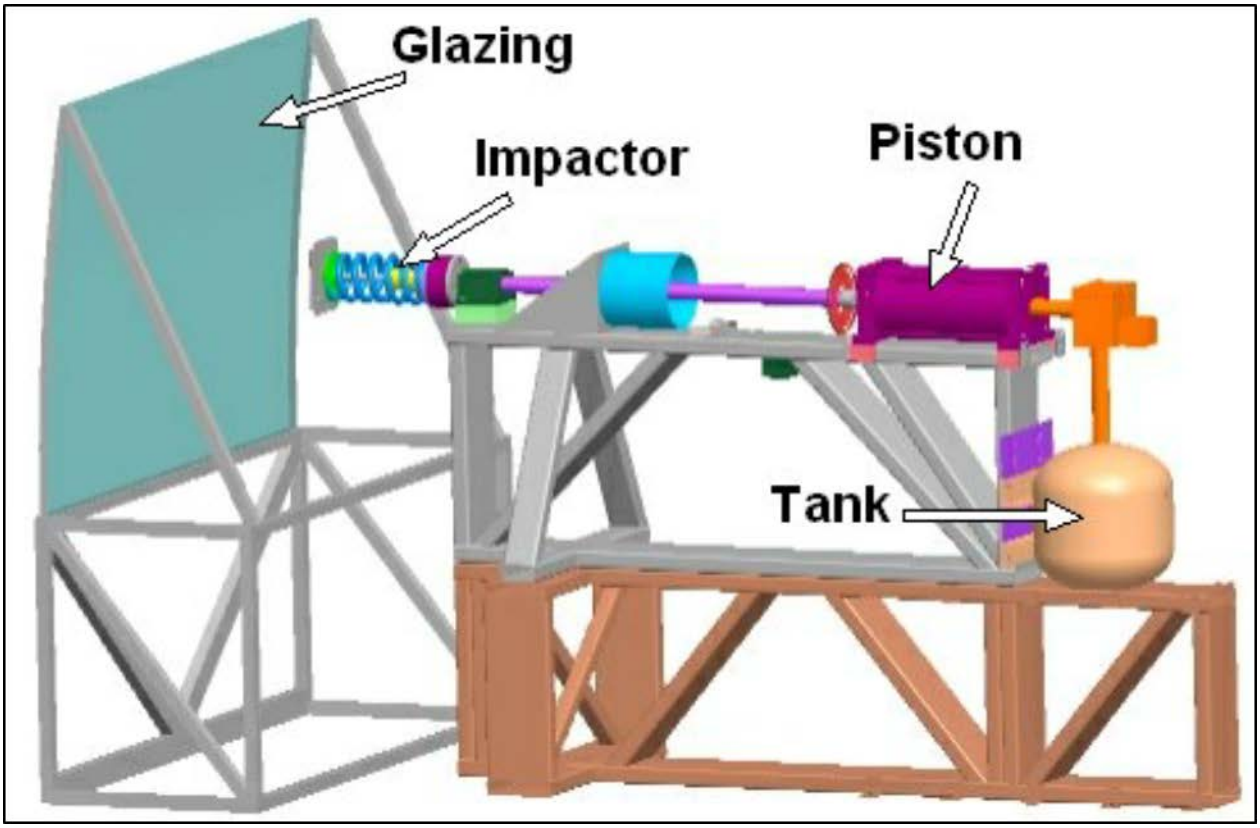

Figure 2: Glazing impactor test apparatus

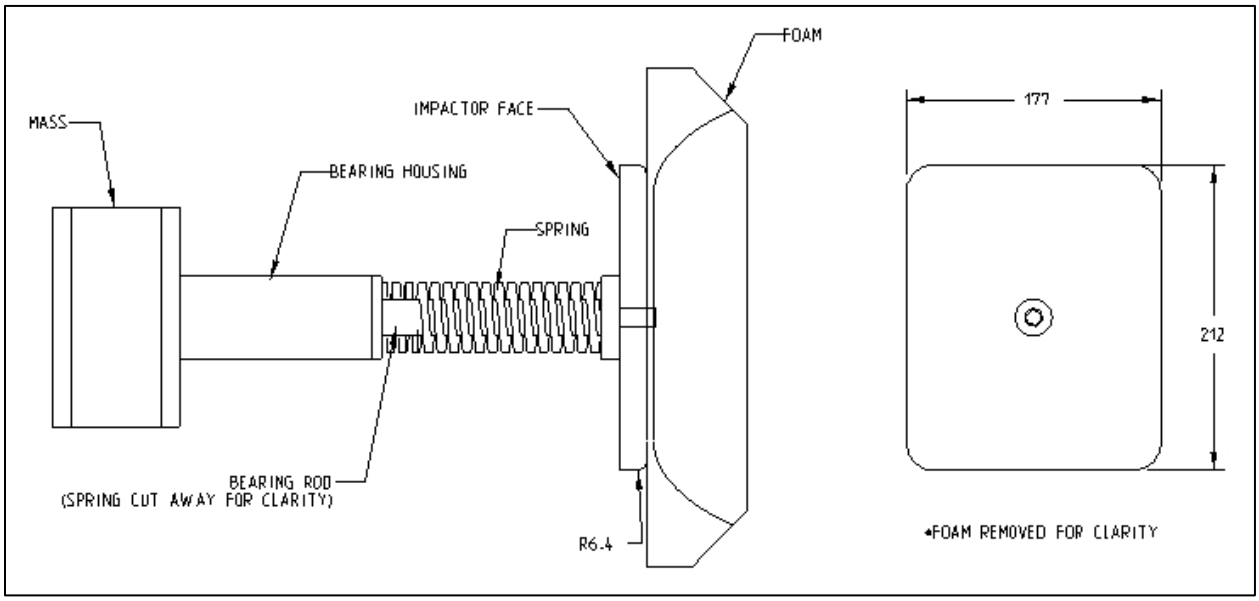

Figure 3: Impactor head assembly (dimensions in millimeters)

In the Martec study, only limited testing was performed in a test fixture representing an OTRB side window structure. Only one glazing composition was tested. No testing was done to establish the motorcoach fleet performance. The study recommended that further testing be performed using other configurations (different glazing types such as laminated glass and polycarbonates and mechanical latching methods) common in the bus industry. The study concluded that more research was needed to establish baseline motorcoach fleet performance, determine the effect of motorcoach structural integrity on window retention and emergency egress, and identify potential improvements for window retention purposes.

NHTSA's follow-on test program, discussed below, was conducted to obtain data in these areas.

b. NHTSA's Motorcoach Side Glazing Research

In 2011 and 2013, respectively, we completed a follow-on test program to the Martec study and a comprehensive test program of bus models and glazing designs to establish anti-

ejection countermeasures and performance requirements.[38] The test programs, conducted at NHTSA's Vehicle Research and Test Center (VRTC), investigated the performance of bus glazing under passenger loading (simulating a far side passenger impacting the roll side glazing during a quarter turn rollover), using standard OTRB side windows (emergency exits and fixed windows) and different variations of glazing and bonding techniques. The objectives were: (1) to evaluate the test procedure from the Martec study; (2) evaluate various types of motorcoach glazing material and bonding techniques; (3) explore countermeasures for current window latches that open during such impacts; and, (4) further develop test procedures to assess the occupant retention provided by different glazing materials used in bus exits and windows.

The following is a summary of the different testing conducted and the test results relevant to this NPRM. Details of the testing and the results can be found in Duffy et al., "Motorcoach Side Glazing Retention Research," supra.

1. Testing on the MCI D-Series Motorcoach Section Emergency Exit Side Windows

In the first stage of testing, VRTC used a section of a Motor Coach Industries (MCI) 1993 102D model motorcoach to conduct impact tests at the center of the window and near the latch. Different types of glazing material (laminated, tempered), double and single pane glazing, and different types of bonding of the glazing to the window frame were evaluated. The windows of the MCI 102D model were 1.5 m (59 inches) in length and 1 m (39.4 inches) in height and weighed between 25-29 kg (55-64 lb) for single glazed panes and 42-47 kg (92.5–103.5 lb) for double glazed panes.

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[38] Duffy, S., Prasad, A., "Motorcoach Side Glazing Retention Research," NHTSA Technical Report DOT HS 811 862, November 2013, http://www.nhtsa.gov/Research/Defects+Analysis+and+Crashworthiness+Division.

The center of daylight opening impacts were conducted using the Martec Study Conditions (26 kg (57 lb) impactor at an impact velocity of 21.6 km/h (13.4 mph)). The near latch impacts were conducted using the 26 kg (57 lb) impactor at impact velocities ranging from 10.3 km/h (6.4 mph) to 21.6 km/h (13.4 mph). Near latch impacts were also conducted with twist introduced on the bus frame during the impact to evaluate the effect of torsion of the bus frame on latch opening.[39] The impact conditions in the tests with twist introduced were in similar conditions as those without twist.

The results of this first stage of testing are as follows:

Center of Daylight Opening Impacts on Emergency Exit Windows of the MCI Bus Section:

- No windows tested opened in the center of daylight opening impacts under the Martec study conditions.
- Windows with tempered glass produced higher forces and lower displacement, than those with laminated glass.
- No windows with tempered glass broke in the center of daylight opening impacts. Single glazed laminated glass broke in the center of daylight opening impacts but the PVB layer did not tear.
- Polycarbonate windows produced lower resistance forces and higher displacement compared to laminated glass windows.
- Acrylic windows produced lower resistance forces compared to most other glazing compositions tested.

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[39] The amount of torsion introduced on the bus section frame was based on the torsion achieved by lifting the left front tire of a full-sized MCI D-series bus by approximately 1 meter (39 inches) using a hydraulic wheel lift which resulted in an angle of 4 degrees about the vehicle's longitudinal axis. Torsion was introduced to the bus section by applying a 18.9 kilonewton (kN) (4,250 lb) downward force to one entire end of the bus section and applying a 18.9 kN (4,250 lb) upward force to one corner of the opposite end of the bus section.

- Windows with greater PVB thickness produced reduced displacements.

Near-Latch Impacts on Emergency Exit Windows of the MCI Bus Section:

- Under the Martec Study Conditions (26 kg (57 lb) impactor and 21.6 km/h (13.4 mph) impact speed), the latches released and the windows opened, regardless of the type of glazing material. The glazing material was not damaged in these impacts.
- At impact speeds (10.3 km/h (6.4 mph) to 15.8 km/h (9.8 mph)) that are lower than the Martec Study Conditions the latches near the impact opened, but the window did not open because the far side latch remained closed.
- Paired impact tests using the 26 kg (57 lb) impactor at speeds of 13.9 to 15.5 km/h (8.6 to 9.6 mph) with and without torsion of the bus frame, showed that torsion in the bus frame either had no effect on latch opening or made latch opening less likely. In 6 out of 11 pairs of comparison tests, the presence of torsion on the bus section did not affect whether the struck latch unlatched. In the 5 other tests, the presence of torsion made it harder to open the latch.

2. Testing of MCI, Prevost, and Van Hool Emergency Exit Windows and Latches on Test Frames

Next, VRTC expanded testing to windows of other coach series and those made by other manufacturers to establish fleet baseline performance. Market share analysis indicated that the fleet would be well represented by expanding the testing to an MCI E/J-series, a Prevost model H3-45, and a Van Hool model C2045. Van Hool and Prevost windows were double glazed tempered glass panes while the MCI E/J-Series windows were either single glazed laminate glass panes or double glazed glass panes with tempered glazing on the exterior and laminate glazing

on the interior. The MCI E/J-Series and the Van Hool C2045 windows were 1.74 m (68.5 inches) in length and 1.1 m (43.3 inches) in height and the Prevost H3-45 model was 1.7 m (66.9 inches) in length and 1.2 m (47.2 inches) in height.[40] The glazing was mounted on test frames that represented the side passenger window frames for each of the three manufacturers. The mounting methods were in accordance with the manufacturers' instructions. Impact tests (impacts at the center of daylight opening and impacts near latches) were conducted under the Martec Study Conditions (26 kg (57 lb) impactor with 21.6 km/h (13.4 mph) impact speed). The significantly different latching mechanisms in the emergency exit windows of these three vehicle models allowed for an evaluation of the different types of latches.[41] Near latch impact tests with the 26 kg (57 lb) impactor were also conducted at different impact velocities to determine the threshold velocity for latch opening of the different types of windows and latching mechanisms. The results of this phase of testing are as follows:

<u>Near-Latch Impacts on Production Emergency Exit Windows:</u>

- Windows from all three manufacturers exhibited latch openings under the Martec Study Conditions.
- The threshold impact velocity for latch opening was higher for the MCI E/J-Series windows than the Van Hool and Prevost windows.

    --Van Hool exhibited latch openings in the 9 to 10 km/h (5.6 to 6.2 mph) range.

[40] The weight of the MCI E/J single glazed laminated window was 35 kg (77 lb) while that of the double glazed window was 51 kg (112.lb). The weight of the Prevost H3-45 was 50 kg (110 lb) and that of the Van Hool C2045 was 45 kg (99 lb).

[41] Details of the testing and the details of the windows and latching mechanisms in these three bus models are available in the NHTSA Technical Report DOT HS 811 862, November 2013.

--Prevost exhibited latch openings in the 11 to 12 km/h (6.9 to 7.5 mph) range.

--MCI E/J-series exhibited latch opening in the 18 to 21 km/h (11.2 to 13.1 mph) range.

Impacts at the Center of the Daylight Opening on Production Emergency Exit Windows (Martec Study Conditions):

- The MCI E/J-Series single laminate glazing window latches (primary and secondary) remained closed and the windows did not open.
- The Van Hool latches opened and produced window openings. The tempered glass panes remained intact.
- The Prevost latches opened and produced window openings. The tempered glass panes remained intact.

3. Testing of MCI, Prevost, and Van Hool Emergency Exit Windows with Countermeasure Latches

Since latches opened in all the near latch impacts on production windows and in two of the three center of daylight opening impacts of production windows in the phase 2 tests presented above, VRTC attempted to modify the latch systems using simple designs to see if the windows would remain closed during impact under the Martec Study Conditions.

The latching mechanism of the MCI E/J-Series production windows includes a lever that latches around a striker post that is press fit into a latch plate. Unlatching occurred in near-latch impacts by one of two modes: 1. the striker plate deformed and the striker post rotated in the direction of impact allowing the lever to slide over the striker post, and 2. the latch bar rotated

upward during impact which opened the detent lever.[42] Modifications to the MCI E/J-series latches involved the simplest modification to improve its performance such that the latch and glass remained intact. No simple countermeasures were identified by VRTC for the Van Hool and Prevost latches.

Center of daylight opening and near latch impacts under the Martec Study Conditions were conducted on the production windows with the countermeasure latches on the test frame. The results of this phase of testing are as follows:

Near-Latch Impacts (Martec Study Conditions) on Production Emergency Exit Windows with Countermeasure Latches:

- The MCI I/J-series countermeasure latch and glass remained intact in the near-latch impacts under the Martec Study Conditions.
- The Van Hool primary countermeasure latch opened, but the secondary latch did not under the near-latch Martec Study Conditions. Only a partial window opening occurred, as the tempered glass remained intact.
- The Prevost countermeasure latches opened in near-latch impacts under the Martec Study Conditions and the window opened.

Center of Daylight Opening Tests on Emergency Exit Windows with Countermeasure Latches (Martec Study Conditions):

- MCI E/J-series latches remained intact. The laminated inside pane broke.
- Van Hool latches remained intact. The tempered glass panes shattered.

[42] Latching mechanisms for Prevost and Van Hool windows and the failures modes observed during testing are provided in detail in the NHTSA Technical Report DOT HS 811 862, November 2013.

- Prevost latches remained intact. The window bowed outward during the impact, but the tempered glass panes did not break.

4. Pre-Broken Glazing Impact Tests of MCI E/J-Series Emergency Exit Windows with Countermeasure Latches

As part of the test program, VRTC conducted impact tests under the Martec Study Conditions on pre-broken glazing to assess glazing strength in the event the window is broken in a rollover prior to occupant loading. The objective of these tests was to develop an objective test procedure for pre-breaking the glazing before the impact tests. Various methods of pre-breaking the glazing were evaluated. These methods included pummeling the glazing with a hammer and punching holes in the glazing in specific grid patterns using an unloaded electric staple gun. The hole punch patterns evaluated were a 75 mm (3 inch) diagonally offset pattern, a 50 mm (2 inch) diagonally offset pattern, and a 75 mm (3 inch) horizontally offset pattern. The MCI E/J-Series was chosen to conduct pre-broken glazing impacts since the MCI E/J-Series model included laminated glazing that would still offer resistance to impact when the glass was pre-broken. To evaluate the strength and retention capabilities of pre-broken glazing, it was important that the windows did not unlatch or open during the impact. Therefore, NHTSA used modified MCI E/J-Series countermeasure latches in these tests to ensure the windows did not unlatch.

After pre-breaking the glazing, the window was mounted on the test frame and the pre-broken glazing was impacted at the center of daylight opening in accordance with the Martec Study Conditions. Displacement of the impactor during the impact was measured. The results of the center of daylight opening impact tests under the Martec Study conditions on the MCI E/J-

Series windows (double-glazed laminated and single-glazed laminated windows) with countermeasure latches for the different pre-breaking methods are as follows:

- The windows remained latched in all the tests and there was no tearing in the PVB layer.
- Average maximum displacement of the impactor in center of daylight opening impacts were:

    -- 214 mm (8.4 inches) for fully pummeled pre-broken glazing.

    -- 184 mm (7.2 inches) (86 percent of fully pummeled glazing) for 50 mm (2 inch) diagonally offset breakage pattern.

    -- 175 mm (6.9 inches) (82 percent of fully pummeled) for 75 mm (3 inch) diagonally offset breakage pattern.

    -- 151 mm (5.9 inches) (71 percent of fully pummeled) for 75 mm (3 inch) horizontally offset breakage pattern.
- The 50 (2 inch) and 75 mm (3 inch) breakage pattern methods are more objective than the fully pummeled method.
- There was little difference in maximum impactor displacements between the 50 (2 inch) and 75 mm (3 inch) diagonally offset pattern methods.

    --The 75 mm (3 inch) horizontally offset pattern method produced less maximum impactor displacement than the diagonally offset methods.
- Use of an electric staple gun (without the staples) to pre-break the glass panes was practical, allowed for single person operation, and did not produce tears in the PVB layer.

NHTSA also tested single-glazed laminated windows with a thicker PVB interlayer to evaluate the impactor displacement as a function of the PVB interlayer thickness. The PVB thickness chosen for this test series was 1.52 mm (0.06 inches) (versus the 0.76 mm (0.03 inches)

standard thickness). Center of the daylight opening impact tests under the Martec Study Conditions to pre-broken glazing (all four breaking methods: fully pummeled, 75 mm (3 inch) diagonally offset pattern, 50 mm (2 inch) diagonally offset pattern, 75 mm (3 inch) horizontally offset pattern) were conducted. The impacts did not produce any tearing in the PVB layer and the windows remained latched in all the tests. The pre-broken glazing with the thicker PVB interlayer produced maximum displacements of the impactor that were on average 14 percent less than similar impacts (center of daylight opening impact under Martec Study Conditions) into similarly pre-broken glazing production MCI E/J-series windows with standard thickness PVB interlayer.

5. Testing of MCI E/J-Series Fixed Windows (Martec Study Conditions)

VRTC also tested fixed windows from the MCI E/J-series to assess their performance under the Martec Study Conditions. The fixed windows were attached to the E/J-series test frame in accordance with manufacturer's recommendations. Tests were conducted on unbroken single-glazed and unbroken and pre-broken double-glazed windows. Impacts were conducted near the primary locking mechanism (retaining clip) that locks the window to the frame and at the center of daylight opening.

- For tests conducted on unbroken glazing near the primary locking mechanism (retaining clip), the retaining clip bent backwards. The secondary clip bent but did not release, resulting in the window only partially opening.
- For tests conducted at the center of the daylight opening on unbroken glazing, the retaining clip bent, but the window opening result depended on the type of glazing impacted.

  --The single-glazed window fully opened.

--The double-glazed window did not open.

- For tests conducted at the center of the daylight opening on pre-broken double-glazed windows, there was no damage to the retaining clips, and the windows did not open.

c. NHTSA's Large Bus Rollover Structural Integrity Research

In support of the agency's proposal to improve the rollover structural integrity of motorcoaches and other large buses, among other things NHTSA evaluated ECE R.66[43] to see if the standard would address the safety needs NHTSA identified in that rulemaking.

In the ECE R.66 full vehicle test, the vehicle is placed on a tilting platform that is 800 mm (31.5 inches) above a smooth and level concrete surface. One side of the tilting platform along the length of the vehicle is raised at a steady rate of not more than 5 degrees/second until the vehicle becomes unstable, rolls off the platform, and impacts the concrete surface below. The vehicle typically strikes the hard surface near the intersection between the sidewall and the roof. The encroachment of structures into a designated "occupant survival space" (defined by use of a survival space template) during and after the rollover structural integrity test is assessed.

NHTSA evaluated several different models of OTRBs. Two older models were selected because they were representative of the range of roof characteristics (such as design, material, pillars, shape, etc.) of large bus roofs in the U.S. fleet. The vehicles selected were two 12.2 meters (m) (40 feet) (ft) long model year (MY) 1992 MCI model MC-12, and two 12.2 m (40 ft) long MY 1991 Prevost model (Prevost) LeMirage buses. The most discernible difference

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[43] ECE R.66 defines "superstructure" as "the load-bearing components of the bodywork as defined by the manufacturer, containing those coherent parts and elements which contribute to the strength and energy absorbing capability of the bodywork, and preserve the residual space in the rollover test." "Bodywork" means "the complete structure of the vehicle in running order, including all the structural elements which form the passenger compartment, driver's compartment, baggage compartment and spaces for the mechanical units and components." (Footnote added.)

between the MCI and Prevost models was that the Prevost had smaller side windows and more roof support pillars.

NHTSA also tested a MY 2000 MCI bus, Model 102-EL3, that was 13.7 m (45 ft) in length. The agency tested this model because it was representative of many buses newer than the MCI and Prevost models. Newer buses are 13.7 m (45 ft) in length instead of 12.2 m (40 ft). The newer buses also tend to have larger windows than the earlier models.

A detail report of the test program of the older buses is available in the docket.[44] A report on the test of the newer bus can be found on NHTSA's website.[45]

In our research, high speed video cameras were used and transfer media were applied to each survival space template to determine if any portion of the vehicle interior had entered the occupant survival space during the rollover test. In addition, two Hybrid III (HIII) 50th percentile adult male anthropomorphic test devices (ATDs) (test dummies) were placed in the vehicle, on the opposite side of the impacted side of the bus, to measure injury potential and seat anchorage performance. One of the ATDs was belted and the other was unbelted. For the purposes of this advanced glazing NPRM, NHTSA reviewed the results from the evaluation to understand better the dummy occupant interaction with the windows during an elevated one-quarter turn roll event.

The following summarizes the findings of the ECE R.66-based tests that are especially relevant to today's NPRM.

1. MY 1991 Prevost Bus

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[44] Docket No. NHTSA-2007-28793-0019.

[45] "ECE Regulation 66 Based Research Test of Motorcoach Roof Strength, 2000 MCI 102-EL3 Series Motorcoach, NHTSA No.: MY0800," October 1, 2009, Report No.: ECE 66-MGA-2009-001, http://www-nrd.nhtsa.dot.gov/database/aspx/searchmedia2.aspx?database=v&tstno=6797&mediatype=r&r_tstno=6797, Report 8. http://www-nrd.nhtsa.dot.gov/database/VSR/veh/QueryTest.aspx, Report 8. Step-by-step instructions on accessing the research report can be found in a memorandum in Docket No. NHTSA-2007-28793-0025.

The Prevost bus was equipped with ten laminated windows on each side of the bus. The windows were 815 mm (32 in) in width and 1,040 mm (41 in) in height. Four of the left windows and three of the right windows were designated emergency exit windows. The emergency exit windows were hinged at the top and latched at the bottom.

Upon impact with the ground (left side of the bus), contact between the front survival space template and the left side window was made. The glass panes of the laminated glazing showed cracking and splintering. All of the glazings on the impact side (left) were retained in the windows. Three of the four left side emergency exit windows unlatched and lost retention during the impact but were held in the closed position by contact with the ground. The remaining left side emergency exit window remained latched during the impact with the ground.

High speed film from the test indicated that the side windows located on the far side of the impact (right) underwent a substantial amount of flexion during the impact with the ground but remained intact. The flexion along with the inertia of the latching bar mechanism for this particular Prevost bus caused all three of the right side emergency exit windows to unlatch and open slightly. However, they were closed by gravity following the impact when the Prevost bus came to its final resting position. The two roof emergency exits also opened during the impact.

The left pelvis of the unrestrained ATD seated far-side of the impact interacted with the inboard armrest prior to the bus impacting the ground. After the bus made contact with the ground, the top of the dummy's head made contact with the left window and the ATD came to rest straddling the third and fourth left windows from the front of the bus.

2. MY 1992 MCI Bus

The MCI bus was equipped with seven laminated windows on each side. All of the windows were designated emergency exit windows with the exception of the right rearmost

window. The windows were 1,310 mm (52 in) in width and 685 mm (27 in) in height. The emergency exit windows were hinged at the top and latched at the bottom.

Upon impact with the ground (left side of the bus), contact between the front survival space template and the left side window was made. The glass panes of the laminated glazing showed cracking and splintering. All of the glazings on the bus were fully retained in the windows.

None of the emergency exit windows unlatched or opened during or after the ground impact. The roof emergency exits opened during the impact and a gap was visible between the roof panel and the emergency exit frame after the test.

The left pelvis of the unrestrained ATD interacted with the inboard armrest during the bus impact with the ground. The top and back of the ATD head struck the left window as the bus impacted the ground, and the dummy came to rest on its head over the window.

3. MY 2000 MCI Bus

The 2000 MCI 102-EL3 bus was equipped with seven laminated glass windows on each side. The front windows were fixed windows and the remaining windows were emergency exit windows. The majority of the windows were 1,564 mm (62 in) in width and 894 mm (35 in) in height, which is substantially larger than the previous two older buses (a 55 percent increase in window area compared to the 1992 MCI model). The larger front windows were 1,564 mm (62 in) in width with a maximum of 1,257 mm (50 in) in height, and the smaller rear windows were 1,042 mm (41 in) in width and 894 mm (35 in) in height.

During the left-side impact with the ground, five of the seven right side glazings (toward the front of the bus) cracked and broke, and the window glazings fell into the occupant compartment during the test. The glazing from one of the right side front windows was retained

by an overhead TV monitor and prevented the window pane from separating from its mounting gasket and falling into the bus. We believe that the glazing fell into the bus in this test, and not in the previous tests, because glazings on this bus are significantly larger, and presumably heavier, than the glazings used on the two older buses tested. The glazing in the last window near the rear cracked and broke but the window was retained and did not fall into the passenger compartment, possibly because the window was shorter in width than the other windows.

The emergency exit window release handles for four of the right side windows rotated approximately 90 degrees; however, all emergency exit windows on both sides remained latched during the test. Both of the roof emergency exits opened during the test.

All seven of the left side (impacted side of the bus) glazings remained fully retained in the windows after the rollover test.

The unrestrained dummy's head first struck the luggage rack above the left side seats, and then the dummy's head hit the glazing of the third window from the front (left side of the bus). The dummy's left and right knees hit the seat back of the left side seats before hitting the center of the window. Its final resting position was on top of this window. The glazing remained intact and retained in the window.

V. Overview of Proposed Requirements

In the 2013 seat belt final rule,[46] NHTSA determined that a significant majority of fatalities in vehicles subject to the rule were attributable to rollovers and that more than three-quarters of rollover fatalities were attributable to ejections. In crashes in which the roof and bus structure remain intact, the main ejection portal for passengers was through the side windows.

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[46] 78 FR 70416, November 25, 2013, supra.

NHTSA is proposing performance requirements that the subject buses would have to meet by way of anti-ejection safety countermeasures. We are proposing to issue an FMVSS No. 217a to specify an impactor test of glazing material used in side and rear windows.[47] In the tests, a 26 kg (57 lb) impactor would be propelled from inside a test vehicle toward the window glazing at 21.6 km/h (13.4 mph). Each window would be subject to any one of three impacts, as selected by NHTSA in a compliance test: (a) an impact near a latching mechanism of an intact window[48]; (b) an impact at the center of the daylight opening of an intact window; and (c) an impact at the center of the daylight opening of a pre-broken window. The impactor and impact speed in these proposed tests simulate the loading from an average size adult male impacting a window on the opposite side of a large bus in a rollover.

The proposed performance requirements are as follows:

- In tests described in (a) and (b) in the above paragraph, the window would have to prevent passage of a 102 mm (4 inch) diameter sphere during the impact, and after the test. The agency would assess the window during the impact by determining whether any part of the window passes a reference plane defined during a pre-test set up procedure. These requirements would ensure that glazing is securely bonded to window frames, no potential ejection portals are created due to breaking of glass, and windows remain closed when impacted.

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[47] A final rule could incorporate the proposed requirements into FMVSS No. 217, rather than in a separate FMVSS No. 217a. This NPRM shows the proposed requirements separately in FMVSS No. 217a for plain language purposes and the reader's convenience.

[48] For non-emergency exit fixed windows, the proposed test would be conducted at the location of one of the fixed latches or discrete attachment points. For fully rubber bonded or glued windows with no latch mechanisms, the test would be conducted along the center of the lower window edge one inch above the daylight opening periphery.

- In the test of (c) above, the maximum displacement of the impactor at the center of the daylight opening would be limited to 175 mm (6.9 inches) for pre-broken glazing. This requirement in particular would drive the installation of advanced glazing. The requirement would also help ensure the advanced glazing reasonably retains occupants within the structural sidewall of the bus even when the glass surrounding the PVB interlayer is broken and ensures that no potential ejection portals are created during and after impact.
- Emergency exit latch protrusions may not extend more than one inch into the emergency exit opening of the window when the window is opened to the minimum emergency egress opening (allowing passage of an ellipsoid 500 mm (19.7 inches) wide by 300 mm (11.8 inches) high). This requirement would minimize the potential for the latch plate protrusions (or other projections) to hinder the emergency egress of passengers.
- Latches would have to remain functional following the impact test to ensure that occupants can open the emergency exits to egress the vehicle after a crash.

Current regulations and industry standards for large buses do not adequately address window retention or ejection mitigation through glazing under dynamic occupant loading in rollovers.[49] FMVSS No. 205, "Glazing materials," industry standards,[50] and various

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[49] On January 19, 2011, NHTSA issued a final rule (76 FR 3212) establishing a new FMVSS No. 226, "Ejection mitigation," to reduce the partial and complete ejection of vehicle occupants through side windows in crashes, particularly rollover crashes. The standard applies to the side windows next to the first three rows of seats, and to a portion of the cargo area behind the first or second rows, in motor vehicles with a GVWR of 4,536 kg (10,000 lb) or less..

[50] ANSI Z26.1, "Safety glazing materials for glazing motor vehicles and motor vehicle equipment operating on land highways," specifies performance tests and requirements for different types of glazing material regarding visibility,

international regulations[51] address the minimum strength and mechanical properties that certain safety glass (test samples) must possess, but they do not address window retention as a whole. FMVSS No. 217 has an ejection mitigation requirement by way of a quasi-static load application test (S5.1), but the test is not representative of the dynamic loading on glazing from an unrestrained adult male occupant during an OTRB rollover. The proposed FMVSS No. 227 requirements for bus structural integrity would require that windows (on the non-roll side) remain intact in their framing during the quarter turn, do not open up during the quarter turn, and have no openings large enough to admit passage of a 102 mm (4 inch) diameter sphere after the quarter turn. However, the forces that would be experienced by the windows in the proposed FMVSS No. 227 test are purely inertial and are not representative of any direct occupant loading from within the bus.

Thus, the requirements proposed in today's NPRM would fill a gap currently existing in NHTSA's motorcoach and large bus safety regulations. NHTSA recently issued a seat belt requirement[52] to mitigate the risk of ejection. However, seat belt usage rates by motorcoach occupants are uncertain, and even if occupants are belted, there are risks associated with partial ejections. Advanced glazing in window openings and improved mountings would mitigate the risk of ejection of occupants who may not be restrained at the time of the crash, and the risk of partial ejections of both restrained and unrestrained occupants. Today's NPRM proposes

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strength, and abrasion resistance. The specified tests do not evaluate the entire window for retention under loading conditions representing an unrestrained occupant impacting a window in a rollover event.

[51] European regulation, ECE R.43, "Uniform provisions concerning the approval of safety glazing materials and their installation on vehicles," Australian Design rule, ADR 8/01, "Safety glazing material," and Japanese Industrial Standards, JI R 3211, "Safety glazing materials for road vehicles," are similar to FMVSS No. 205 and ANSI Z26.1. These standards only specify requirements on glazing characteristics but do not specify requirements for window retention under occupant loading.

[52] 78 FR 70416, supra.

requirements that would result in portal improvements by way of advanced glazing, consistent with the goals of the Motorcoach Safety Enhancement Act of MAP-21.

This NPRM is based on a number of research studies.

NHTSA formulated this NPRM based on findings from the Martec study. Through computer simulation using the ECE R.66 rollover test, the Martec study established the forces that motorcoach occupants exert on the side window during rollover events, and the impact forces applied to the roof of the motorcoach. The Martec study also established the basis for the dynamic test procedure proposed today to test glazing materials and bonding techniques.

NHTSA also designed this NPRM based on the findings of our 2011 and 2013 follow-on testing of real-world motorcoach windows. The later study examined the exact failure mechanism(s) for side windows in a rollover event. We used the dynamic impactor device developed in the Martec study, along with its prescribed impact speed 21.6 km/h (13.4 mph) and impactor mass 26 kg (57 lb), to evaluate modern bus windows that were representative of the fleet population. We obtained data about fleet baseline performance and the performance of various bonding methods and glazing materials, such as laminated glass and polycarbonates, tested on test frames representing side passenger window frames of actual motorcoaches.

We also found in our 2013 testing that latch mechanisms on emergency windows routinely failed when the glazing near them was struck with the impactor. Failure of the latch caused the exit to open, posing an unreasonable risk of ejection in a rollover. These results indicated there is a safety need for a test that assesses the ability of the latches to remain closed when subjected to impactor loading. We were also able to modify some of the latch systems with simple designs, enabling the latch to stay closed when struck. This showed the practicability of meeting an ejection mitigation requirement when glazing is struck near the latch.

NHTSA also based this NPRM on the findings from NHTSA's large bus structural integrity research program.[53] In that program, NHTSA conducted ECE R.66 tests of a 1991 Prevost bus, a 1992 MCI bus and a 2000 MCI bus. The 1991 Prevost and the 1992 MCI motorcoaches were able to retain the glazings on both the side of the bus impacting the ground and on the far side, showing the practicability of producing sufficient bonding techniques for glazing materials in motorcoaches.

Additionally, the structural integrity test program showed that bus design can influence glazing retention. In the test of the 2000 MCI bus, during the left-side impact with the ground five of the seven glazings on the right side of the bus cracked and broke, and the window glazings fell into the occupant compartment during the test. We believe that the glazing fell into the bus in this test, and not in the previous tests of the 1991 Prevost and the 1992 MCI, because glazings on the 2000 MCI bus were significantly larger, and presumably heavier, than the glazings used on the two older buses tested. The bonding technique was not strong enough to support the heavier glazings. The glazing in the last window near the rear of the 2000 MCI bus cracked and broke but the window was retained and did not fall into the passenger compartment, possibly because the window was shorter in width than the other windows.

NHTSA's structural integrity testing showed good performance by laminated glazing. The 1991 Prevost bus was equipped with ten laminated windows on each side of the bus. In the ECE R.66 test, upon impact with the ground (left side of the bus), the glass panes of the laminated glazing on the left side showed cracking and splintering but were retained in the windows. The 1992 MCI bus was equipped with seven laminated windows on each side. Upon impact with the ground (left side of the bus), the glass panes of the laminated glazing on the left

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[53] Supra.

side showed cracking and splintering. All of the glazings on the bus were fully retained in the windows.

Studies show that bus glazings are exposed to multiple and chaotic impacts in a rollover. In the Martec study, the simulation showed glazing struck by the unbelted passenger occupant before the bus was completely on its side. In NHTSA's structural integrity tests, the unrestrained ATD was basically freefalling from the seat as the bus tipped over, and did not contact the side windows until after the bus had already impacted and made contact with the ground surface. In the test of the 1992 MCI bus, the top and back of the restrained ATD head struck the third window from the front of the bus on the left side as the bus impacted the ground. The window glazing cracked and splintered as the laminated glazing hit the ground. The test dummy came to rest on its head over this window which remained intact after the test.

Because glazings are subject to multiple, unpredictable impacts from occupant and/or ground contact in a rollover, NHTSA has tentatively determined that the dynamic impact test proposed today should include a test set-up specification and method that involves pre-breaking the glazing prior to the impactor test. Pre-breaking the glazing mimics a real-world condition, as the side window glazing is often broken when the bus contacts the ground. With advanced glazing, the procedure would likely result in the outside glass breaking without deforming the laminate. With tempered (non-advanced) glazing, the procedure would likely result in the glazing shattering into fragments. As a result, to meet a final rule resulting from this NPRM, buses covered by the rule would likely use laminated glazing, and not tempered glazing, to meet the requirements proposed today.

VI. Test Procedure Specifications

a. Impactor

NHTSA proposes to use the impact test device developed in the Martec study, supra. That study determined that a mid-size adult male would strike the glazing with his head, followed closely by his shoulder/torso. Simulations also showed that the impact area between the bus occupant and the window glazing was primarily along the side of the occupant.

The proposed impactor design is as outlined in Figure 3, representing the torso of the SID. The mass of the impactor is 26 kg (57 lb), representing the effective mass measurements from the numerical analysis of the Martec study. A spring with the appropriate stiffness (258 N/m) was used to replicate compression of the thorax. The impactor face is a rectangle measuring 177 mm x 212 mm (7 inch x 8.3 inch) with rounded corners. A shoulder foam part from the SID is affixed to the impactor face to replicate the compression of the foam located beneath the dummy's chest jacket (Figure 3).

b. Test Speed

The impact speed in these proposed tests simulates the loading from an average size adult male impacting a window on the opposite side of a large bus in a rollover. In the Martec study, computer modeling of a bus rollover predicted the loads on the bus windows from a mid-size adult male occupant. The Martec study found that the impact velocity of the occupant striking the glazing with his head, followed closely by his shoulder/torso, could be as high as 6.0 m/s (21.6 km/h or 13.4 mph). We propose to use this impact speed of 21.6 km/h (13.4 mph) for each of the proposed dynamic impact tests.

c. "Portal" Improvements

The Motorcoach Enhanced Safety Act directs the agency to consider requiring advanced glazing standards for "each motorcoach portal" (§ 32703(b)(2)). The Act defines "portal" as "any opening on the front, side, rear, or roof of a motorcoach that could, in the event of a crash

involving the motorcoach, permit the partial or complete ejection of any occupant from the motorcoach, including a young child" (§ 32702(9)).

We have considered requiring advanced glazing standards for each motorcoach portal in accordance with the Act, and have decided, based on accident data, to apply this NPRM to the bus side and rear windows and to glass panels/windows on the roof. We are not applying the proposed requirements to the front windshield, or to emergency exit doors, service doors, or roof hatches. Accident data of real world rollover incidents indicate that passenger ejections are not occurring from the front windshield or emergency or service doors. We are aware of only one incident of a real world rollover crash involving a front windshield ejection, and that was a non-fatality.[54]

To the extent emergency roof exits are opening during the impact with the ground, NHTSA's rulemaking on large bus rollover structural integrity will address that ejection risk. NHTSA has proposed in that rulemaking to require emergency exits to remain shut during the rollover test, and to be operable in the manner required under FMVSS No. 217 after the test. Those proposed requirements would ensure that roof hatches do not open during a quarter-turn rollover, at minimum, from the inertial loading of its own weight.

We have applied the proposed advanced glazing requirements to the portals we believe pose a valid risk of ejection. We estimate that side bus windows account for about 80 percent of portals (potential ejection routes) on buses, which presents a high exposure risk to potential ejection. Given this exposure, this NPRM will focus advanced glazing and other ejection mitigation efforts on the bus side and rear windows (emergency and non-emergency exits). In

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[54] The crash occurred in Victory, NY. The front right occupant was ejected only after the windshield had broken out during a frontal collision.

addition, we have recently become aware of some motorcoaches equipped with glass roofs or glass panel ceilings to provide an enhanced view for bus passengers. These glass panels/windows on roofs can become ejection portals if advanced glazing is not used. Therefore, we propose to apply this NPRM to roof glass panels/windows as well, assuming they are of a minimum size.

We also propose to apply this NPRM to rear windows. We recognize that OTRBs typically have the bus engine in the rear, and therefore usually have no window on the rear of the bus. However, nothing precludes bus designs from having windows in the rear of the bus that could be potential ejection portals. However, to be subject to the proposed requirements, the windows would have to be a minimum size.

A minimum size criterion would thus apply to side and rear windows, and to roof glass panels/windows. The criterion would address limitations of testing with the impactor. The window would be tested if it is large enough to fit the impactor face plus a 25 mm (1 inch) border around the impactor face plate edge without contact with the window frame. The dimensions of the dynamic impactor we propose to use are 177 mm by 212 mm (7 inches by 8.3 inches). Using the 8.3 inches dimension of the dynamic impactor, the proposed dynamic test procedure would be applicable to a side window whose minimum dimension measured through the center of its area is (280 mm) (11 inches) or greater. (The rationale for the 280 mm (11 inches) is provided below in the next paragraph.) The 25 mm (1 inch) clearance is needed to make sure we are testing the strength of the glazing and bonding in retaining the impactor and that of the latches withstanding the impact, and not the strength of the window frame. If the impactor were to strike the window frame structure, the impactor could be partially restrained by

the window frame structure and the performance of the glazing and bonding would not be fully assessed.

The proposed exclusion is consistent with FMVSS No. 217, which currently excludes from S5.1's window retention requirements "a window whose minimum surface dimension measured through the center of its area is less than 8 inches" (S5.1.2). FMVSS No. 217 uses a head form with a 76 mm (3 inch) spherical radius (152 mm (6 inch) diameter) to apply the quasi-static force application (S5.1). We are proposing that the new dynamic test be applicable only to bus windows with a proportional minimum surface dimension. That is, using the wider 212 mm (8.3 inch) dimension of the dynamic impactor, the proposed dynamic test procedure would be applicable to a side window whose minimum dimension measured through the center of its area is 280 mm (11 inch) or greater.[55]

d. Definition of Daylight Opening

This NPRM proposes a procedure for testing glazing in each side and rear window opening and roof glass panels/windows. To describe precisely where the impactor would be targeted on the glazing, we would first define how the "daylight opening" (window opening) would be determined. For side windows, the "daylight opening" would be the locus of all points where a horizontal line, perpendicular to the vehicle longitudinal centerline, is tangent to the periphery of the opening. For rear windows, the "daylight opening" would be the locus of all points where a horizontal line, parallel to the vehicle longitudinal centerline, is tangent to the periphery of the opening. For roof glass panels/windows, the "daylight opening" would be the locus of all point where a vertical line is tangent to the periphery of the opening. The periphery would include surfaces 100 mm (3.94 inches) inboard of the inside surface of the window

[55] (6 inch / 8 inch) = (8.3inch / X inch), therefore (X = 11 inch)

glazing and 25 mm (0.98 inches) outboard of the outside surface of the window glazing. The periphery would exclude any flexible gasket material or weather stripping, grab handles, and any part of a seat.

This definition of daylight opening would be similar to the definition of "side daylight opening" in FMVSS No. 226, "Ejection mitigation." As explained in the FMVSS No. 226 rulemaking, flexible gasket material, weather stripping and the like are excluded from the "daylight opening" definition because the flexible material is unlikely to impede occupant ejection through the opening.[56] The glazing underlying the flexible material should be considered part of the daylight opening for testing purposes, thus subject to impactor testing. The exclusion results in keeping the glazing area that NHTSA may test as large as possible.

Grab handles would be excluded from the definition for the same reasons explained in the FMVSS No. 226 rulemaking.[57] In a rollover, grab handles are unlikely to have any effect mitigating the likelihood of ejection since occupants will move toward the daylight opening from many different angles. Grab handles are unlikely to contribute toward lowering the risk of occupant ejection through the window (i.e., they do not lower the chance of ejection because they would block the opening). Thus, we believe it would not make sense for the test procedure to allow grab handles to define the area of glazing tested.

We note that there currently is a definition of the term "daylight opening" in FMVSS No. 217 (S4). The term is defined as: "the maximum unobstructed opening of an emergency exit when viewed from a direction perpendicular to the plane of the opening." The term was

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[56] 74 FR 63180, 63205.
[57] Final rule; response to petitions for reconsideration, 78 FR 55138, 55152 (September 9, 2013).

inadvertently added to the standard by a May 9, 1995 final rule (60 FR 24562); the term is not used in any other part of the regulatory text. We propose to delete the term in S4.

e. Glass Breakage Procedure

NHTSA is proposing a breaking specification and method that involves punching holes in the glazing, to simulate the damage the glazing could experience in a rollover prior to impact by an occupant.[58] The holes would be punched at set distances on both the interior and exterior glass plies of the laminated glazing. The window breaking procedure would damage but not destroy laminated glazing, while it would obliterate tempered glazing. Since tempered glazing would be obliterated, a final rule resulting from this proposal would have the effect of prohibiting manufacturers from having bus windows made solely from tempered glazing.

NHTSA studied various methods to break the glazing prior to the impact tests, including impacts with a hammer (pummeled), using an automatic center punch, and an unloaded electric staple gun.[59] The agency also studied several patterns of breakage (75 mm (3 inch) diagonally offset, 75 mm (3 inch) horizontally offset, and 50 mm (2 inch) diagonally offset grids).[60] The study is discussed in NHTSA's "Motorcoach Side Glazing Retention Research," November 2013, supra.

In NHTSA's study, the Martec study impact tests were performed on broken glazing with the impactor striking the window at the center of the daylight opening, as measured on the

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[58] In NHTSA's developmental testing, the agency found that using an electric staple gun without any staples worked well. Holes punched with the unloaded electric staple gun did not penetrate through the PVB interlayer. See "Motorcoach Side Glazing Retention Research," November 2013, supra.

[59] A Duo Fast Model EWC electric staple gun without staples was used. With the front nose opening of the staple gun normal to the glazing, the staple gun applied a 12.7 mm (0.5 inch) line load with an average force of 4,200 Newton (N) (994 lb) (standard deviation = 850 N (191 lb)) when fired. This force was sufficient to break the glass without any damage to the inner laminate layer.

[60] The breakage pattern developed in the ejection mitigation regulation (FMVSS No. 226) where the 75 mm (3 inch) pattern is "horizontally offset" was also studied. NHTSA found that the automatic center punch used in FMVSS No. 226's procedure was not practical for large bus windows.

interior window frame. Not surprisingly, the results showed that more glass breakage (maximum breakage was achieved in the pummeled test) yields more peak impactor displacement. However, the 75 and 50 mm (3 and 2 inch) diagonally offset matrix hole punching methods were found to be more controllable and objective than the pummeling method, while also creating extensive breakage patterns. Thus, NHTSA decided to incorporate the hole punching method rather than the pummeling method in the proposed test procedure.

Results also indicated that there does not appear to be a significant difference in displacement of the impactor between the 75 and 50 mm (3 and 2 inch) diagonally offset patterns. Yet, the 75 mm (3 inch) diagonally offset grid pattern has 53 percent fewer punch holes compared to the 50 mm (2 inch) diagonally offset grid pattern, i.e., the 75 mm (3 inch) diagonally offset pattern would require less than half the number of hole punches compared to the 50 mm (2 inch) pattern. Additionally, the 75 mm (3 inch) diagonally offset pattern resulted in glazing performance that was closer to the 50 mm (2 inch) diagonally offset and pummeled glazing tests, compared to the 75 mm (3 inch) horizontally offset grid pattern. For these reasons, NHTSA has chosen the 75 mm (3 inch) diagonally offset grid pattern to incorporate into the proposed test procedure.

The first step in the test procedure would be to mark the glazing surface on the occupant interior glass in a horizontal and vertical grid of points separated by 75 mm (3 inches), with the first point coincident with the geometric center of the daylight opening. Next, the grid on the opposite side of the glazing would be marked. For most glazing, the grid on the opposite side of the glazing would be staggered to avoid tearing the PVB interlayer. For laminates, “the opposite side of the glazing” means the opposing glass ply directly opposite of the PVB interlayer. “Staggered” means that the 75 mm (3 inch) offset pattern has a 75 mm x 75 mm (3 inch x 3 inch)

pattern on the occupant interior glass and the same pattern, offset by 37.5 mm (1.5 inch) horizontally and vertically, on the outside exterior glass surface.

For windows that are a single-pane unit, we would use the grid pattern on the occupant space interior surface and the staggered grid pattern on the outside exterior surface of the glass pane.

For double-glazed windows, we would use a grid pattern on the occupant space side of the interior pane and on the outside of the exterior pane. For double-glazed windows that consist of one pane of tempered glass, that pane would be broken and removed, and the remaining glass pane (that is not of tempered glass) would be pre-broken on both sides (occupant interior and outside exterior) with the grid and staggered grid patterns, respectively. For double-glazed windows that do not consist of any tempered glass pane, it would not be practical to apply the 75 mm (3 inch) pre-break pattern to the insulated surface (inside the air gap) of the individual glass panes. In these cases in which neither pane is tempered glass, both the occupant space side of the interior pane and the outside of the exterior pane would be broken in the grid pattern, but the patterns would not be offset (one side would not use the staggered pattern) due to a lack of need. That is, for those windows there would be little likelihood of tearing the PVB interlayer even when the patterns are not offset.

The agency envisions breaking the defined grid points using an unloaded electric staple gun, since the device worked well for that purpose in our developmental testing. The staple gun we use would apply 12.7 mm (0.5 inch) line load (with a thickness of 1.3 mm (0.05 inches)) (the size of a standard staple) on the glazing with a force in the range of 3,500 Newtons (N) (787 lb) to 5,000 N (1,124 lb) when the front nose opening of the staple gun is held normal to the glazing. These staple gun specifications are designed so as to break the glass with a single punch without

producing tears in the PVB interlayer. Holes would be punched in the glazing starting with the inside surface of the glazing, and starting with the forward-most, lowest hole in the pattern. We would continue punching holes 75 mm (3 inches) apart, moving rearward on the bus. When the end of a row is reached, we would move to the most forward hole in the next higher row, 75 mm (3 inches) from the punched row. After completing the holes on the inside surface, we would repeat the process on the outside surface.

When punching a hole, we would place a 100 mm (4 inch) by 100 mm (4 inch) piece of plywood on the opposite side of the glazing as a reaction surface against the punch. If a particular window were constructed such that the inner laminated material is penetrated or damaged, the procedure would not be halted or invalidated. The impactor test would be conducted at the conclusion of the glazing breakage procedure. If punching a hole causes the glazing to disintegrate, as would occur when testing tempered glazing, the procedure would be halted for that item of glazing and the impactor test would be conducted on what glazing, if any, remains. If there is no glazing remaining after the hole-punching procedure, there would be a failure to comply since the window would not be able to restrain the impactor or prevent passage of the 102 mm (4 inch) diameter sphere.

VII. Performance Requirements

NHTSA proposes to specify performance requirements for windows comprised of unbroken and broken glazing when the glazing is subjected to impactor testing. The impactor would be propelled along a horizontal plane for side and rear windows and would be propelled along a vertical plane for roof glass panels/windows.

a. Unbroken Glazing

The amendments proposed by this NPRM would require buses to meet performance requirements during and after the impactor test. Each unbroken window would be subject to either of the following two impacts, as selected by NHTSA in a compliance test: (a) an impact near a latching mechanism,[61] and (b) an impact at the center of the daylight opening. The tests would ensure that glazing is securely bonded to window frames and that glass breakage during impact does not result in a potential ejection portal. In addition, the test near a latching mechanism would ensure that the latch system is able to keep the window closed when subjected to direct occupant loading, so as not to become a potential ejection portal. In NHTSA's motorcoach side glazing retention research program, production windows from all three manufacturers resulted in window opening during the impact.

We are proposing that windows (a) prevent passage of a 102 mm (4 inch) diameter sphere during the impact, and (b) be sturdy enough such that there are no openings after the test that allow the passage of the sphere when a force of no more than 22 N (5 lb) is applied with the sphere at any vector in a direction from the interior to the exterior of the vehicle. The requirement described in (b) is a simple one based on a longstanding requirement currently in S5.1 of FMVSS No. 217. The compliance test for S5.1 of Standard No. 217 involves a compliance technician probing the window with the sphere. NHTSA would assess compliance with the requirement in (b) above using the same basic procedure.

However, the requirement in (a) is more challenging. Because it is impractical to probe for openings with the 102 mm (4 inch) sphere during a dynamic test, NHTSA is proposing a requirement that is premised on the concept of passage of the sphere, but is one that can be more

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[61] For non-emergency exit fixed windows, the proposed test would be conducted at the location of one of the fixed latches or discrete attachment points. For fully rubber bonded or glued windows with no latch mechanisms, the test would be conducted along the center of the lower window edge one inch above the daylight opening periphery.

easily assessed in a dynamic test. This requirement would be that during the impactor test, no portion of the window (excluding glazing shards) may displace past a specified reference plane that is determined in a pre-test procedure. The procedure is explained below.

Ejection Reference Plane

In NHTSA's impactor test of glazing near a latching mechanism and in the impactor test of glazing at the center of daylight opening, an "ejection reference plane" would be determined prior to the test. The plane would be based on the passage of a 102 mm (4 inch) diameter sphere through a potential ejection portal of the window. We would require that no part of the window (excluding glazing shards) may pass this "ejection reference plane" during the dynamic impact test. If any part of the window frame passes the plane, there would be a failure to comply.

For side windows, the "ejection reference plane" is a vertical plane parallel to the longitudinal vertical center plane of the bus passing through a point located at a lateral distance of 102 mm (4 inches) from the lateral most point on the glazing and surrounding frame, with the window in the closed position.

For rear windows, the "ejection reference plane" is a vertical plane perpendicular to the longitudinal vertical center plane of the bus passing through a point located at a longitudinal distance of 102 mm (4 inches) from the rear most point on the glazing and surrounding frame, with the window in the closed position.

For roof glass panels/windows, the "ejection reference plane" is a horizontal plane passing through a point located at a vertical distance of 102 mm (4 inches) from the highest point on the glazing and surrounding frame, with the window/panel in the closed position.

Displacement Limit of 102 mm (4 inches)

The proposed performance requirements are built on preventing passage of a 102 mm (4 inch) diameter sphere. The principle underlying the 102 mm (4 inch) displacement limit is to prevent gaps or openings to form in advanced glazing through which occupants ("including children," states MAP-21 at § 32703(b)(2)) can be partially or totally ejected. A 100 mm (3.94 inch) performance limit is used in several regulations relating to occupant retention. FMVSS No. 217 already requires manufacturers to ensure that each piece of glazing and each piece of window frame be retained by its surrounding structure in a manner that prevents the formation of any opening large enough to admit the passage of a 102 mm (4 inch) diameter sphere under a specified force. The 102 mm (4 inch) value is also used in FMVSS No. 206, "Door locks and door retention components" (49 CFR 571.206). In FMVSS No. 206, the door is loaded with 18,000 N (4,047 lb) and the space between the interior of the door and the exterior of the door frame must be less than 100 mm (3.94 inches).

In addition, the 102 mm (4 inch) limit is used in FMVSS No. 226, "Ejection mitigation" (49 CFR 571.226). It was noteworthy to NHTSA when developing the NPRM proposing the standard that a value of approximately 100 mm is used by the International Code Council (ICC) in developing building codes used to construct residential and commercial buildings. The ICC 2006 International Building Code and 2006 International Residential Code require guards to be placed around areas such as open-sided walking areas, stairs, ramps, balconies and landings. The guards must not allow passage of a sphere 102 mm (4 inches) in diameter up to a height of 864 mm (34 inches). NHTSA noted that the ICC explains in the Commentary accompanying the Codes that the 102 mm (4 inch) spacing was chosen after considering information showing that the 102 mm (4 inch) opening will prevent nearly all children 1 year in age or older from falling

through the guard. That information helped NHTSA decide on a 100 mm (3.94 inch) limit for the displacement of the head form impactor used in FMVSS No. 226.

NHTSA requests comment on the linear displacement limit of 100 mm (3.94 inch) as an appropriate value.

b. Broken Glazing

Under this NPRM, each window would have to meet performance requirements during and after an impact while pre-broken prior to the test. The impact would be at the center of the daylight opening of the window. The maximum displacement of the impactor would be limited to 175 mm (6.89 inches). The 75 mm (3 inch) diagonally offset pattern would be used to pre-break the glazing with an unloaded electric staple gun.

This proposed test is to better simulate a real-world test condition. As explained above in this preamble, the proposed dynamic test simulates the loading of an unrestrained far-side 50^{th} percentile adult male passenger falling onto and loading the roll-side window. The roll-side glazing may not always be intact prior to this occupant loading. For instance, the glazing could break or shatter from objects interior or exterior to the bus, torsion or deformation of the bus structure, or even from the roll-side seated passenger loading prior to the far-side occupant loading. This proposed test would evaluate the strength and retention capabilities of pre-broken glazing (particularly the plastic interlayer of laminated glass) to ensure that there is enough strength left in the glazing to withstand the loading of the occupant and to retain the occupant within the bus. In addition, the window would be prohibited from having any opening after the test that would allow passage of the 102 mm (4 inch) diameter sphere.

NHTSA requests comments on the proposed 175 mm (6.9 inch) impactor displacement value. The proposed 175 mm (6.9 inch) limit was chosen in the interest of practicability,

potential costs, and safety need. The 175 mm (6.9 inch) value is the average displacement from the two tests of single-glazed laminated windows (standard thickness PVB laminates 0.76 mm (0.03 inch) layer), that were pre-broken using the 75 mm (3 inch) diagonally offset grid. However, the MCI E/J-series was the only bus model tested at VRTC that offered production windows with a laminated glass configuration. Therefore, the proposed requirement is based solely on the MCI E/J windows that were tested. We seek comments on whether 175 mm (6.9 inch) maximum impactor displacement is an appropriate value for other bus window designs and window dimensions.

Comments are also requested on the practicability, costs and benefits of a lower impactor displacement limit, such as 146 mm (5.75 inches). One hundred forty-six (146) mm (5.75 inches) is the average displacement of the impactor in the center of daylight opening impacts under the Martec Study Conditions of pre-broken (using the 75 mm (3 inch) diagonally offset pattern) MCI E/J-Series glazing with the thicker 1.52 (0.06 inches). We observe that a 100 percent increase in the PVB interlayer thickness only resulted in a 14 percent reduction of average impactor displacement.

VIII. Other Proposed Requirements

Other requirements are also proposed for emergency exit latches and other related release mechanisms.

a. Latch Protrusions

NHTSA proposes to amend FMVSS No. 217 to specify that emergency exit latches and other related release mechanisms not protrude more than 25 mm (1 inch) into the opening of an emergency exit when the window is opened as described in S5.4.1 of the standard (when the

window is opened to the minimum emergency egress opening (allowing passage of an ellipsoid 500 mm (19.7 inches) wide by 300 mm (11.8 inches) high)).

This requirement would respond to Recommendation No. H-11-37 of the NTSB, supra, which NTSB issued after investigating an August 5, 2010 multi-vehicle collision school bus crash in Grey Summit, Missouri, in which egress from emergency windows was hindered by protruding latches.[62] H-11-37 states:

> Modify FMVSS No. 217 or the corresponding laboratory test procedure to eliminate the potential for objects such as latch plates to protrude into the emergency exit window opening space even when the protrusion still allows the exit window to meet the opening size requirements.

We seek comment on what an appropriate maximum latch protrusion might be. The MCI E/J and Van Hool latches (both production and countermeasure designs) met the proposed 25 mm (1 inch) height protrusion limit, while the Prevost latch (both production and countermeasure design) did not.[63]

The maximum latch plate protrusion requirement would be applicable to the buses to which the impactor tests would apply.[64] This NPRM's proposed impact tests on the glazing would require emergency exit latches to be sufficiently strong to pass the proposed dynamic impactor test requirements at the near latch (and even center of daylight opening) impact. The latch plates on those buses would likely need to be redesigned to meet the proposed dynamic

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[62] Several passengers in the lead school bus, and a witness who assisted in the evacuation, stated in post-crash interviews that emergency egress was hindered by the design of the emergency exit window. Particularly, the 102 mm (4 inch) by 76.2 mm (3 inch) emergency release latch plate for the emergency exit window was elevated about 25.4 mm (1 inch) from the window base and snagged the clothing of several passengers as they were exiting through the window opening.

[63] Although the striker posts on the MCI E/J latch protrude less than 25.4 mm (1 inch) into the emergency exit opening, the MCI E/J latching system also includes the guide cams (Figure 43) which protrude more than 25.4 mm (1 inch) into the emergency exit opening.

[64] New OTRBs (except school buses) and all new non-OTRBs with a GVWR greater than 11,793 kg (26,000 lb) that are not transit buses, school buses or perimeter seating buses.

impact requirements, so new designs for latch plates that do not protrude past the allowable limit can be readily incorporated into manufacturers' redesigns at the same time.

However, NHTSA is also proposing to extend the maximum latch plate protrusion requirement to other buses as well. NTSB recommendation H-11-37 was issued as a result of a school bus crash. Thus, NHTSA is proposing to extend the proposed requirement to school buses also. In addition, since this proposal of limiting the size of emergency exit latch plate protrusions is intended to mitigate hindrance from the window latches during emergency egress, we request comment on the merits of requiring all buses to which FMVSS No. 217 applies to meet the requirement. Such a requirement could enhance emergency egress from all buses.

b. Latch Workable After Impact

The NPRM proposes to require that latches be functional in accordance to the emergency egress requirements of FMVSS No. 217 following the impact tests. This requirement is intended to increase the likelihood that, after a rollover event, all emergency exits are operable to enable bus occupants to egress out of the bus. Requiring emergency windows to remain operable after the impact test would increase the likelihood that these windows are operable in real world rollover events where occupants may load the window before the bus comes to rest. A similar requirement was also proposed in the August 6, 2014 NPRM for FMVSS No. 227, "Bus rollover structural integrity," where the emergency exits are required to remain shut during the bus rollover test and be operable in the manner required under FMVSS No. 217 after the test.

IX. Applicability

NHTSA proposes to apply the proposed dynamic impact test requirements to generally the same group of vehicles that would be covered by the structural integrity NPRM.[65] We have tentatively concluded that both rulemakings would apply to high-occupancy vehicles associated with unreasonable risk of fatal rollover involvement, and that these vehicles are generally buses with a GVWR greater than 11,793 kg (26,000 lb).

The buses that would be covered would be (a) new OTRBs (regardless of GVWR), pursuant to the Motorcoach Enhanced Safety Act of MAP-21, and (b) all new buses other than OTRBs, with a GVWR greater than 11,793 kg (26,000 lb).[66] The reasons for this two-prong approach towards determining applicability are discussed in detail in the structural integrity NPRM, supra. See 49 FR at 46102-46105. The approach would be to cover all of the buses covered by MAP-21 and all of the buses with similar safety risks as the buses covered under MAP-21.

Our proposed applicability of this NPRM also reflects a holistic approach toward adopting anti-ejection safety countermeasures for unbelted passengers. NHTSA's strategy has been first to seek improvements to the rollover structural integrity of motorcoaches (roof strength and crush resistance) and then to pursue measures that would drive use of advanced glazing. This ordered approach is based on findings from the Martec study that the integrity of the bus structure has a profound impact on the effectiveness of the glazing. That is, in the absence of a threshold of requisite performance for bus structural integrity, a twisting motion of a bus in a rollover could simply pop out any advanced glazing used in the windows and negate the potential benefits of the glazing.

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[65] 79 FR 46090, supra.
[66] Transit buses, school buses, and perimeter-seating buses would be excluded from the standard under this latter category.

Thus, to better ensure that the full benefits of anti-ejection countermeasures such as advanced glazing would be realized, we first focused on improving bus structural integrity and the strength of side window mountings by way of the large bus structural integrity NPRM. Improvements to the bus structure would increase the likelihood that bus glazing will be retained in their mountings in a rollover. Next in our strategy is issuance of today's NPRM, which has performance requirements that would increase use of advanced glazing that prevent partial or complete ejection of motorcoach passengers and further ensure the integrity of glazing mounting. Since today's NPRM builds on the 2014 rollover structural integrity NPRM, we propose to apply today's dynamic impact test to the vehicles subject to the 2014 NPRM.

However, prison buses were among the buses to which NHTSA proposed applying the structural integrity requirements. We have tentatively determined that an advanced glazing standard would not be appropriate for prison buses since these buses typically have bars over the windows. The bars would impede the impactor. FMVSS No. 217 currently does not apply to "buses manufactured for the purpose of transporting persons under physical restraint" (S3).

Further, note that today's NPRM proposes requirements limiting how far emergency exit latches may protrude into the exit space. We propose applying the requirement to the buses to which NHTSA proposed would be subject to the 2014 rollover structural integrity NPRM, and also to school buses. In addition, we are considering applying the proposed maximum emergency exit latch protrusion requirements to all buses governed under FMVSS No. 217. We believe that vehicles would not need to have their roofs and side structure improved to meet the latch protrusion requirements. Comments are requested on this issue.

X. Retrofitting

The Secretary of Transportation has authority to promulgate safety standards for "commercial motor vehicles and equipment subsequent to initial manufacture."[67] The Office of the Secretary has delegated authority to NHTSA to "promulgate safety standards for commercial motor vehicles and equipment subsequent to initial manufacture when the standards are based upon and similar to a [FMVSS] promulgated, either simultaneously or previously, under chapter 301 of title 49, U.S.C."[68] Further, §32703(e)(2) of MAP-21 states that the "Secretary may assess the feasibility, benefits, and costs with respect to the application of any requirement established under subsection . . . (b)(2) to motorcoaches manufactured before the date on which the requirement applies to new motorcoaches…"[69] NHTSA has issued this NPRM under subsection (b)(2), which directs the agency to consider advanced glazing standards for each motorcoach portal and consider other portal improvements to prevent partial and complete ejection of motorcoach passengers.

The agency has designed our approach toward adopting anti-ejection safety countermeasures for unbelted passengers to first force improvements to the rollover structural integrity of motorcoaches (roof strength and crush resistance) and then to pursue measures that would drive use of advanced glazing. This ordered approach is based on findings from the Martec study that the integrity of the bus structure has a profound impact on the effectiveness of the glazing. That is, in the absence of a threshold of requisite performance for bus structural integrity, a twisting motion of a bus in a rollover could simply pop out any advanced glazing used in the windows and negate the potential benefits of the glazing. Thus, NHTSA has

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[67] Under Sec. 101(f) of Motor Carrier Safety Improvement Act of 1999 (Public Law 106-159; Dec. 9, 1999).
[68] See 49 CFR§ 1.95(c). Additionally, the Federal Motor Carrier Safety Administration (FMCSA) is authorized to enforce the safety standards applicable to commercial vehicles operating in the U.S.
[69] See Moving Ahead for Progress in the 21st Century Act, Pub. L. No. 112-141, § 32703(e)(2).

tentatively decided that it would not be sensible to apply the requirements proposed today to buses that do not have sufficient structural integrity to retain the advanced glazing in a rollover.

In the proposal for improved structural integrity of motorcoaches and other large buses, NHTSA sought comment on the retrofitting issue, while tentatively concluding that requiring retrofitting of existing buses appears impracticable. The agency discussed its tentative determination that, based on NHTSA's testing of the MY 1991 Prevost and the MY 1992 MCI buses, it appears that major structural changes to the vehicle's entire sidewall and roof structure would be needed for some existing buses to meet the proposed requirements. We discussed concerns that such extensive modifications may not be possible on all existing vehicles that would be covered by the proposed rollover structural integrity rule. In addition, we stated that the structural changes that would be entailed—assuming they could be done--would likely have significant cost impacts, and possibly have a substantial impact on a significant number of small entities (e.g., owner-operators of large buses used for transport).

If NHTSA decides not to require buses to be retrofitted to meet rollover structural integrity requirements, then a retrofit requirement for advanced glazing appears unwarranted. Without measures to prevent the glazing from popping out in a rollover, the anti-ejection benefits may not be achieved. Yet, Congress was particularly interested in a possible retrofit requirement for advanced glazing and we would like to learn more about the issue. We request comments on the feasibility, benefits, and costs of any potential requirement to retrofit existing buses with advanced glazing.

Thus, the agency seeks information on the technical and economic feasibility of a potential retrofit requirement. Which requirements in today's proposal could be appropriately applied to used buses? Is the agency's view reasonable that the benefits of advanced glazing

might not be achieved if the bus's structure were not also upgraded to ensure the glazing stays in place in a rollover? What potential test procedures could the agency utilize to objectively measure compliance? Would it be reasonable to assess compliance with a retrofit requirement by means of only visually inspecting the vehicle? What lead time and phase-in issues should the agency consider for a potential retrofit requirement? What would the potential costs be?

XI. Lead Time

If the proposed changes in this NPRM were made final, NHTSA is proposing a compliance date of three years after publication of a final rule. MAP-21 (in § 32703(e)) directs the agency to apply regulations prescribed in accordance with § 32703(b) "to all motorcoaches manufactured more than 3 years after the date on which the regulation is published as a final rule." Based on the VRTC research, we believe that some manufacturers would need to redesign their emergency exit latch systems or adopt a design that would meet the proposed requirements. Also, manufacturers would also have to transition from double-glazed tempered/tempered windows to one that has at least one layer of laminated glass or advanced glazing that can meet all the proposed requirements. We have tentatively determined that a 3-year lead time after publication of a final rule is appropriate as some design, testing, and development will be necessary to certify compliance to the new requirements.

The rollover structural integrity NPRM has proposed a compliance date of 3 years after publication of a final rule.[70] Similarly, we are proposing a compliance date of 3 years after publication of the final rule for this advanced glazing rulemaking. Alternatively, since this advanced glazing rulemaking and the structural integrity rulemaking are interrelated, and since

[70] 79 FR at 46113.

the two rulemakings have been developed fairly close to each other in time, we are also considering the merits of making the compliance date of the two rulemakings the same.

We also propose that, to enable manufacturers to certify to the new requirements as early as possible, optional early compliance with the standard would be permitted.

XII. Additional MAP-21 Considerations

MAP-21 directs that any regulation prescribed under § 32703(b), which includes this NPRM, to take into account potential impacts on seating capacity, on the size/weight of motorcoaches, and to be based on the best available science.[71] Further, MAP-21 directs the agency to consider combining the various motorcoach rulemakings contemplated by MAP-21 and to avoid duplicative benefits, costs, and countermeasures.[72]

NHTSA does not believe that the requirements proposed in today's NPRM would result in a loss of seating capacity. We estimate that the material and design changes resulting from this rulemaking would be a transition, for some side windows, from a double-glazed tempered/tempered configuration to a single-glazed laminated configuration, and relatively simple changes to latch designs that would enable latches to stay closed when subjected to a nearby impact. Design changes would also be made to latches so that they do not protrude more than 25 mm (1 inch) into the opening of an emergency exit when the window is open. We do not expect these material and design changes to result in a loss of seating capacity. The agency requests comment on this issue.

There could be potential impacts from this rulemaking on the weight of motorcoaches, but we believe there would be a potential weight decrease (and thus a potential cost savings due

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[71] *See* Moving Ahead for Progress in the 21st Century Act, Pub. L. No. 112-141, § 32703(e)(1)(B).
[72] *See id.* at § 32706(b)-(c).

to decreased fuel consumption). As discussed in the next section, the transition from a double-glazed tempered/tempered configuration to a single-glazed laminated configuration could save an estimated 23-33 pounds per window (276-396 pounds per bus), thereby increasing the overall fuel economy during the lifetime of these buses. In the accompanying PRE, we have attempted to quantify and account for this potential cost savings in our cost-benefit analysis of the rule. Comments are requested on this issue.

NHTSA has considered the best available science in developing today's NPRM. We discuss in the section on "Research," supra, the studies on which this NPRM is based. In that section, we discuss the findings from the joint NHTSA and Transport Canada motorcoach program (the Martec Study), NHTSA's motorcoach side glazing retention research, and NHTSA's large bus rollover structural integrity research program. We discuss how we used those findings to develop this NPRM.

Ejections are a large part of the safety problem in crashes of motorcoaches and other large buses, particularly in rollovers. To mitigate ejections, NHTSA has adopted a final rule to require passenger seat belts, and has proposed today's NPRM on advanced glazing to reduce full ejections of unbelted passengers and partial ejections of belted and unbelted occupants. Consistent with MAP-21, the agency has taken a holistic approach toward adopting anti-ejection safety countermeasures for unbelted passengers, by first seeking improvements to the rollover structural integrity of motorcoaches (roof strength and crush resistance) and then pursuing measures that would drive use of advanced glazing, while making sure to avoid duplicative benefits, costs and countermeasures. NHTSA tentatively believes that the proposed structural integrity test (based on ECE R.66) can be used not only to evaluate the structural integrity of a large bus in maintaining the occupant compartment but also to evaluate the strength of its

structural integrity in supporting side window glazing retention. Thus, the agency has fashioned the two rulemakings to complement each other to achieve portal improvements in preventing partial and complete ejection of motorcoach passengers.

NHTSA believes it avoided the duplication of benefits, costs, and countermeasures of other potential NHTSA rules being considered pursuant to MAP-21.[73] There is no regulation that adequately addresses window retention or ejection mitigation through glazing under dynamic occupant loading in rollovers. The proposed FMVSS No. 227 requirements for bus structural integrity would require that windows (on the non-roll side) remain intact in their framing during the quarter turn, do not open up during the quarter turn, and have no openings large enough to admit passage of a 102 mm (4 inch) diameter sphere after the quarter turn. However, the forces that would be experienced by the windows in the proposed FMVSS No. 227 test are purely inertial and are not representative of any direct occupant loading from within the bus.

Our seat belt requirement mitigates the risk of ejection of passengers on motorcoaches and other large buses, but seat belt usage rates by occupants of these vehicles are uncertain. In addition, even if occupants are belted, there are risks associated with partial ejections. Advanced glazing in window openings and improved mountings would mitigate the risk of ejection of occupants who may not be restrained at the time of the crash, and would help protect against

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[73] As we further discuss in the next section and in the PRE for today's NPRM, we have adjusted the target population based on the projected benefits that would be attributable to other NHTSA rulemakings for the subject buses. Separately, we also considered whether there have been any recent FMCSA actions which might affect the projected target population and we have tentatively concluded that they would not. FMCSA has issued several final rules directed at bus and truck safety, including Medical Certificate Requirements as Part of the Commercial Driver's License in 2008, Drivers of Commercial Vehicles: Restricting the Use of Cellular Phones in 2011, Hours of Service in 2011, and National Registry of Certified Medical Examiners in 2012. In addition, FMCSA has had several recent enforcement efforts to improve bus safety, including several nationwide "Strike Force" enforcement events. NHTSA believes that the benefits estimated in this NPRM would not overlap with the benefits attained by FMCSA actions associated with bus safety.

partial ejections of both restrained and unrestrained occupants. Today's NPRM proposes requirements that would result in portal improvements by way of advanced glazing, consistent with the goals of the Motorcoach Safety Enhancement Act of MAP-21.

XIII. Overview of Benefits and Costs

A detailed discussion of the benefits and costs estimates may be found in the PRE for this NPRM.[74]

Target Population

Figure 4 below shows the annual fatal target population in OTRB and certain large bus rollovers and estimated lives saved from various bus rulemakings. The overall fatal target population in OTRB and certain large bus rollovers is 14.7 fatalities annually. ESC equipment on the subject buses reduces the chance of a rollover, and is estimated to prevent 1.47 fatalities annually. The resulting overall fatal target population in the subject OTRBs and other buses, with ESC, is 13.23 fatalities annually.

In the 2013 seat belt final rule and the structural integrity NPRM, NHTSA estimated that seat belt use rates would range from 15 percent to 84 percent and that the effectiveness of seat belts in rollover crashes is 77 percent. Therefore, the seat belt final rule would save 1.45 lives at 15 percent belt use rate and 8.1 lives at 84 percent belt use rate and thereby reducing the fatal target population in the subject buses to 11.78 and 5.13 fatalities annually, respectively. For the 15 percent seat belt use rate, the fatal population is broken down to 0.78 restrained occupant fatalities and 11.0 unrestrained occupant fatalities. Likewise, for the 84 percent seat belt use rate, the fatal population is broken down to 2.77 restrained occupant fatalities and 2.36

[74] The PRE discusses issues relating to the potential costs, benefits and other impacts of this regulatory action. The PRE is available in the docket for this NPRM and may be obtained by downloading it or by contacting Docket Management at the address or telephone number provided at the beginning of this document.

unrestrained occupant fatalities. Each restrained and unrestrained population is further broken down to subpopulations of ejected and non-ejected fatalities (see Figure 4).

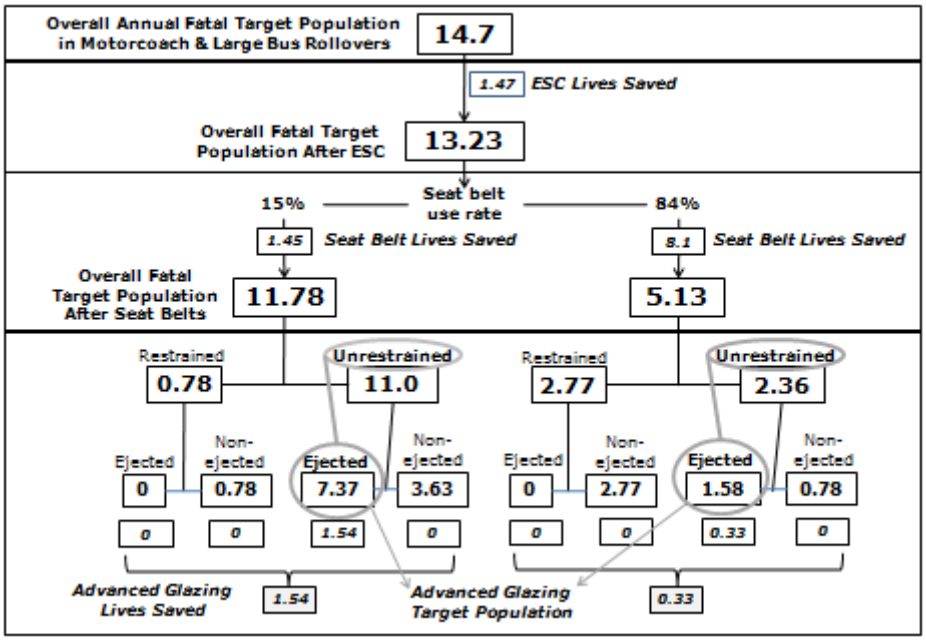

Figure 4: Fatal target population and estimated lives saves from recent bus rules.

The agency estimates in the rollover structural integrity PRE a 71 percent effectiveness of ejection mitigation in preventing fatalities. The rollover structural integrity PRE further estimates that, since the enhanced rollover structural integrity test procedure does not include a condition simulating occupant loading, NHTSA would estimate a midpoint effectiveness of 35 percent for unbelted ejected fatalities. That is, that effectiveness would result from just the windows being retained in their surrounding structures due to the rollover structural integrity requirements. Due to today's proposed requirements, advanced glazing and secure bonding techniques would be used that withstand occupant loading. Accordingly, we estimate that the remainder of the overall 71 percent effectiveness for the ejected fatal population is accounted for

with today's NPRM (36 percent effectiveness). Based on the various rollover tests on buses performed by the agency, we determined that advanced glazing is effective in one and two quarter turn rollovers. Evaluating the various bus rollover crashes that have occurred in the real world, we estimated that 58 percent of large bus rollover crashes are one and two quarter turns. Therefore, the overall effectiveness of advanced glazing for all large bus rollover crashes is approximately 21 percent (58 percent of 36 percent effectiveness).

The target population (unrestrained ejected occupants in rollover crashes) estimated for this proposal, after discounting the benefits from the other initiatives applicable to the same group of buses (ESC, seat belts, rollover structural integrity) is 7.37 fatalities at the 15 percent seat belt use rate and 1.58 fatalities at the 84 percent seat belt use rate.

Benefits

Applying a 21 percent effectiveness of enhanced window retention, we estimate this proposal to save 1.54 (=7.37x0.209) lives annually at the 15 percent seat belt use rate and 0.33 (=1.58x0.209) lives annually at the 84 percent seat belt use rate.

Assuming that the proposed glazing and window retention requirements are only effective in one and two quarter turn bus rollover events in preventing serious and critical injuries to bus passengers, we estimated that 0.4 and 0.08 serious to critical injuries would be prevented for a 15 percent and 84 percent belt use rate, respectively. Therefore the equivalent lives saved by the proposed requirements are 1.6 for 15 percent belt use rate and 0.34 for 84 percent belt use rate.

We believe that our benefits estimate is conservative. We did not consider benefits that could result in crash modes other than rollovers, although advanced glazing could be beneficial in those crashes as well. In addition, potential benefits could also accrue from the requirement

that would limit how far emergency exit latch protrusions may extend into the emergency exit opening of the window when the window is opened for emergency egress. Comments are requested on how NHTSA could estimate or account for these potential benefits.

Costs

We estimated the cost of this rulemaking by comparing the cost of glazing made from tempered glass (which would not meet the proposed advanced glazing requirements) to glazing comprised of laminated glass (which would meet the proposed requirements). We estimate that a fully framed and assembled double-glazed tempered/tempered window (approximately 25 square feet) costs $340. We estimate that a fully framed and assembled single-glazed laminated window (approximately 25 square feet) costs $353.75. Thus, the incremental cost of choosing a single-glazed laminated window over a double-glazed tempered/tempered window is $13.75 per window ($0.55 per square foot).

Our cost estimate for this rulemaking also includes changes that would have to be made to window latch systems. NHTSA found[75] that none of the production latches the agency studied could meet the proposed dynamic impact test requirement. However, a simple washer screwed onto the top of the existing MCI E/J-series striker post proved to be a simple and inexpensive countermeasure that enabled the latches to meet the proposed requirements.[76] The cost of each washer was $0.05.

We estimate that there are 2,200 new over-the-road and subject large buses manufactured annually. Assuming an OTRB or large bus has 6 large windows on each side and that all of them

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[75] "Motorcoach Side Glazing Retention Research," November 2013, supra.

[76] It could be that a simple washer countermeasure only worked for the MCI latch design, and hence other bus models may need to use other designs to achieve compliance. However, other manufacturers could adopt a system similar to the MCI latch system, so costs are not likely to be significantly greater to redesign the latches.

are emergency exits with latch mechanisms similar to that of the MCI E/J-series, the total incremental cost of redesigning the bus (from a double-glazed tempered/tempered window to a single-glazed laminated window) to meet the proposed requirements is $165.60 (=$13.75x12 + $0.05x12).

On the other hand, we believe that there are a substantial number of buses that already meet the proposed advanced glazing requirements. We estimated that 47.7 percent of large buses covered by this proposal are already equipped with laminate glazing. Assuming that 47.7 percent of the 2,200 new buses covered by the proposal are MCI designs that already use laminated glazing, the buses would only need the necessary latch countermeasures to meet the proposed requirements. The remaining 60 percent of the new annual covered bus production would have to incur the incremental cost of having to convert to a single-glazed laminated configuration, at a minimum, as well as provide latch countermeasures, in order to meet the proposed requirements of this rulemaking. Assuming these factors, the total annual incremental cost for new buses covered under this proposal is estimated to be $191,169 (= 2,200 x 0.477 x $0.60 + 2,200 x 0.523 x $165.60).

We note that there could be cost savings resulting from this rulemaking due to weight implications. The transition from a double-glazed tempered/tempered configuration to a single-glazed laminated configuration could save an estimated 23-33 pounds per window (276-396 pounds per bus), thereby increasing the overall fuel economy during the lifetime of these buses. We estimate that the fuel savings ($2.18 million to $2.9 million) exceed the material costs of $0.19 million for the proposal. Comments are requested on this issue.

The proposed test is estimated to cost $8,700 per bus model, including the cost of the replacement windows and labor.[77] Testing cost is not explicitly included in the cost analysis since it is considered research and development or overhead for the manufacturers, which is already included in the 1.5 markup factor from variable costs to retail price equivalent.

The benefits and costs of this proposed rule are summarized in the following tables 7, 8, and 9.

Table 7: Estimated Annual Costs (2013 dollars)

Potential Costs	
Material Costs Per Vehicle	$87
Material Costs, Total New Fleet	$0.19 Million

Table 8: Estimated Annual Benefits (Undiscounted Equivalent Lives Saved)

15 percent belt usage	1.6
84 percent belt usage	0.34

Table 9: Annualized Net Benefits In Millions (M) of 2013 Dollars

Discount Rate	Benefits	Net Costs	Net Benefits
3%	$13.22 - $2.82	($4.30 - $3.05)	$17.52 - $5.87
7%	$9.95 - $2.12	($3.20 - $ 2.25)	$13.15 - $4.37

The Value of a Statistical Life (VSL) is $9.2M in 2013 dollars. The estimated net benefit for this rule is $5.87 million to $17.52 million (with a 3 percent discount rate) and $4.37 million to $13.15 million (with a 7 percent discount rate).

XIV. Regulatory Notices and Analyses

[77] For a bus with emergency (with latch) and non-emergency (without latch) windows, the cost of testing both types of windows is as follows: For an approximate cost of single-glazed laminate window of $1,320, cost of 6 replacement windows and installation material is $8,100. Three technicians with $20/hr wage for one day would be $480 and with 25 percent overhead, total labor cost is $600. Therefore the total cost of testing window retention for a bus is $8,700 (=$8,100+$600).

Executive Order 12866, Executive Order 13563, and DOT Regulatory Policies and Procedures

This rulemaking document was not reviewed by the Office of Management and Budget under E.O. 12866. It is not considered to be significant under E.O. 12866 or the Department's Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). NHTSA has prepared a PRE for this NPRM.

This NPRM proposes to adopt a standard that would drive the installation of advanced glazing in the subject buses. NHTSA would adopt an impactor test of glazing material. In the tests, a 26 kg (57 lb) impactor would be propelled from inside a test vehicle toward the window glazing. The impactor and impact speed in these proposed tests simulate the loading from an average size adult male impacting a window on the opposite side of a large bus in a rollover. Performance requirements would apply to side and rear windows and glass panels on roof that ensure that glazing is securely bonded to window frames, that advanced glazing retains occupants within the structural sidewall of the bus even when damaged, and that emergency exit latches remain closed when impacted. NHTSA also proposes to limit how far emergency exit latch protrusions may extend into the emergency exit opening of the window when the window is opened for emergency egress.

Beyond the benefits attributable to the rule on seat belts and ESC for this same group of vehicles and a possible rule on bus structural integrity, we estimate that requiring new large buses of these types to meet the proposed performance criteria would save 1.54 lives annually at a 15 percent seat belt use rate and 0.33 lives annually at a 84 percent seat belt use rate. The total annual incremental material cost for new buses covered under this proposal is estimated to be approximately $0.19 million (for the entire new fleet) and fuel savings due to reduced weight of single glazed laminate over double glazed tempered window configuration is $2.18 million to

$2.9 million. The estimated net benefit for this rule is $5.87 million to $17.52 million with a 3 percent discount rate and $4.37 million to $13.15 million with a 7 percent discount rate. The benefits, costs, and other impacts of this rulemaking are summarized in the previous section of this preamble and fully discussed in the PRE.

Executive Order 13609: Promoting International Regulatory Cooperation

The policy statement in section 1 of Executive Order 13609 provides, in part:

> The regulatory approaches taken by foreign governments may differ from those taken by U.S. regulatory agencies to address similar issues. In some cases, the differences between the regulatory approaches of U.S. agencies and those of their foreign counterparts might not be necessary and might impair the ability of American businesses to export and compete internationally. In meeting shared challenges involving health, safety, labor, security, environmental, and other issues, international regulatory cooperation can identify approaches that are at least as protective as those that are or would be adopted in the absence of such cooperation. International regulatory cooperation can also reduce, eliminate, or prevent unnecessary differences in regulatory requirements.

As mentioned in the body of this preamble, the agency has developed this NPRM by building on the changes to motorcoach structure that manufacturers would implement in response to the agency's August 6, 2014 structural integrity NPRM (79 FR 46090). NHTSA based that NPRM on the ECE R.66 complete vehicle rollover test. By designing NHTSA's approach to anti-ejection safety countermeasures to incorporate ECE R.66, NHTSA would reduce unnecessary differences in regulatory requirements between the U.S. and its trading partners. A bus that meets ECE R.66 would have the bus structure needed to ensure that glazing is retained in bus portals in a rollover, and today's NPRM would ensure that windows are only made of advanced glazing.

Regulatory Flexibility Act

Pursuant to the Regulatory Flexibility Act (5 U.S.C. 601 et seq., as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996), whenever an agency is

required to publish a notice of rulemaking for any proposed or final rule, it must prepare and make available for public comment a regulatory flexibility analysis that describes the effect of the rule on small entities (i.e., small businesses, small organizations, and small governmental jurisdictions). The Small Business Administration's regulations at 13 CFR Part 121 define a small business, in part, as a business entity "which operates primarily within the United States." (13 CFR §121.105(a)). No regulatory flexibility analysis is required if the head of an agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. The SBREFA amended the Regulatory Flexibility Act to require Federal agencies to provide a statement of the factual basis for certifying that a rule will not have a significant economic impact on a substantial number of small entities.

NHTSA has considered the effects of this rulemaking action under the Regulatory Flexibility Act. According to 13 CFR § 121.201, the Small Business Administration's size standards regulations used to define small business concerns, manufacturers of the vehicles covered by this proposed rule would fall under North American Industry Classification System (NAICS) No. 336111, Automobile Manufacturing, which has a size standard of 1,000 employees or fewer. NHTSA estimates that there are 26 manufacturers of these types of vehicles in the United States (including manufacturers of motorcoaches, cutaway buses, second-stage motorcoaches, and other types of large buses covered by this proposal). Using the size standard of 1,000 employees or fewer, we estimate that approximately 10 of these 26 manufacturers would be considered small businesses.

The agency does not believe that this proposed rule would have a significant economic impact on those small entities. First, the agency estimates that the incremental costs to each vehicle that currently does not comply with the proposed requirements would be approximately

$165 per unit to meet the proposed rule. This incremental cost would not constitute a significant impact given that the average cost of the vehicles covered by this proposed rule ranges from $200,000 to $400,000. Further, these incremental costs, which are very small compared to the overall cost of the vehicle, can ultimately be passed on to the purchaser and user.

In addition, the agency believes that certifying compliance with the proposed rule would not have a significant impact on the manufacturers. Small manufacturers have various options available that they may use in certifying compliance with the proposed standard. Manufacturers are not required to use NHTSA's test as the basis for their certification. While the agency's test defined in the proposed regulatory test would be an objective test capable of determining which vehicles meet the minimum requirements, manufacturers can use other methods in certifying the compliance of their own vehicles.

For instance, a manufacturer could obtain advanced glazing windows from a glazing supplier and test the glazing on body sections of the vehicle. NHTSA used this approach in its motorcoach side glazing retention research program. The manufacturer could "section" the vehicle or otherwise obtain a body section representative of the vehicle, or test the glazing on test frames. It could base its certification on these tests, without testing a full vehicle.

Unlike NHTSA, manufacturers certifying compliance of their own vehicles have more detailed information regarding their own vehicles and can use reasonable engineering analyses to determine whether their vehicles will comply with the proposed requirements. We believe that a small manufacturer would be closely familiar with its own vehicle design and would be able to utilize modeling and relevant analyses on a vehicle-by-vehicle basis to reasonably predict whether its design will meet the requirements of today's proposed rule.

We also note that the product cycle of the covered buses is significantly longer than other vehicle types. With a longer product cycle, we believe that the costs of certification for manufacturers would be further reduced as the costs of conducting compliance testing and the relevant analyses could be spread over a significantly longer period of time.

Finally, we note that the requirements in today's proposed rule may affect the operators of the buses that are the subject of today's NPRM—some of which may be small businesses—but only indirectly as purchasers of these vehicles. As mentioned above, we anticipate that the impact on these businesses will not be significant because the expected price increase of the vehicles (those that do not comply with the proposed requirements) used by these businesses is small ($165 for each vehicle valued between $200,000 and $400,000). Further, we anticipate that fuel costs for these businesses may decrease due to today's proposed amendments.

For the aforementioned reasons, I hereby certify that if made final, this proposed rule would not have a significant economic impact on a substantial number of small entities.

With regard to a retrofit requirement applying to a population of on-road vehicles, the agency has tentatively determined that requiring retrofitting of existing vehicles would not be practical. Comments are requested on this issue. An estimated 78.8 percent of the 3,137 motorcoach carriers (according to the 2008 Motorcoach Census) in the United States in 2007 (i.e. about 2,470 carriers) have less than 10 motorcoaches in their fleet. Further, these companies have an average of three vehicles and eleven employees.[78] NHTSA tentatively believes that to include retrofit requirements would be a substantial burden on these small carriers.

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[78] While the vehicles included in the motorcoach census are not exactly the same as the vehicles covered in today's proposal, we believe the industry's Motorcoach Census offers a reasonable estimate of the proportion of bus carrier companies that would be affected as owners/operators of the buses covered in today's NPRM.

Furthermore, we believe that it would not make sense to require retrofitting of windows with advanced glazing if the underlying structure of the buses were not reinforced to prevent the glazing from popping out in a rollover. It may not be structurally viable for many of these used large buses to be retrofitted. In the August 6, 2014 structural integrity NPRM, NHTSA tentatively decided not to include retrofit requirements but requested comments on the issue. In today's NPRM, we also seek comment as to whether the advanced glazing requirements should be applied to used buses.

Executive Order 13132 (Federalism)

NHTSA has examined today's proposed rule pursuant to Executive Order 13132 (64 FR 43255; Aug. 10, 1999) and concluded that no additional consultation with States, local governments, or their representatives is mandated beyond the rulemaking process. The agency has concluded that the proposed rule does not have sufficient federalism implications to warrant consultation with State and local officials or the preparation of a federalism summary impact statement. The proposed rule does not have "substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government."

NHTSA rules can have preemptive effect in two ways. First, the National Traffic and Motor Vehicle Safety Act contains an express preemption provision: When a motor vehicle safety standard is in effect under this chapter, a State or a political subdivision of a State may prescribe or continue in effect a standard applicable to the same aspect of performance of a motor vehicle or motor vehicle equipment only if the standard is identical to the standard prescribed under this chapter. 49 U.S.C. § 30103(b)(1). It is this statutory command by

Congress that preempts any non-identical State legislative and administrative law address the same aspect of performance.

The express preemption provision described above is subject to a savings clause under which "[c]ompliance with a motor vehicle safety standard prescribed under this chapter does not exempt a person from liability at common law." 49 U.S.C. § 30103(e) Pursuant to this provision, State common law tort causes of action against motor vehicle manufacturers that might otherwise be preempted by the express preemption provision are generally preserved. However, the Supreme Court has recognized the possibility, in some instances, of implied preemption of State common law tort causes of action by virtue of NHTSA's rules—even if not expressly preempted.

This second way that NHTSA rules can preempt is dependent upon the existence of an actual conflict between an FMVSS and the higher standard that would effectively be imposed on motor vehicle manufacturers if someone obtained a State common law tort judgment against the manufacturer—notwithstanding the manufacturer's compliance with the NHTSA standard. Because most NHTSA standards established by an FMVSS are minimum standards, a State common law tort cause of action that seeks to impose a higher standard on motor vehicle manufacturers will generally not be preempted. However, if and when such a conflict does exist – for example, when the standard at issue is both a minimum and a maximum standard – the State common law tort cause of action is impliedly preempted. See Geier v. American Honda Motor Co., 529 U.S. 861 (2000).

Pursuant to Executive Order 13132, NHTSA has considered whether this proposed rule could or should preempt State common law causes of action. The agency's ability to announce

its conclusion regarding the preemptive effect of one of its rules reduces the likelihood that preemption will be an issue in any subsequent tort litigation.

To this end, the agency has examined the nature (e.g., the language and structure of the regulatory text) and objectives of today's proposed rule and does not foresee any potential State requirements that might conflict with it. NHTSA does not intend that this proposed rule preempt state tort law that would effectively impose a higher standard on motor vehicle manufacturers than that established by today's rule. Establishment of a higher standard by means of State tort law would not conflict with the standards proposed in this NPRM. Without any conflict, there could not be any implied preemption of a State common law tort cause of action.

National Environmental Policy Act

NHTSA has analyzed this NPRM for the purposes of the National Environmental Policy Act. The agency has determined that implementation of this action would not have any significant impact on the quality of the human environment.

Paperwork Reduction Act

Under the procedures established by the Paperwork Reduction Act of 1995, a person is not required to respond to a collection of information by a Federal agency unless the collection displays a valid OMB control number. This rulemaking would not establish any new information collection requirements.

National Technology Transfer and Advancement Act

Under the National Technology Transfer and Advancement Act of 1995 (NTTAA) (Public Law 104-113), "all Federal agencies and departments shall use technical standards that are developed or adopted by voluntary consensus standards bodies, using such technical standards as a means to carry out policy objectives or activities determined by the agencies and

departments." Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies, such as the Society of Automotive Engineers (SAE). The NTTAA directs this agency to provide Congress, through OMB, explanations when the agency decides not to use available and applicable voluntary consensus standards.

NHTSA is not aware of any voluntary standards that exist regarding advanced glazing as an anti-ejection safety countermeasure for large buses. However, this NPRM proposes to adopt a performance test that is based on the test procedures developed in the joint NHTSA and Transport Canada research program (the Martec study). NHTSA's consideration of this procedure accords with the principles of NTTAA, in that NHTSA is considering an existing procedure and has not had to expend additional agency resources studying the same safety need addressed by the Martec study.

Executive Order 12988

With respect to the review of the promulgation of a new regulation, section 3(b) of Executive Order 12988, "Civil Justice Reform" (61 FR 4729, February 7, 1996) requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) Clearly specifies the preemptive effect; (2) clearly specifies the effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct, while promoting simplification and burden reduction; (4) clearly specifies the retroactive effect, if any; (5) adequately defines key terms; and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. This document is consistent with that requirement.

Pursuant to this Order, NHTSA notes as follows. The issue of preemption is discussed above in connection with E.O. 13132. NHTSA notes further that there is no requirement that individuals submit a petition for reconsideration or pursue other administrative proceeding before they may file suit in court.

Unfunded Mandates Reform Act

The Unfunded Mandates Reform Act of 1995 requires agencies to prepare a written assessment of the costs, benefits and other effects of proposed or final rules that include a Federal mandate likely to result in the expenditure by State, local or tribal governments, in the aggregate, or by the private sector, of more than $135 million annually (adjusted for inflation to 2009 dollars with base year of 1995). This NPRM would not result in expenditures by State, local or tribal governments, in the aggregate, or by the private sector in excess of $135 million annually.

Plain Language

Executive Order 12866 and E.O. 13563 require each agency to write all rules in plain language. Application of the principles of plain language includes consideration of the following questions:

- Have we organized the material to suit the public's needs?
- Are the requirements in the rule clearly stated?
- Does the rule contain technical language or jargon that isn't clear?
- Would a different format (grouping and order of sections, use of headings, paragraphing) make the rule easier to understand?
- Would more (but shorter) sections be better?
- Could we improve clarity by adding tables, lists, or diagrams?

- What else could we do to make the rule easier to understand?

If you have any responses to these questions, please include them in your comments on this proposal.

Regulation Identifier Number (RIN)

The Department of Transportation assigns a regulation identifier number (RIN) to each regulatory action listed in the Unified Agenda of Federal Regulations. The Regulatory Information Service Center publishes the Unified Agenda in April and October of each year. You may use the RIN contained in the heading at the beginning of this document to find this action in the Unified Agenda.

Privacy Act

Anyone is able to search the electronic form of all comments received into any of our dockets by the name of the individual submitting the comment (or signing the comment, if submitted on behalf of an association, business, labor union, etc.). You may review DOT's complete Privacy Act Statement in the Federal Register published on April 11, 2000 (Volume 65, Number 70; Pages 19477-78).

XV. Public Participation

How do I prepare and submit comments?

Your comments must be written and in English. To ensure that your comments are correctly filed in the Docket, please include the docket number of this document in your comments.

Your comments must not be more than 15 pages long. (49 CFR 553.21). We established this limit to encourage you to write your primary comments in a concise fashion. However, you

may attach necessary additional documents to your comments. There is no limit on the length of the attachments.

Comments may also be submitted to the docket electronically by logging onto the Docket Management System website at http://www.regulations.gov. Follow the online instructions for submitting comments.

Please note that pursuant to the Data Quality Act, in order for substantive data to be relied upon and used by the agency, it must meet the information quality standards set forth in the OMB and DOT Data Quality Act guidelines. Accordingly, we encourage you to consult the guidelines in preparing your comments. OMB's guidelines may be accessed at http://www.whitehouse.gov/omb/fedreg/reproducible.html.

How can I be sure that my comments were received?

If you wish Docket Management to notify you upon its receipt of your comments, enclose a self-addressed, stamped postcard in the envelope containing your comments. Upon receiving your comments, Docket Management will return the postcard by mail.

How do I submit confidential business information?

If you wish to submit any information under a claim of confidentiality, you should submit three copies of your complete submission, including the information you claim to be confidential business information, to the Chief Counsel, NHTSA, at the address given above under FOR FURTHER INFORMATION CONTACT. In addition, you should submit a copy, from which you have deleted the claimed confidential business information, to the docket at the address given above under ADDRESSES. When you send a comment containing information claimed to be confidential business information, you should include a cover letter setting forth the information specified in our confidential business information regulation. (49 CFR Part 512.)

Will the agency consider late comments?

We will consider all comments received before the close of business on the comment closing date indicated above under DATES. To the extent possible, we will also consider comments that the docket receives after that date. If the docket receives a comment too late for us to consider in developing a final rule (assuming that one is issued), we will consider that comment as an informal suggestion for future rulemaking action.

How can I read the comments submitted by other people?

You may read the comments received by the docket at the address given above under ADDRESSES. The hours of the docket are indicated above in the same location. You may also see the comments on the Internet. To read the comments on the Internet, go to http://www.regulations.gov. Follow the online instructions for accessing the dockets.

Please note that even after the comment closing date, we will continue to file relevant information in the docket as it becomes available. Further, some people may submit late comments. Accordingly, we recommend that you periodically check the Docket for new material. You can arrange with the docket to be notified when others file comments in the docket. See www.regulations.gov for more information.

List of Subjects in 49 CFR Part 571

Imports, motor vehicles, motor vehicle safety.

In consideration of the foregoing, NHTSA proposes to amend 49 CFR Part 571 as follows:

PART 571—FEDERAL MOTOR VEHICLE SAFETY STANDARDS

1. The authority citation for Part 571 continues to read as follows:

Authority: 49 U.S.C. 322, 30111, 30115, 30117, and 30166; delegation of authority at 49 CFR 1.95.

2. Section 571.217 is amended by removing the definition of "Daylight opening" in S4, adding a sentence to the end of the text in S5.4.1, revising S5.4.2.2, and adding Figure 4 (which was inadvertently removed during publication of the standard in the CFR), to read as follows:

§ 571.217 Standard No. 217; Bus emergency exits and window retention and release.

*** * * * ***

S5.4.1 * * * The emergency exit latches, or other related release mechanisms, shall not protrude more than 25 millimeters into the opening of the emergency exit when the window is in the open position as described in this paragraph.

* * * * *

S5.4.2.2 School buses with a GVWR of 10,000 pounds or less. A school bus with a GVWR of 10,000 pounds or less shall conform to all the provisions of S5.4.2.1, except that the parallelepiped dimension for the opening of the rear emergency door or doors shall be 45 inches high, 22 inches wide, and six inches deep. The emergency exit latches, or other related release mechanisms, shall not protrude more than (1 inch) into the opening of the emergency exit when the window is in the open position as described in S5.4.1.

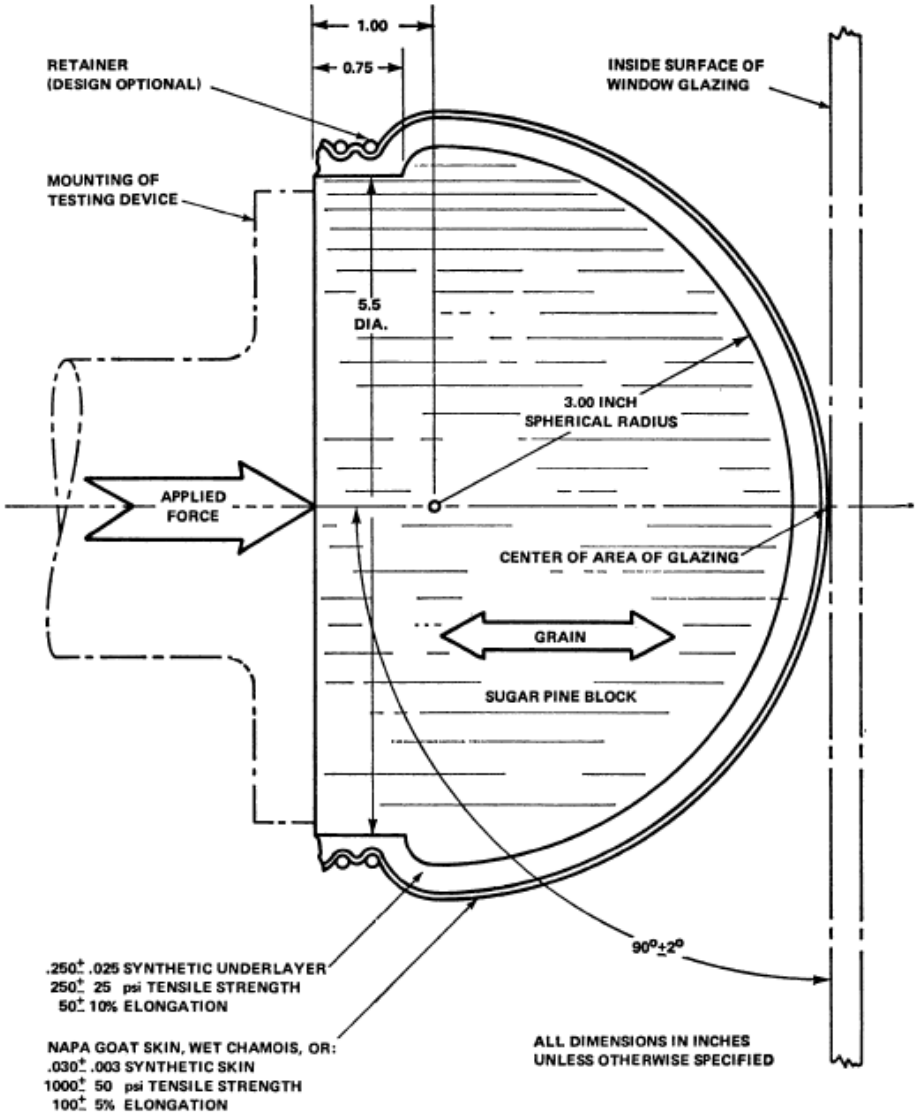

FIGURE 4A. HEAD FORM

3. Section 571.217a is added to read as follows:

§ 571.217a Standard No. 217a; Anti-Ejection Glazing for Bus Portals

S1. Scope. This standard establishes requirements to improve side, rear, and roof bus portals by way of glazing that is highly resistant to partial or complete occupant ejection in all types of crashes.

S2. Purpose. The purpose of this standard is to reduce death and injuries resulting from complete and partial ejections of bus occupants through side, rear, and roof portals during rollovers and other crashes.

S3. Application.

(a) Subject to S3(b), this standard applies to:

(1) Over-the-road buses, and

(2) Buses, other than over-the-road buses, that have a gross vehicle weight rating (GVWR) greater than 11,793 kilograms.

(b) This standard does not apply to school buses, transit buses, prison buses, and perimeter-seating buses.

S4. Definitions.

Daylight opening means, for openings on the side of the vehicles (other than a door opening), the locus of all points where a horizontal line, perpendicular to the vehicle longitudinal centerline, is tangent to the periphery of the opening. For openings on the rear of the vehicle (other than a door opening), daylight opening means the locus of all points where a horizontal line, parallel to the vehicle longitudinal centerline, is tangent to the periphery of the opening. For openings on the roof of the vehicle, daylight opening means the locus of all points where a

vertical line is tangent to the periphery of the opening. The periphery includes surfaces 100 millimeters (mm) inboard of the inside surface of the window glazing and 25 mm outboard of the outside surface of the window glazing. The periphery excludes the following: any flexible gasket material or weather stripping used to create a waterproof seal between the glazing and the vehicle interior; grab handles used to facilitate occupant egress and ingress; and any part of a seat.

Over-the-road bus means a bus characterized by an elevated passenger deck located over a baggage compartment.

Perimeter-seating bus means a bus with 7 or fewer designated seating positions rearward of the driver's seating position that are forward-facing or can convert to forward-facing without the use of tools and is not an over-the-road bus.

Portal means an opening that could, in the event of a crash involving the vehicle, permit the partial or complete ejection of an occupant from the vehicle, including a young child.

Prison bus means a bus manufactured for the purpose of transporting persons subject to involuntary restraint or confinement and has design features consistent with that purpose.

Stop-request system means a vehicle-integrated system for passenger use to signal to a vehicle operator that they are requesting a stop.

Transit bus means a bus that is equipped with a stop-request system sold for public transportation provided by, or on behalf of, a State or local government and that is not an over-the-road bus.

S5 Requirements. When tested according to the procedures specified in S6 and under the conditions specified in S7, each bus shall meet the following requirements specified in this section. The requirements of S5 do not apply to portals other than side, rear, and roof portals, and

do not apply to a side, rear, or roof portal whose minimum surface dimension measured through the center of its area is less than 279 millimeters.

S5.1 Edge impact.

(a) When the ejection impactor described in S8 contacts the target location specified in S6.1.1 of each side, rear, or roof daylight opening of a vehicle at 21.6 km/h, no portion of the window (excluding glazing shards) may pass the ejection reference plane defined under the procedures of S6.

(b) Each piece of window glazing and each surrounding window frame shall be retained by its surrounding structure in a manner that prevents the formation of any opening large enough to admit the passage of a 102 millimeter diameter sphere when a force of no more than 22 Newtons is applied with the sphere at any vector in a direction from the interior to the exterior of the vehicle.

S5.2 Center impact.

(a) When the ejection impactor described in S8 contacts the target location specified in S6.1.2 of each side, rear, or roof daylight opening of a vehicle at 21.6 kilometers per hour, no portion of the window (excluding glazing shards) may pass the ejection reference plane defined under the procedures of S6.

(b) Each piece of window glazing and each surrounding window frame shall be retained by its surrounding structure in a manner that prevents the formation of any opening large enough to admit the passage of a 102 millimeter diameter sphere under a force, including the weight of the sphere, of up to 22 Newtons.

S5.3 Center impact to pre-broken glazing.

(a) When the ejection impactor described in S8 contacts the target location specified in S6.1.3 of each side, rear, or roof daylight opening of a vehicle at 21.6 kilometers per hour, no portion of the impactor may displace more than 175 mm past where the surface of the glazing had been in an unbroken condition.

(b) Each piece of window glazing and each surrounding window frame shall be retained by its surrounding structure in a manner that prevents the formation of any opening large enough to admit the passage of a 102 millimeter diameter sphere when a force of no more than 22 Newtons is applied with the sphere at any vector in a direction from the interior to the exterior of the vehicle.

S5.4 After the impact described in S5.1, S5.2 and S5.3, each emergency exit provided in accordance with Standard No. 217 (§ 571.217) shall be capable of releasing and opening according to the requirements specified in that standard.

S6. Test procedures.

S6.1 Target locations.

S6.1.1 Edge impact. Position the impactor face on the glazing adjacent to a latch or discrete attachment point such that, when viewed perpendicular to the glazing surface, the center of the impactor face plate is as close as practicable to the center of the latch or discrete attachment point with the impactor face plate either horizontal or vertical, whichever orientation provides the shortest distance between the two centers, while maintaining at least a 25 millimeter distance between the impactor face plate edge and the window frame. “Window frame” includes latches, handles, attachments, and any solid structures other than the glazing material or flexible gaskets. If the window does not have any latches or discrete attachment points (e.g., it is fully rubber bonded or glued), position the impactor directly above the center of the lower window

edge, with the impactor face plate either horizontal or vertical, whichever orientation provides the shortest distance between the two centers, with the bottom edge of the impactor face plate 25 millimeter above the daylight opening periphery when viewed perpendicular to the glazing surface.

S6.1.2 Center impact. Position the center of the impactor face, with the long axis of the impactor face plate either vertical or horizontal, at the center of the daylight opening area of the window with the glazing intact.

S6.1.3 Center impact to pre-broken glazing. Position the center of the impactor face, with the long axis of the impactor face plate either vertical or horizontal, at the center of the daylight opening area of the window with the glazing pre-broken following the procedure in S6.2.

S6.2 Window glazing pre-breaking procedure.

S6.2.1 Breakage pattern. Locate the geometric center of the daylight opening. Mark the surface of the window glazing in a horizontal and vertical grid of points separated by 75 ± 2 millimeters with one point coincident within ± 2 millimeters of the geometric center of the daylight opening.

(a) If the window is a single-pane unit, then both the occupant space interior and outside exterior surfaces of the glass pane are marked with the 75 millimeter grid pre-break pattern. The patterns are offset diagonally from one another (the points on one surface of the glass pane are offset 35 millimeters horizontally and 35 millimeters vertically from the points on the contralateral surface of the glass pane).

(b) If the window is an insulated-unit or double-glazed window, then both the occupant space side of the interior pane and the outside of the exterior pane are marked with the 75 millimeter grid pre-break pattern.

(1) If one of the glass panes is constructed of tempered or toughened glass, the insulated surface of the remaining glass pane (within the air gap) are marked with the 75 millimeter grid pre-break pattern. The patterns are offset diagonally from its contralateral surface.

(2) If neither pane is tempered glass, then both the occupant space side of the interior pane and the outside of the exterior pane are marked with the 75 millimeter grid pre-break pattern. The patterns are not diagonally offset from one another. The insulated surfaces of the glass panes (within the air gap) are not pre-broken.

S6.2.2 Breakage method.

(a) Start with the inside surface of the window and forward-most, lowest mark made as specified in S6.2.1 of this Standard No. 217a. Use an electric staple gun without any staples to make a hole in the glazing. The staple gun applies a line load of about 12 to 14 millimeters on the glazing.

(b) Use a 100 ±10 millimeters x 100 ±10 millimeters piece of rigid material as a reaction surface on the opposite side of the glazing to prevent to the extent possible the window surface from deforming by more than 10 millimeters when pressure is being applied by the staple gun.

(c) Continue making holes by moving rearward in the grid until the end of a row is reached. Then move to the forward-most mark on the next higher row and make a hole. Continue in this pattern until all the holes on the inside surface of the glazing are made.

(d) Repeat the process on the outside surface of the window.

(e) If punching a hole causes the glazing to disintegrate, halt the breakage procedure and proceed with the next step in the compliance test.

S6.3 Determination of ejection reference planes.

(a) For side windows, the "ejection reference plane" is a vertical plane parallel to the longitudinal vertical center plane of the bus passing through a point located at a lateral distance of 102 millimeter from the lateral most point on the glazing and surrounding frame, with the window in the closed position.

(b) For rear windows, the "ejection reference plane" is a vertical plane perpendicular to the longitudinal vertical center plane of the bus passing through a point located at a longitudinal distance of 102 millimeter from the rear most point on the glazing and surrounding frame, with the window in the closed position.

(c) For roof glass panels/windows, the "ejection reference plane" is a horizontal plane passing through a point located at a vertical distance of 102 millimeter from the highest point on the glazing and surrounding frame, with the window/panel in the closed position.

S7. Test conditions.

(a) During testing, the ambient temperature is between 18 degrees C. and 29 degrees C., at any relative humidity between 10 percent and 70 percent.

S8. Guided impactor. The impactor test device has the dimensions shown in Figure 1. It has a total impactor mass of 26 kilograms and a spring stiffness of 258 Newton per millimeter. The impactor is propelled in the horizontal direction in impacts to the side and rear daylight openings and is propelled vertically in impacts to the roof daylight openings.

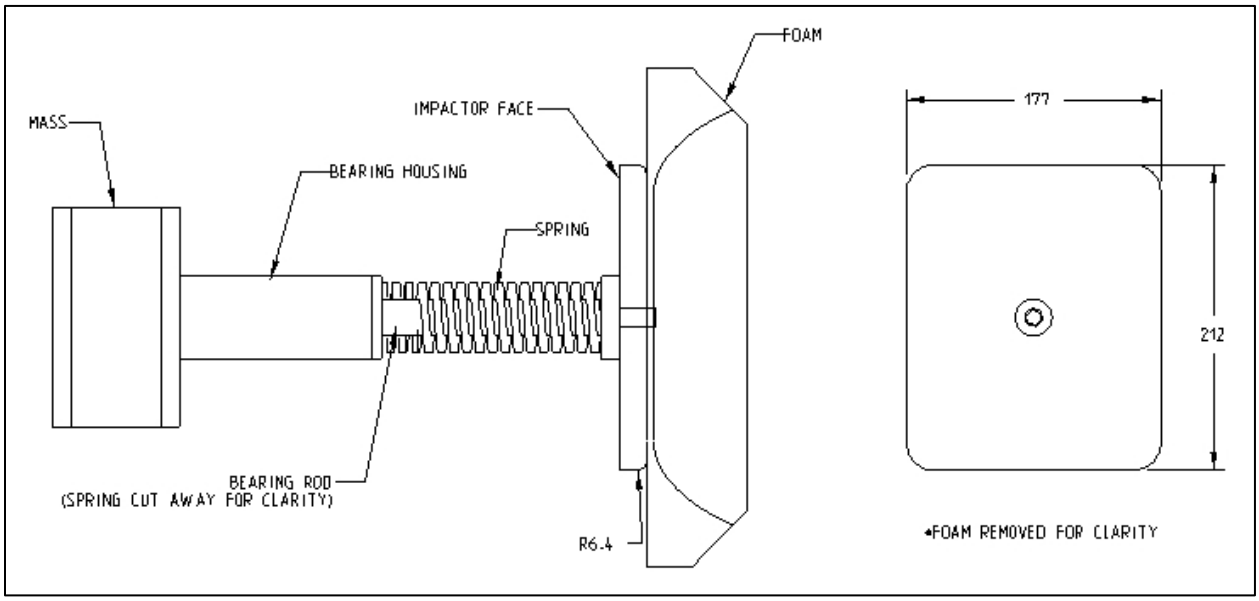

FIGURE 1 to Standard No. 217a.
DYNAMIC IMPACTOR

Issued on:

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Raymond R. Posten
Associate Administrator for Rulemaking

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