

**DEPARTMENT OF TRANSPORTATION****Federal Railroad Administration****49 CFR Parts 236 and 238**

[Docket No. FRA–2013–0060, Notice No. 1]

RIN 2130–AC46

**Passenger Equipment Safety Standards; Standards for Alternative Compliance and High-Speed Trainsets**

**AGENCY:** Federal Railroad Administration (FRA), Department of Transportation (DOT).

**ACTION:** Notice of proposed rulemaking (NPRM).

**SUMMARY:** FRA is proposing to amend its regulations for passenger equipment safety standards, which currently provide for passenger rail service in a shared right-of-way under two separate tiers of safety standards: Tier I (speeds up to 125 miles per hour (mph)) and Tier II (speeds up to 150 mph). Consistent with the regulations' approach supporting interoperable passenger rail service by sharing the right-of-way, this proposed rulemaking would add a new tier of safety standards (Tier III) to facilitate the safe implementation of interoperable high-speed passenger rail service at speeds up to 220 mph. However, Tier III standards would require operations at speeds above 125 mph to be in an exclusive right-of-way without grade crossings. The proposal also would establish crashworthiness and occupant protection performance requirements in the alternative to those currently specified for Tier I passenger trainsets. Adopting the proposed alternative crashworthiness and occupant protection requirements would remove regulatory barriers, allowing a more open U.S. rail market, incorporating recent technological designs. In addition, the proposal would increase from 150 mph to 160 mph the maximum speed FRA's existing regulations allow for passenger equipment that complies with FRA's Tier II standards.

**DATES:** Written comments must be received by February 6, 2017. Comments received after that date will be considered to the extent possible without incurring additional expense or delay.

FRA anticipates it can resolve this rulemaking without a public, oral hearing. However, if FRA receives a specific request for a public, oral hearing prior to January 5, 2017, FRA will schedule one and will publish a supplemental notice in the **Federal Register** to inform interested parties of

the date, time, and location of any such hearing.

**ADDRESSES:** *Comments:* Comments related to Docket No. FRA–2013–0060, Notice No. 1, may be submitted by any of the following methods:

- *Web site:* The Federal eRulemaking Portal, [www.regulations.gov](http://www.regulations.gov). Follow the Web site's online instructions for submitting comments.
- *Fax:* 202–493–2251.
- *Mail:* Docket Management Facility, U.S. Department of Transportation, 1200 New Jersey Avenue SE., Room W12–140, Washington, DC 20590.
- *Hand Delivery:* Docket Management Facility, U.S. Department of Transportation, 1200 New Jersey Avenue SE., Room W12–140 on the Ground level of the West Building, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

*Instructions:* All submissions must include the agency name, docket name, and docket number or Regulatory Identification Number (RIN) for this rulemaking (2130–AC46). Note that all comments received will be posted without change to <http://www.regulations.gov>, including any personal information provided. Please see the Privacy Act heading in the **SUPPLEMENTARY INFORMATION** section of this document for Privacy Act information related to any submitted comments or materials.

*Docket:* For access to the docket to read background documents or comments received, go to <http://www.regulations.gov> at any time or visit the Docket Management Facility, U.S. Department of Transportation, 1200 New Jersey Avenue SE., Room W12–140 on the Ground level of the West Building, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

**FOR FURTHER INFORMATION CONTACT:** Devin Rouse, Mechanical Engineer, Passenger Rail Division, U.S. Department of Transportation, Federal Railroad Administration, Office of Railroad Safety, Mail Stop 25, West Building 3rd Floor, 1200 New Jersey Avenue SE., Washington, DC 20590 (telephone: 202–493–6185); or Michael Hunter, Trial Attorney, U.S. Department of Transportation, Federal Railroad Administration, Office of Chief Counsel, Mail Stop 10, West Building 3rd Floor, 1200 New Jersey Avenue SE., Washington, DC 20590 (telephone: 202–493–0368).

**SUPPLEMENTARY INFORMATION:****Common Abbreviations**

AAR Association of American Railroads  
 APTA American Public Transportation Association

ATD anthropomorphic test dummy  
 AWO ready-to-run weight, empty  
 CEM crash energy management  
 CFR Code of Federal Regulations  
 CG center of gravity  
 EN EuroNorm  
 ETF Engineering Task Force  
 FE finite element  
 FEA finite element analysis  
 FRA Federal Railroad Administration  
 g gravitational acceleration (32.2 feet/second/second)  
 HSR high-speed rail  
 in inch(es)  
 kip kilopound(s)  
 kN kilo-Newton(s)  
 kph kilometer(s) per hour  
 lbf pound(s)-force  
 lbs pounds  
 mph mile(s) per hour  
 ms millisecond(s)  
 MU multiple unit  
 NEC Northeast Corridor  
 OVI occupied volume integrity  
 PTC Positive Train Control  
 ROW right-of-way  
 RSAC Railroad Safety Advisory Committee  
 ITM inspection, testing, and maintenance  
 PTEP Passenger Train Emergency Preparedness  
 PESS Passenger Equipment Safety Standards  
 U.S.C. United States Code  
 UIC International Union of Railways

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## I. Executive Summary

This proposed rule is the product of consensus reached by FRA's Railroad Safety Advisory Committee (RSAC), which accepted the task of reviewing passenger equipment safety needs and programs and recommending specific actions that could be useful to advance the safety of passenger service, including the development of standards for the next generation of high-speed trainsets. The RSAC established the Passenger Safety Working Group ("PSWG" or "Working Group") to handle this task and develop recommendations for the full RSAC to consider. In September 2009, the Working Group in turn established the Engineering Task Force ("ETF" or "Task Force") for the purpose of producing a set of technical criteria and procedures to evaluate passenger rail equipment built based on alternative designs. This work led to the development of the report entitled "Technical Criteria and Procedures for Evaluating the Crashworthiness and Occupant Protection Performance of Alternatively Designed Passenger Rail Equipment for Use in Tier I Service" (Technical Criteria and Procedures Report or Report).<sup>1</sup> The guidance in the Technical Criteria and Procedures Report has assisted railroads and rolling stock manufacturers who have petitioned FRA for waivers from compliance with FRA's Tier I passenger equipment crashworthiness standards, and has been useful to FRA in evaluating such petitions. In addition to developing the criteria in that Report, the task of the ETF was expanded to develop formal recommendations to the full RSAC for adopting these alternative crashworthiness criteria into FRA's regulations and to establish minimum safety requirements for the next generation of high-speed trainsets, capable of operating at speeds of up to 220 mph, classified as Tier III passenger equipment. The ETF reached consensus on recommending the adoption of these alternative crashworthiness criteria in

49 CFR part 238 for Tier I passenger equipment. The ETF also reached consensus on criteria for Tier III passenger equipment, specifically trainset structure, side-window glazing, brake systems, interior fittings and surfaces, certain emergency systems and cab equipment, and cab glazing. The ETF further reached consensus on the definition of Tier III, including the proposed speed limitations on when Tier III equipment can operate on shared infrastructure and when the equipment must operate in an exclusive right-of-way. On June 14, 2013, the full RSAC voted to recommend the consensus items to the Administrator of FRA, as the basis for a formal rulemaking.

This NPRM is based on these RSAC recommendations and, in particular, represents the first phase of rulemaking to establish Tier III passenger equipment safety standards as the work of the ETF continues.

This NPRM proposes requirements in three main subject areas: (1) Tier III trainset safety standards; (2) alternative crashworthiness and occupant protection performance requirements for Tier I passenger equipment; and (3) the maximum authorized speed for Tier II passenger equipment. The following is a brief overview of the proposed rule organized by subject area and a summary of its economic impact.

### *Tier III Trainset Safety Standards*

This NRPM proposes to define Tier III passenger train operations and outline minimum safety standards for the use of such trainsets in the United States, focusing on core structural and critical system design criteria. FRA intends for the Tier III trainset requirements to facilitate safe implementation of interoperable high-speed rail service, enable the use of common infrastructure, and promote efficiencies. The Tier III operating environment would be unique: Tier III passenger trains would operate in a shared right-of-way at speeds up to 125 mph and in an exclusive right-of-way without grade crossings at speeds up to 220 mph. The requirements would provide for the sharing of rail infrastructure among various types of rail equipment, especially in more urban areas, while providing for dedicated passenger rail service at maximum speeds up to 220 mph. FRA's Passenger Equipment Safety Standards would therefore continue to allow high-speed passenger rail service to be interoperable with other types of rail service, the same way that Tier I and Tier II passenger train operations are currently interoperable.

The proposed rule would establish requirements for Tier III trainset structure, window glazing, brake systems, interior fittings and surfaces, certain emergency systems (including window egress and rescue access requirements), and certain cab equipment. To support operational compatibility, the proposed Tier III trainset crashworthiness and occupant protection requirements are predominantly based on the proposed alternative crashworthiness and occupant protection requirements for Tier I passenger equipment and are intended to safely apply to operations at speeds up to 220 mph in a dedicated environment as approved by FRA. Specialized RSAC task groups developed the requirements for braking systems and cab glazing by focusing on the development of performance-based requirements that could be implemented in a technology-neutral manner, wherever possible.

To develop their recommendations, the ETF and full RSAC considered the latest trainset designs and technology available globally, and adapted their recommendations for North American standards. The intent of the proposed requirements is to ensure that safety and reliability are paramount, while incorporating elements from the most advanced, service-proven technology. The proposed requirements would be supplemented by additional requirements FRA intends to propose in a subsequent rulemaking based on recommendations the ETF is developing, which remains active addressing the topics of inspection, testing, and maintenance (ITM), as well as safety planning for high-speed operations.

### *Alternative Crashworthiness Requirements for Tier I Passenger Trainsets*

As noted above, FRA proposes to codify a set of technical evaluation criteria the ETF developed as guidance to those seeking to use alternatively designed Tier I passenger trainsets to demonstrate the trainsets' crashworthiness and occupant protection performance is equal to the requirements in part 238. We intend for the proposed alternative technical criteria to allow industry greater flexibility to use contemporary design techniques and more fully apply emerging technology, including crash energy management (CEM) technology, without requiring a waiver of compliance for operating the equipment. The technical criteria are based on established international standards and significant research and

<sup>1</sup> U.S. Department of Transportation Report No. DOT-FRA-ORD-11/22. Washington, DC: Federal Railroad Administration, Office of Railroad Policy Research and Development, October 2011, available at [http://www.fra.dot.gov/eLib/details/L01292#p4\\_z50\\_gD\\_IRT](http://www.fra.dot.gov/eLib/details/L01292#p4_z50_gD_IRT).

testing both the industry and DOT's John A. Volpe National Transportation Systems Center (Volpe Center) conducted over the past 25 years. Codifying the technical criteria would dovetail with alternative crashworthiness performance requirements FRA established in part 238 for the front-end structures of cab cars and multiple-unit (MU) locomotives, thereby broadening application of such requirements to other main structures.

#### *Tier II Maximum Authorized Speed*

On March 13, 2013, FRA issued a final rule (78 FR 16052) to amend the Federal Track Safety Standards to promote the safe interaction of rail vehicles and the tracks they operate on at speeds up to 220 mph. That final rule revised the track geometry and safety limits for various track classes, extended the limits for the highest track speeds from 200 to 220 mph (Class 9 track), and affirmed that the maximum authorized speed for Class 8 track is 160 mph. This proposed rule would make the maximum authorized operating speed for Tier II passenger equipment consistent with the limits for Class 8 track. Under the proposal, existing Tier II operations FRA has approved to operate at speeds up to 150 mph would be required to provide sufficient testing and vehicle/track interaction performance data required under 49 CFR 213.329 and 238.111 and obtain FRA approval before any operations occur at the new maximum authorized speed of 160 mph.

At this time, FRA is not proposing to amend the Tier II crashworthiness and occupant protection requirements, or other specific Tier II requirements, to make them more performance-based. The Tier II standards are more stringent than those for Tier I passenger equipment or proposed for Tier III passenger equipment principally because they were developed to support operations above 125 mph in a right-of-way shared with freight and other rail traffic. See 64 FR 25629. To compensate for the increased risk of a collision, a more crashworthy trainset design was needed. FRA's focus in this NPRM, as informed by the RSAC process, has been principally to address the industry's need for more performance-based Tier I crashworthiness and occupant protection standards and to develop new Tier III standards to support the next generation of high-speed rail in an environment where operations above 125 mph are in a dedicated right-of-way (so as to avoid the risk of collision with other rail traffic at speeds above 125 mph). However, FRA makes clear that

its approach to this NPRM does not mean FRA may not reexamine its Tier II requirements in the future.

#### *Economic Analysis*

This rule proposes to expand and make more flexible FRA's Passenger Equipment Safety Standards. The rule would introduce a new tier of safety standards, Tier III, passenger equipment must meet to operate at speeds up to 220 mph. Currently, FRA's Passenger Equipment Safety Standards do not specifically address safety requirements for passenger rail equipment operations at speeds above 150 mph. Furthermore, the current regulatory framework generally sets Tier I safety compliance through equipment design requirements which limit application of recent technology. Therefore, this rule would facilitate using more performance-based requirements to demonstrate Tier I compliance in alternative ways. FRA believes this rule would have a net beneficial effect on the passenger rail industry and society as a whole.

Specifically, the proposed rule would generate cost savings benefits by enabling high-speed rail operators to avoid new right-of-way acquisition and infrastructure construction for dedicated rail lines in dense urban areas. Instead it would allow such trains to travel on existing, non-dedicated rail lines but at slower speeds than permissible for travel on dedicated rail lines. As there is no comprehensive set of equipment safety regulations for this type of operation in the United States, a high-speed rail operation of this nature (operating at speeds up to 220 mph) could be constructed in the absence of this rule only if the operation was governed by a rule of particular applicability, which would set forth the minimum safety standards and conditions that would apply to the operator's proposed operation. Most likely, FRA would grant this regulatory approval only if the proposed system was self-contained (*i.e.*, no high-speed passenger trains intermixing with conventional passenger or freight trains, and no highway-rail grade crossings). Such a dedicated high-speed rail system would not be as efficiently integrated with the rest of the general rail system. Not issuing the proposed regulation would also increase costs associated with the acquisition of new passenger trains and could delay new U.S. passenger rail infrastructure projects. The proposed rule would ensure additional existing alternative designs can operate in the U.S. railroad environment on a widespread basis compared to existing FRA regulations. This would help avert a potential

patchwork in the U.S. passenger rail fleet that would perpetuate the current unattractiveness of the U.S. passenger equipment market to manufacturers. The proposed rule would allow U.S. trainsets to use technological advances for the improvement of safety and passenger rail operations which cannot be used under existing regulations. (For example it would be cost prohibitive to adapt Japanese high speed train technologies under current U.S. regulations.)

There would also be safety benefits associated with improvement of the existing rail infrastructure to accommodate the operation of new high-speed rail equipment in these shared rights-of-way. Additionally, as the requirements herein are largely performance-based standards and not prescriptive requirements, the proposal would result in equipment benefits generated by passenger rail operators being able to adopt service-proven safety-equivalent technology and practices and apply future technological advancements.

Over a 30-year period, FRA estimates quantifiable benefits would range from \$8.7 to \$16.8 billion.<sup>2</sup> Of this total, \$1.2 to \$2.1 billion would be for equipment benefits and \$7.5 to \$14.7 billion would be for infrastructure benefits. FRA estimates the present value of the total benefits to be \$3.8 to \$7.1 billion (when discounted at a 7-percent rate) or \$6.0 to \$11.2 billion (when discounted at a 3-percent rate). The proposed rule would have a positive effect on society and the safety performance of the passenger railroad system. Some of the identified safety benefits are due to the ability to adopt safe equivalent technology and best practices to better the current safety environment, and to apply future technological advancements to improve rail safety.

<sup>2</sup> Tier III benefits are uncertain because they are based on assumptions regarding the future growth of high-speed rail operations and how those operations will be incorporated into the U.S. rail network. It is possible that all benefits relating to Tier III equipment, including infrastructure benefits, will be zero, which would occur if no high-speed rail projects come to fruition over the forecast horizon. Similarly, the estimated infrastructure benefits hinge on the assumption of not having to build dedicated HSR track for the whole system (*i.e.*, they represent savings from being able to operate HSR using shared infrastructure). If the baseline is shared infrastructure, then these benefits will not be realized. Tier III benefits, including infrastructure benefits, are provided for expository purposes. Similarly, Tier I benefits from having performance standards are challenging to quantify, as is always the case for such benefits. However, given that they provide an option to design standards, operators would only comply with such standards voluntarily if they found it beneficial to do so.

Over the same period, FRA estimates industry would incur approximately \$4.6 billion in quantifiable costs, with a present value of \$2.0 billion (when discounted at a 7-percent rate) or \$3.2 million (when discounted at a 3-percent rate). All quantified costs<sup>3</sup> would be for testing to demonstrate compliance with either the Tier I alternative or Tier III standards. FRA assumes that the proposed rulemaking would provide an option, not a mandate, for railroads to use a different type or design of passenger equipment in Tier I service and would not impose any burden on existing rolling stock or new equipment qualifying under existing regulations. Similarly, the proposed rulemaking would only provide a framework for railroads to operate equipment in new Tier III service—it would not impose any burden on existing rolling stock or new equipment qualifying under existing regulations.

*Alternatives Considered*

One of the main purposes of the proposed regulation is to provide a set of minimum Federal safety requirements to determine whether passenger equipment platforms designed to contemporary standards outside of the U.S. are safe for operation in the U.S. rail environment. Traditionally, U.S. railroad safety regulations evolved as a consequence of specific accidents scenarios, which have led to the identification of specific risks in the operating environment. While FRA seeks to continue ensuring the safety risks are adequately addressed for the operating environment, the proposed rule places special emphasis

on measures to avoid those risks rather than simply mitigating them.

Importantly, the proposed rule does not intend to adopt or incorporate by reference a specific international design standard. But it is intended to open up the U.S. passenger rail market, to the greatest extent possible, to global manufacturers while ensuring passenger equipment is safe.

The alternatives FRA considered in establishing the proposed safety requirements for Tier III trainsets are the European and Japanese industry standards. These options provide a continuum of safety requirements for a range of aspects such as: Varying levels of regulatory requirements; market accessibility; benefits and costs; and operational efficiency and safety.

FRA prepared a high-level cost comparison of those options based on the key attributes of the alternatives and the effect of those attributes on societal welfare and the regulatory purpose. FRA compared the technical requirements of other established high-speed rail standards to illustrate the primary differences, not a direct comparison between comparable requirements/standards.

Passenger rail equipment crashworthiness and occupant protection design standards have been largely standardized by Euronorms.<sup>4</sup> FRA concluded that there are no significant differences between trains built to the design standards contained in Euronorms and trains built to meet the crashworthiness and occupant protection requirements in the proposed rule. FRA estimates that on average trainset prices would increase \$310,250

(0.62 percent) per trainset to meet the proposed Tier III requirements in this rule.

In Japan, railroad safety regulation is governed by the Railway Bureau, Ministry of Land, Infrastructure and Transport, and is codified in the Technical Regulatory Standards on Railways.<sup>5</sup> These technical standards are primarily performance-based and railways have the obligation to conform their operations, equipment and infrastructure to these standards. In the case of its high-speed rail system, the Shinkansen, the railway transports only passengers and the rail line is entirely dedicated to high-speed rail with no conventional trains operating and has full grade separation. These are the significant differences underlying the design of Shinkansen trainsets operating in Japan when compared to passenger trainsets currently operating in the U.S. The key to the Japanese high-speed rail network’s ongoing safety and reliability is the principle of crash avoidance. Modifying advanced Japanese high-speed trainsets to comply with the proposed Tier III requirements and be interoperable in the U.S. rail system would likely be cost prohibitive; FRA estimates \$4.7 million per trainset.

European trains generally would not need carbody, truck, suspension, or brake modifications to comply with the proposed Tier III requirements. However, either the analysis used to demonstrate compliance of the train safety features or components would require modification or minor design modification(s) would likely be needed, or both. These differences are illustrated in the following:

**SUMMARY OF POTENTIAL CHANGES FOR EQUIPMENT DESIGNED TO EUROPEAN STANDARDS TO COMPLY WITH PROPOSED RULE IN THE U.S.**

Analysis difference	Minor modifications required
<ul style="list-style-type: none"> <li>• Quasi static compression .....</li> <li>• Dynamic collision scenario .....</li> <li>• Override protection .....</li> <li>• Fluid entry inhibition .....</li> <li>• Roof and side structure integrity .....</li> <li>• Glazing .....</li> </ul>	<ul style="list-style-type: none"> <li>• End structure integrity of non-cab end.</li> <li>• Interior fixture attachment.</li> <li>• Seat crashworthiness.</li> <li>• Luggage racks.</li> <li>• Emergency window egress &amp; rescue access windows.</li> <li>• Emergency lighting.</li> <li>• Alerters.</li> </ul>

The regulatory impact analysis (RIA) that accompanies this proposed rule contains a preliminary analysis of regulatory alternatives FRA considered.

Specifically, the preliminary analysis compares at a general level the costs and benefits of the proposed Tier III requirements to both European and

Japanese standards for high-speed trains. The preliminary analysis concludes that a hypothetical \$50 million European high-speed trainset

<sup>3</sup> This assessment allows railroads to plan for future improvements and maintenance activities, minimizing capital investment but ensuring plant and operations are balanced for the expected service. Potential train delay was not quantified in this assessment. The relationship between train delays and the number of trains per day is

determined by several factors inherent to the infrastructure, operations, and equipment used in the line segment. At this stage, it is difficult, to estimate the exact effect of the proposed rule on train delay in the United States because the characteristics of the rail lines affected by the proposed rule are still unknown.

<sup>4</sup> Euronorms title derived: “Standard” means “norme” in French and “norm” in German. <https://www.cen.eu/work/ENdev/whatisEN/Pages/default.aspx>.

<sup>5</sup> [http://www.mlit.go.jp/english/2006/h\\_railway\\_bureau/Laws\\_concerning14.pdf](http://www.mlit.go.jp/english/2006/h_railway_bureau/Laws_concerning14.pdf).

could be modified to comply with the proposed Tier III requirements with only minor structural modifications and as indicated above at little additional cost—about \$310,000 per trainset. Modifications are expected to ensure such trainsets will safely operate in a U.S. setting. Due to the lack of historical safety information for operations at Tier III speeds in the U.S., FRA was unable to estimate the incremental safety benefit that would be provided by our proposed Tier III requirements as compared to the European standards. However, proposed requirements are supported by the recommendation of the RSAC and FRA is confident about the cost-beneficial nature of the proposal. Additionally, our analysis concludes that a hypothetical \$50 million Japanese high-speed trainset would need significant structural modifications, including those to the carbody, trucks, and suspension, to comply with the proposed Tier III requirements, and would incur significant additional costs—about \$4.7 million per trainset, as indicated above. Similarly, FRA is unable to provide an estimate of the expected incremental benefit of our proposed Tier III requirements, but we believe these additional costs are justified by the unique risks within the U.S. rail operating environment and the recommendations of the RSAC. U.S. high-speed trains may share track with other rail operations, including heavy and long freight trains, and operate on track with highway-rail grade crossings and the accompanying risks of colliding with trucks and other highway vehicles.

FRA conducted a qualitative analysis comparing the proposed Tier I alternative requirements to two alternatives: Not taking any regulatory action or adopting existing international design standards. As discussed in the RIA, trainsets compliant with international design standards (such as European or Japanese) would require extensive modifications to meet existing Tier I requirements if FRA elected to take no regulatory action. However, under the proposed Tier I Alternative requirements, FRA believes the cost associated with compliance would be similar to those discussed for Tier III equipment.

A second alternative would be to codify EN standards as a Federal regulation, instead of the proposed Tier I alternative requirements. This option opens the possibility for manufacturers to accrue savings from fewer modifications; however, such an option would require manufacturers to expend resources that favor a particular technology or approach to equipment

design. Additionally, codifying EN standards in lieu of the proposed regulation may require equipment that is designed to some other standard to incur certain costs related to modifying the equipment to bring it into compliance. This means that regardless of the requirements codified, manufacturers will have to modify trainsets in order to meet these regulatory requirements. Importantly, trainsets meeting only a European standard (or Japanese or other international standard) would not be interoperable with existing U.S. passenger or freight equipment. Therefore, this equipment could only operate on an exclusive right-of-way, unable to take advantage of existing infrastructure.

FRA requests public comment on the alternatives presented and discussed here and invites suggestions for other alternatives that should be considered. Please also see the RIA's "Alternatives Considered" section, in which FRA similarly requests public comment on these and other alternatives.

FRA did consider the alternative of standalone HSR systems operating on an exclusive right-of-way (not physically connected to the general railroad system), utilizing passenger equipment that complies with European or other international standards but not necessarily with FRA's proposed requirements. For the reasons discussed below, FRA rejected this alternative. A major tenet of this rule is to safely facilitate the implementation of nationwide, interoperable HSR service. Standalone systems operating equipment that is not compliant with FRA's current or proposed passenger equipment safety standards would significantly limit the interoperability of HSR service. When developing the proposed requirements, FRA did not envision a network of standalone, non-interoperable HSR systems comprising the nationwide network.

Additionally, it would be very costly for a standalone system to attempt to connect with major metropolitan areas because those standalone systems could not take advantage of a major regulatory benefit—operating over existing infrastructure. FRA determined that 86 to 89 percent of the regulatory benefits are due to infrastructure cost avoidance for operations electing to use Tier I alternative and Tier III equipment. Interoperability will allow HSR operators to reach into major metropolitan areas where building a new, exclusive right-of-way may not be feasible due to land density, environmental, and other considerations.

An advantage of the standalone alternative is that such an individual railroad system could optimize its operations to high levels of performance without necessarily having to adhere to requirements generally applicable to railroad systems in the U.S. However, for such a project to attain that level of performance, the project would have to optimize the design of the entire system, not only the passenger equipment. Basically, a standalone system would have to bring together all the other aspects of railroad safety (such as operating practices, signal and train control, and track) that must be applied to the individual, standalone system. Given that such an approach covers more than passenger equipment, and would likely necessitate particular right-of-way intrusion protection and other safety requirements not adequately addressed in FRA's current regulations, FRA continues to believe that addressing proposals for standalone HSR systems on a case-by-case basis (RPA or waiver) is prudent because of the very small number of potential operations and the potential for significant differences in their design. Moreover, this form of regulatory approval is comprehensive, covering more than equipment safety concerns, to ensure proposed standalone systems properly address all rail safety concerns. Entities considering such operations voluntarily assume the higher costs of building new infrastructure, knowing they cannot take advantage of the cost savings from sharing existing infrastructure. Nonetheless, FRA requests public comment on whether the final rule should adopt other standards—including but not limited to the Japanese and European standards—that could be used in the alternative to the proposed requirements, potentially only in appropriate Tier I or Tier III operational environments. Comment on the specific alternative standard(s) it should consider, the operational environments in which it would be appropriate to allow use of such standard(s), and information on the benefits and costs of the alternative standard(s) compared to FRA's proposed approach is requested.

## II. Statutory and Regulatory Background

### A. Statutory Background

In September 1994, the Secretary of Transportation (Secretary) convened a meeting of representatives from all sectors of the rail industry with the goal of enhancing rail safety. As one initiative of this Rail Safety Summit, the Secretary announced that DOT would

begin developing safety standards for rail passenger equipment over a five-year period. In November 1994, Congress adopted the Secretary's schedule for implementing rail passenger equipment safety regulations and included it in the Federal Railroad Safety Authorization Act of 1994 (the Act), Public Law 103-440, 108 Stat. 4619, 4623-4624 (November 2, 1994). In the Act, Congress also authorized the Secretary to consult with various organizations involved in passenger train operations for purposes of prescribing and amending these regulations and to issue orders under it. See section 215 of the Act (codified at 49 U.S.C. 20133).

#### *B. Implementation of the 1994 Passenger Safety Rulemaking Mandate*

On May 4, 1998, under section 215 of the Act, FRA published the Passenger Train Emergency Preparedness final rule (PTEP). See 63 FR 24629. The PTEP contained minimum Federal safety standards for the preparation, adoption, and implementation of emergency preparedness plans by railroads connected with the operation of passenger trains, including freight railroads hosting the operations of passenger rail service. The rule also established specific requirements for passenger train emergency systems and contained specific requirements for participation in debrief and critique sessions following emergency situations and full-scale simulations.

On May 12, 1999, FRA published the Passenger Equipment Safety Standards final rule (PESS). See 64 FR 25540. The PESS established comprehensive safety standards for railroad passenger equipment including requirements for carbody structure and emergency systems. FRA subsequently amended the PESS to address petitions seeking FRA's reconsideration of certain requirements contained in the rule. In response to the petitions, FRA grouped issues together and published three sets of amendments to the final rule. See 65 FR 41284, Jul. 3, 2000; 67 FR 19970, Apr. 23, 2002; and 67 FR 42892, June 25, 2002.

FRA has engaged in a number of rulemakings to amend and enhance its passenger safety requirements. On October 19, 2006, FRA published a final rule addressing various requirements on the inspection, testing, and operation of passenger equipment, and the attachment of safety appliances. See 71 FR 61835. On February 1, 2008, FRA published the Passenger Train Emergency Systems final rule promoting passenger occupant safety by addressing emergency communication, emergency

egress, and rescue access requirements. See 73 FR 6370. FRA also established additional requirements for passenger train emergency systems on November 29, 2013, see 78 FR 71785, revised and clarified its PTEP regulations on March 31, 2014, see 79 FR 18128, and established new standards to improve the integrity of passenger train exterior side door safety systems on December 7, 2015, see 80 FR 76118.

On January 8, 2010, FRA published a final rule enhancing requirements for the structural strength of the front end of cab cars and MU locomotives. See 75 FR 1180. FRA included energy-absorption requirements in the 2010 rulemaking to address traditional cab car and MU locomotive designs, with very strong underframes and relatively weaker superstructures, because it is vitally important to provide protection to crewmembers and passengers if the superstructure is impacted. In that rulemaking, FRA applied mature technology and design practice to extend requirements from linear-elastic to elastic-plastic and provided descriptions of allowable deformations without complete failure of the system. Although FRA believed at the time of the rulemaking that the alternative performance requirements would principally apply to shaped-nose equipment designs or CEM designs, or both, FRA also intended for them to apply to conventional flat-nosed equipment designs. In particular, the alternative performance requirements allow innovative designs that protect the occupied volume for its full height, even without traditional full-height collision and corner post structures, and the rule has been applied to such innovative end frame designs and traditional end frame designs.

#### *C. Overview of the Railroad Safety Advisory Committee*

FRA established the RSAC in March 1996 and it serves as a forum for developing consensus recommendations on rulemakings and other safety program issues. The RSAC includes representation from all of the agency's major stakeholders, including railroads, labor organizations, suppliers and manufacturers, and other interested parties.<sup>6</sup>

<sup>6</sup>The member groups are: American Association of Private Railroad Car Owners (AAPRCO); American Association of State Highway and Transportation Officials (AASHTO); American Chemistry Council; American Petroleum Institute; American Public Transportation Association (APTA); American Short Line and Regional Railroad Association (ASLRRA); American Train Dispatchers Association (ATDA); Association of American Railroads (AAR); Association of State Rail Safety Managers (ASRSM); Association of

When appropriate, FRA assigns a task to the RSAC, and, after consideration and debate, RSAC may accept or reject the task. If the task is accepted, the RSAC establishes a working group that possesses the appropriate expertise and representation of interests to develop consensus recommendations to FRA for action on the task. A working group may establish one or more task forces to develop facts and options on a particular aspect of a given task. The individual task force then provides that information to the working group for consideration.

When a working group comes to unanimous consensus on recommendations for action, the package is presented to the full RSAC for a vote. If the proposal is accepted by a simple majority of RSAC members, the proposal is formally recommended to the Administrator of FRA. FRA then determines what action to take on the recommendation. Because FRA staff members play an active role at the working group level discussing the issues and options and drafting the language of the consensus proposal, FRA often adopts the RSAC recommendation.

FRA is not bound to follow the recommendation, and the agency exercises its independent judgment on whether a recommended rule achieves the agency's regulatory goal(s), is soundly supported, and is consistent with policy and legal requirements. Often, FRA varies in some respects from the RSAC recommendation in developing the actual regulatory proposal or final rule. FRA explains any such variations in the rulemaking. However, to the maximum extent

Tourist Railroads and Railway Museums; Brotherhood of Locomotive Engineers and Trainmen (BLET); Brotherhood of Maintenance of Way Employees Division (BMWED); Brotherhood of Railroad Signalmen (BRS); Chlorine Institute; Federal Transit Administration (FTA);\* Fertilizer Institute; Institute of Makers of Explosives; International Association of Machinists and Aerospace Workers; International Association of Sheet Metal, Air, Rail and Transportation Workers (SMART), including the Sheet Metal Workers' International Association (SMWIA) and United Transportation Union (UTU); International Brotherhood of Electrical Workers (IBEW); Labor Council for Latin American Advancement (LCLAA);\* League of Railway Industry Women;\* National Association of Railroad Passengers (NARP); National Association of Railway Business Women;\* National Conference of Firemen & Oilers; National Railroad Construction and Maintenance Association (NRCMA); National Railroad Passenger Corporation (Amtrak); National Transportation Safety Board (NTSB);\* Railway Supply Institute (RSI); Safe Travel America (STA); Secretaria de Comunicaciones y Transporte (Mexico);\* Transport Canada;\* Transport Workers Union of America (TWU); Transportation Communications International Union/BRC (TCIU/BRC); and Transportation Security Administration (TSA).\*

\*Indicates associate, non-voting membership.

practicable, FRA utilizes RSAC to provide consensus recommendations with respect to both proposed and final agency action. If RSAC is unable to reach consensus on a recommendation for action, the task is withdrawn and FRA determines the best course of action.

#### *D. Establishment of the Passenger Safety Working Group and the Engineering Task Force*

On May 20, 2003, FRA presented the RSAC with the task of reviewing existing passenger equipment safety needs and programs and recommending consideration of specific actions that could be useful in advancing the safety of passenger rail service. In turn, the RSAC accepted the task and established the PSWG to handle the task and develop recommendations for the full RSAC to consider. Members of this Working Group, in addition to FRA, include many of the same entities as the full RSAC.<sup>7</sup>

On September 23, 2009, the Working Group established the ETF. The ETF was given the mission of developing technical criteria for the evaluation of passenger rail equipment built to alternative designs. Members of the ETF include representatives from various organizations that are part of the larger Working Group, in addition to FRA.<sup>8</sup>

The ETF developed the Technical Criteria and Procedures Report. After it developed the Report, the task of the ETF was expanded to (1) develop formal recommendations to the full RSAC to

adopt the alternative crashworthiness criteria into FRA's regulations and (2) establish minimum safety requirements for the next generation of high-speed trainsets able to operate at speeds up to 220 mph,<sup>9</sup> classified as Tier III passenger equipment. While much of the ETF's initial work was used to develop the proposed crashworthiness elements of this NPRM, the ETF found it necessary to create smaller task groups to develop other and related technical criteria and recommendations for the safe operation of high-speed trainsets: The Brake Systems Task Group (BTG); Engineering, Structures, and Integrity (ESI) Task Group; Tier III Cab Glazing Task Group; and Vehicle-Track Interaction (VTI) Task Group. In addition, as explained below, the ETF established a task group to examine various requirements in 49 CFR part 229 and determine their applicability to Tier III trainsets. FRA intends to use the work of that part 229/Inspection, Testing and Maintenance Task Group—the "229/ITM Task Group"—in a future rulemaking so it is not specifically included in this proposal. With the exception of the Tier III Cab Glazing Task Group, the task groups consisted primarily of ETF members and participants.

The BTG was established in June 2011, in response to a request from industry representatives to develop technology-neutral requirements applicable to brake systems and technology commonly found on today's high-speed trainsets worldwide. The BTG met as a group from November 2011 to December 2012. Group members reviewed and compared current U.S. brake system requirements and international brake system requirements, including current U.S. inspection and maintenance requirements; analyzed common brake system features to determine basic brake system parameters; and identified performance-based requirements to permit operators to develop equipment-specific maintenance, inspection and service plans. The BTG divided into two sub-groups representing the Asian and European perspectives on high-speed trainset design. Each sub-group independently compared Asian and European best practices to current U.S. brake system regulations. As needed, each sub-group developed proposed amendments to current U.S. regulations to incorporate international best

practices. The BTG presented its recommendations to the ETF on December 6, 2012, jointly to the PSWG and the ETF on May 30, 2013, and to the full RSAC on June 14, 2013.

The ESI Task Group was established in June 2012 to provide additional technical and engineering guidance to standardize (to the extent possible and practical) how compliance with the provisions of the proposed requirements should be demonstrated. Since many of the proposed requirements in the NPRM rely heavily on computer analysis and simulations to demonstrate compliance, the ETF sought to separate the criteria (the performance requirements) from the methodology of demonstrating compliance with those requirements. The original Report included both technical criteria and procedures for actually demonstrating that the proposed alternatives to current requirements could provide an equivalent level of safety. The Task Force agreed that the procedures were not appropriate to include in the regulatory language, and recommended that the rule text contain only the criteria and conditions for which such criteria apply. It recommended that the detailed procedures for demonstrating compliance with the criteria be in an accompanying guidance document or industry standard. The ESI Task Group met from July 2012 to March 2013, and developed a draft guidance document of suggested methods for demonstrating compliance with proposed Tier I alternative and Tier III crashworthiness requirements. This group will reconvene to finalize this document and develop a more general compliance document to accompany ETF rulemakings.

The Tier III Cab Glazing Task Group was created to resolve particular issues related to proposed cab glazing requirements for Tier III trainsets. The group consists of ETF members, and glazing experts and manufacturers from around the world. The group met four times between March and May 2013. It presented its recommendations to this NPRM to the PSWG on May 30, 2013, which FRA has adopted.

The VTI Task Group evaluated whether high-speed trainsets operate safely under conditions the Federal Track Safety Standards in 49 CFR part 213 establish. The VTI Task Group focused on the conditions presented at lower-speed classes of track, and whether certain conditions presented a challenge to the highly-specialized suspension systems of high-speed trainsets. This group provided intermediate findings to the ETF. However, the ETF decided the

<sup>7</sup> AAR, including BNSF Railway Company (BNSF), CSX Transportation, Inc. (CSXT), and Union Pacific Railroad Company (UP); AAPRCO; AASHTO; Amtrak; APTA, including Bombardier, Inc., Herzog Transit Services, Inc., Interfleet Technology, Inc. (Interfleet), Long Island Rail Road (LIRR), Maryland Transit Administration (MTA), Metro-North Commuter Railroad Company (Metro-North), and Northeast Illinois Regional Commuter Railroad Corporation; ASLRRR; ATDA; BLET; BRS; IBEW; NARP; NRCMA; NTSB; RSI; SMART, including SMWIA and UTU; STA; TCIU/BRC; Transport Canada; TSA; and TWU.

<sup>8</sup> AAR; AAPRCO; AASHTO, including California Department of Transportation, and Interfleet; APTA, including Alstom, Ansaldo Breda, Bombardier, Central Japan Railway Company (JRC), China South Locomotive and Rolling Stock Corporation (CSR), Denver Regional Transportation District (RTD), East Japan Railway Company, Faiveley Transport, GE Transportation, Japan International Transport Institute, Japan's Ministry of Land, Infrastructure, Transport and Tourism, Kawasaki, Keolis, KPS N.A., LIRR, LTK Engineering Services, Marsh, Metro-North, Nippon Sharyo, Parsons Brinckerhoff, PS Consulting, Safetran Systems, SEPTA, Sharma & Associates, Siemens, Southern California Regional Rail Authority (SCRRA), Stadler, STV, Talgo, Texas Central Railway, Veolia, Voith Turbo, and Wabtec; Amtrak; ASLRRR; BLET; European Railway Agency (ERA); NTSB; RSI, including Battelle Memorial Institute, and ENSCO; SMART, including SMWIA and UTU; TCIU/BRC; and Transport Canada.

<sup>9</sup> FRA elected 220 mph as the maximum operating speed for Tier III equipment to remain harmonious with FRA's track safety standards (49 CFR part 213). See 78 FR 16052, Mar. 13, 2013 (discussing the reasoning and research behind the 220 mph maximum track speed).

information was not sufficiently conclusive to warrant continued exploration of the topic at the time.

As noted above, the ETF established an additional task group to examine various requirements in 49 CFR part 229 and determine their applicability to Tier III trainsets. This task group more narrowly addresses concerns and discussions originating from the BTG. This ongoing 229/ITM Task Group is developing appropriate language to apply pertinent elements from 49 CFR part 229 and ITM provisions from 49 CFR part 238 to both Tier I and Tier II passenger equipment, and recommending equivalent requirements for Tier III trainsets. The work of the 229/ITM Task Group is ongoing, and the ETF intends to incorporate the group's work into future rulemaking recommendations.

Overall, in addition to the work of the various task groups, the full ETF met 18 times over four years in support of the development of this NPRM. Minutes of each of the meetings are part of the docket in this proceeding and are available for public inspection.<sup>10</sup>

To assist the ETF, FRA often drafted proposed regulatory text for discussion at the various task groups' meetings and task group participants offered suggested changes and additions to the proposed draft text. In addition, staff from the Volpe Center attended all of the ETF's meetings and made significant contributions to the technical discussions and development of the ETF's work product, especially the Technical Criteria and Procedures Report.

Through the many meetings and discussions, proposed regulatory language was developed and then presented, accepted, and approved at a joint meeting of the ETF and the Working Group on May 30, 2013. The consensus language was then presented before the full RSAC on June 14, 2013, where it was approved by consensus vote, including the recommendations from the Tier III Cab Glazing Task Group (which were in a separate document). The Working Group's

recommendations were thereby adopted by the full RSAC as its recommendations to FRA. The ETF did hold an additional meeting on September 11–12, 2013, which concerned these recommendations; the ETF addressed comments from ETF members to add clarification to, but not alter, the agreed-upon recommendations.

This NPRM is a product of the RSAC's consensus recommendations and FRA believes the NPRM is consistent with RSAC's recommendations. Please note that the RSAC did not expressly consider FRA's proposal concerning the removal of the requirement for a rule of particular applicability to conduct operations at speeds above 150 mph, as specified in subpart I of part 236 of this chapter. See the discussion of proposed changes to § 236.1007 of this chapter in the section-by-section analysis, below. FRA nonetheless believes this proposal, concerning the removal of this language from part 236, is consistent with the RSAC recommended approach to Tier III operations.

### III. Technical Background and Overview

#### A. General: Approaches to Crashworthiness and Occupant Protection

FRA, with help from the Volpe Center, conducted substantial research on rail equipment crashworthiness to establish a base of information to use to evaluate, amend, and develop regulations (with a specific focus on performance-based regulations) to respond to industry needs. Recognizing that railroads seek to deploy equipment designed to more performance-based and modern standards, FRA advanced its efforts to keep its crashworthiness regulations apace with current safety technology, particularly for passenger trains. In a passenger train collision or derailment, the principal crashworthiness risks that occupants face are the loss of safe space inside the train due to crushing of the train structure and, as the train decelerates, the risk of secondary impacts with interior surfaces. Therefore, the principal goals of the crashworthiness research FRA sponsored are twofold: First, to preserve a safe space in which occupants can ride out the collision or derailment; and, second, to minimize the physical forces occupants are subjected to when impacting surfaces inside a passenger train as the train decelerates.

Crashworthiness regulations and specifications are intended to result in equipment features that increase

survivability in accidents. The traditional approach to verify rail equipment crashworthiness in the U.S. (which is the approach used in FRA's existing regulations) is essentially car-oriented, prescribing such characteristics as the strength of the carbody and the strength of the attachment of the trucks. These features are intended to be effective for a wide range of accident conditions the equipment may be subjected to in service. The modern approach to rail equipment crashworthiness adds train-oriented specifications and typically includes minimum survivability requirements for prescribed collision scenarios. The modern approach to rail equipment crashworthiness does not replace the traditional approach. Rather, the modern approach expands the focus and manner in which rail equipment crashworthiness is evaluated, often using the traditional requirements as a performance baseline.

Modern specifications generally describe the crashworthiness performance desired of equipment that utilizes CEM features. Significant research has been conducted on CEM strategies by both FRA/Volpe and industry. CEM systems in passenger trains can improve crashworthiness by incorporating crush zones in unoccupied areas of the train cars. These zones are designed to collapse in a controlled fashion during a collision, dissipating collision energy by distributing crush through the unoccupied areas of the cars. This occupant protection strategy intends to preserve the occupied volumes in the train and limit the decelerations that occupants experience. In fact, Tier II passenger equipment must be designed with a CEM system to dissipate kinetic energy during a collision, see § 238.403, and Amtrak's Acela Express trainsets were designed with a CEM system complying with this requirement. CEM-designed equipment has demonstrated that it preserves all occupied volume in a train-to-train collision scenario at more than twice the closing speed of conventional equipment in the same scenario where the CEM-designed equipment has the same level of occupied volume strength as conventional equipment.

#### B. Development of Technical Criteria and Procedures Report

In 2009, FRA elected to develop, in consultation with RSAC, alternative criteria and procedures to assess the crashworthiness and occupant protection performance of rail passenger equipment applicable to a wide range of equipment designs to be used in Tier I

<sup>10</sup> These meetings were held on the following dates and in the following locations: September 23–24, 2009, Cambridge, Massachusetts; November 3–4, 2009, Philadelphia, Pennsylvania; January 7–8, 2010, Atlanta, Georgia; March 9–10, 2010, Orlando, FL; October 20–21, 2010, Cambridge, Massachusetts; January 11–12, 2011, Orlando, Florida; February 14–15, 2011, Washington, DC; March 30–31, 2011, Washington, DC; June 16–17, 2011, Boston, Massachusetts; October 6–7, 2011, New Orleans, Louisiana; June 27–28, 2012, Manhattan Beach, California; September 25–26, 2012, Washington, DC; December 6, 2012, Arlington, Virginia; February 13–14, 2013, Washington, DC; May 30, 2013, Washington, DC; and September 11–12, 2013, Washington, DC.

service. The ETF was charged with producing a set of technical criteria and procedures for evaluating petitions for waivers from (or, as appropriate under § 238.201(b), approval of alternative compliance with) one or more of the Passenger Equipment Safety Standards; these technical criteria and procedures were published in 2011.<sup>11</sup> The ETF developed the technical evaluation criteria and procedures so that they would provide a means of establishing whether equipment of an alternative design would result in at least equivalent performance to that of equipment designed in accordance with the structural standards in 49 CFR part 238.

FRA intended that entities (*i.e.*, railroads, equipment manufacturers, and consultants) would apply these criteria and procedures to support requests for waiver of the applicable regulations to allow alternative evaluation of safety performance. To assist with this effort, RSAC's ETF had the following goals: Produce clear, realistic technical requirements, benefiting from the collective "best" thinking in the passenger rail industry; define the analysis and testing required to demonstrate compliance with the technical requirements; provide clear pass/fail criteria for the analyses and tests; and work expeditiously so that sponsors of potential passenger service recognize available equipment options. Through RSAC's ETF, FRA began to work with the industry to develop new criteria to evaluate passenger equipment designed to standards differing from those historically used for procurements in the U.S. (*e.g.*, AAR and APTA standards), while providing an equivalent level of crashworthiness. The initial work of the ETF culminated in development of the Technical Criteria and Procedures Report. The Report contains guidelines for assessing the crashworthiness and occupant protection performance of alternatively-designed equipment used in Tier I service, including trainsets designed for operation outside the U.S. that may not be compliant with FRA's current requirements. As described in the Report, the criteria are defined by the specific conditions evaluated and the critical results of the evaluation; the procedures are defined as the analysis and test techniques applied to demonstrate compliance with the criteria. The criteria and procedures developed take advantage of the latest technology in rail equipment crashworthiness.

### *C. Adoption of Alternative Crashworthiness and Occupant Protection Performance Standards for Tier I Passenger Equipment and New Standards for Tier III Passenger Equipment*

After initial publication of the Technical Criteria and Procedures Report, FRA concluded it would be beneficial to revise the Passenger Equipment Safety Standards to formally adopt the alternative crashworthiness and occupant protection performance criteria, in part due to renewed demand for passenger equipment in the U.S. By codifying the criteria into the regulations, FRA could expand the options for regulatory compliance in a clearer and more direct manner. This would reduce the industry's burden and risk of relying solely on waiver petitions to provide flexibility for additional safety-equivalent options for passenger car designs and the use of modern CEM technology. Therefore, FRA presented the ETF with a regulatory plan to formally adopt Tier I alternative crashworthiness and occupant protection performance standards within part 238, based on the criteria previously developed by the ETF.

At the same time, while the ETF developed the Technical Criteria and Procedures Report, the RSAC expanded the mission of the ETF to develop new safety standards for the next generation of interoperable high-speed rail passenger equipment capable of speeds up to 220 mph (Tier III). The technical criteria and procedures the ETF originally developed as alternatives for Tier I equipment also are the basis for the proposed crashworthiness and occupant protection requirements for Tier III equipment in this NPRM. Therefore, FRA discusses the crashworthiness and occupant protection performance requirements proposed in this NPRM together for both tiers of passenger train service and highlights the pertinent differences between the alternative criteria and procedures described in the Report for Tier I equipment and the crashworthiness and occupant protection proposals for Tier III equipment in the section-by-section analysis.

It is important to note that the development of the Technical Criteria and Procedures Report was heavily influenced by international experience with high-speed rail.<sup>12</sup> In particular,

FRA drew from European standards, attempting to harmonize, to the extent possible, the technical criteria and procedures FRA developed (and is consequently proposing to require in this NPRM) with the technical requirements in the European standards. This was done in part to minimize the burden on foreign car builders entering the U.S. marketplace and to take advantage of sophisticated means of validating equipment designs.

However, FRA found that in some instances the technical requirements of the European standards did not fully address the safety concerns presented by the U.S. operating environment. FRA, in the section-by-section analysis, has highlighted those divergences. For example, in § 238.705, Dynamic collision scenario, FRA discusses the need for an additional collision scenario with a large rigid mass (a rigid or non-deformable locomotive) as opposed to a deformable mass. The additional scenario provides further insight on how tested equipment performs in preserving the occupied volume during a collision with a rigid mass, which is a known collision scenario in the U.S. rail operating environment.

Additionally, in § 238.733, Interior fixture attachment, FRA proposes a greater level of interior fixture attachment strength than the European standard of  $\pm 1g$  laterally. This enhancement is necessary for safety, is not an onerous requirement, and represents only a minimal increase in overall trainset cost if modifications are required.

Overall, it is important to recognize that differences between the proposed requirements and international technical standards do not mean that in all cases structural modifications are necessary. Equipment designed to international standards can meet the requirements of this proposal. Therefore, the most immediate burden this proposal places on a foreign equipment manufacturer is to validate, and provide supporting documentation, that the equipment meets FRA's requirements, as proposed.

#### 1. Occupied Volume Integrity

To meet FRA's existing passenger train crashworthiness regulations, the underframe of a train car must not experience permanent deformation when subjected to a large compressive load at the coupler locations at either end of the car. Car deformation must remain elastic (no permanent deformation) when subjected to 800,000

<sup>11</sup> [http://www.fra.dot.gov/eLib/details/L01292#p4\\_z50\\_gd\\_IRT](http://www.fra.dot.gov/eLib/details/L01292#p4_z50_gd_IRT).

<sup>12</sup> See U.S. Department of Transportation Report No. DOT-FRA-ORD-11/22. Washington, DC: Federal Railroad Administration, Office of Railroad Policy Research and Development, October 2011,

available at [http://www.fra.dot.gov/eLib/details/L01292#p4\\_z50\\_gd\\_IRT](http://www.fra.dot.gov/eLib/details/L01292#p4_z50_gd_IRT).

pounds (lbs) of force applied along the line of draft (the theoretical line running from the coupler at one end of the car to the other). Beginning in 1939, AAR formally recommended this practice for new passenger equipment operated in trains of more than 600,000 lbs empty weight in response to numerous fatal accidents involving compromised occupied volumes. In 1945, this recommendation was adopted into AAR Standard S-034—Specifications for the Construction of New Passenger Equipment Cars. Federal law applied this standard to all MU locomotives built new after April 1, 1956 and operated in trains having a total empty weight of 600,000 lbs or more. See 49 CFR 229.141(a). In 1999, when FRA issued the Passenger Equipment Safety Standards, FRA expanded this 800,000-pound static strength standard by Federal regulation to virtually all intercity passenger and commuter rail equipment (see 49 CFR 238.203, 238.405).

This line-of-draft strength approach has remained the cornerstone of occupied volume integrity (OVI) evaluation for nearly a century for several reasons. The pass/fail criterion of no permanent deformation anywhere in the vehicle is straightforward to implement and can be readily examined visually and confirmed using strain gages or other measuring devices. If the test is conducted properly and successfully, the vehicle remains in its original condition and can therefore enter service following the test. The intended nondestructive nature of the test makes it economical to perform because the first manufactured vehicle serves both as test article and proven, deliverable product.

In addition, this proof-strength approach provides additional crashworthiness benefits and has increased in importance as additional crashworthiness features are incorporated in the structure of passenger rail vehicles. For instance, for an end frame to successfully prevent an intrusion from impacts above the floor, the structure supporting the end frame must itself be sufficiently strong. A strong end frame attached to an insufficiently robust supporting structure may prevent intrusion at the end of the vehicle but cause loss of occupied volume elsewhere in the vehicle as collision loads travel through the occupied volume. The proof-strength approach is effective in demonstrating the sufficiency of the underlying supporting structure and FRA is proposing to optimize it for application to CEM designs.

Ultimately, preserving the occupied volume is accomplished primarily by ensuring the strength of the structure protecting it. If the occupied compartment is sufficiently strong, survivable space for the occupants is maintained. Secondary impacts are limited through a combination of structural crashworthiness and occupant protection measures. Allowing portions of the car to crush in a predetermined manner can limit the forces applied to the structure surrounding the occupied volume and control the decelerations that occupants experience. Conventional practice is to make individual cars uniformly strong and principally attempt to control the behavior of individual cars during a collision. The CEM approach is train-oriented, controlling the load into the occupied volume, and apportioning the structural crushing to unoccupied areas throughout the train.

Within Europe, passenger trains are subject to two distinct standards for ensuring adequate OVI. European Standard (or Euronorm) EN 12663, “Railway Applications—Structural Requirements of Railway Vehicle Bodies—Part 1: Locomotives and Passenger Rolling Stock (and Alternate Method for Freight Wagons),” contains several quasi-static load cases to be evaluated at different locations on train cars, including a line-of-draft load case. The load locations and the magnitude of the load to be applied at each location tend to differ from U.S. requirements. In addition to EN 12663, a second standard, EN 15227, also applies to passenger rail equipment in Europe. EN 15227, “Railway Applications—Crashworthiness Requirements for Railway Vehicle Bodies,” contains several dynamic impact scenarios that must be evaluated. EN 12663 and EN 15227 were developed to work in concert with one another, with EN 12663 used to ensure a baseline level of OVI and EN 15227 used to ensure a baseline level of performance in an idealized collision.

FRA has employed a similar, two-step approach to OVI in this NPRM. Because a strong OVI serves as the foundation for other crashworthiness features, such as CEM components, a quasi-static OVI requirement is included. Whereas current domestic practice provides that the evaluation loads be applied along the line-of-draft, the proposed regulation instead places the evaluation loads at the locations on the occupied volume that constitute the ends of the collision load path. FRA intends for this change in placement of the loads to ensure that for designs featuring CEM elements, or another non-conventional

longitudinal load path, the evaluation loads are applied in areas that will actually experience high compression loads during an accident. This helps ensure the rail vehicle possesses adequate OVI to restrict crushing to the intended CEM elements during a collision severe enough to activate the CEM system. The load magnitudes proposed in this NPRM were chosen to help ensure structural compatibility between existing Tier I rail equipment and any future vehicles designed to meet the proposed requirement.

The second OVI requirement FRA is proposing in this NPRM involves a dynamic collision scenario evaluated using a standardized train consist (the “initially-standing train”) being struck by the trainset undergoing evaluation (the “initially-moving train”). Whereas the quasi-static OVI requirement is applied at the individual car-level, this scenario is applied at the trainset-level. The results of the scenario evaluation are used to evaluate CEM system performance, override resistance, and truck attachment integrity. Working together, the quasi-static OVI requirement and the dynamic collision scenario requirements help ensure the energy-absorbing features of a design function at a trainset-level and that each car possesses sufficient OVI to resist loss of occupied volume during operation of the energy-absorption components.

## 2. Truck Attachment Strength

The current FRA regulation for Tier I passenger equipment truck attachment, 49 CFR 238.219, Truck-to-car-body attachment, specifies static load requirements. In an effort to develop standards that are more performance-based, the ETF recommended dynamic load requirements for alternatively evaluating truck attachment strength. However, comparing the safety differences between the proposed dynamic requirements and existing static requirements is not straightforward. There are many different design approaches in service for attaching the truck to the carbody and meeting the current static load requirements. The different designs have exhibited varied performance in accidents: In some relatively severe accidents, compliant designs have remained attached; while in some less severe accidents, compliant designs have become detached. The ETF strove to assure the performance the alternative, dynamic truck attachment requirements provide would be at least as effective as that the attachment strength of an average or typical truck compliant with the current static

requirements provides. The alternative, dynamic truck attachment requirements the ETF developed and recommended provide for demonstration of compliance using results from the same computer simulation of the train-to-train collision scenario used to demonstrate sufficient OVI.

### 3. Interior Attachment Strength

FRA's existing, acceleration-based performance requirements for interior attachments were established after years of industry practice designing interior fittings to withstand the forces due to accelerations of 6g longitudinally, 3g laterally, and 3g vertically. As noted in the 1997 NPRM for the Passenger Equipment Safety Standards rulemaking (62 FR 49728), FRA and NTSB investigations of accidents involving passenger trains designed based on this practice revealed that luggage racks, seats, and other interior fixtures breaking loose were a frequent cause of injury to passengers and crewmembers. Due to injuries caused by broken seats and other loose fixtures, FRA concluded that the practice of designing interior fittings to withstand accelerations of 6g longitudinally, and 3g laterally and vertically, was not adequate. FRA therefore proposed to enhance interior attachment fitting strength. In the 1999 final rule (64 FR 25540), FRA then set the current attachment strength requirements of 8g longitudinally, and 4g laterally and vertically. Subsequent accident investigations have revealed that interior fixtures that comply with the requirements for Tier I passenger equipment in § 238.233 perform significantly better than interior fixtures in passenger cars that do not meet the current regulations, *i.e.*, generally passenger cars already in service at the time the 1999 final rule took effect.

The ETF discussed at length requirements for interior fittings and occupant protection during accidents. As these discussions developed, there was a desire to accommodate existing equipment designs built to European standards, *i.e.*, EN 12663 and EN 15227, while maintaining a comparable level of safety to that within the U.S. rail operating environment. Many manufacturers of high-speed trainsets stressed during these discussions that this approach would allow the use of "service-proven" designs and avoid the need for significant redesign that would affect critical suspension characteristics or lead to a completely new and unproven vehicle platform. In the interest of maintaining the industry's ability to adopt service-proven designs, the ETF examined existing practices throughout the world to help establish

how current and proven design practice could be evaluated for application in the U.S.

The ETF adopted an approach that incorporates specific requirements of Railway Group Standard GM/RT2100, Issue Four, "Requirements for Rail Vehicle Structures," Rail Safety and Standards Board Ltd., December 2010 (GM/RT2100). GM/RT2100 is a safety standard that mandates requirements for the design and integrity of rail vehicle structures, including interior fixtures, for trains that operate in the United Kingdom (U.K.). GM/RT2100 (referencing EN 12663) requires interior fixtures to withstand carbody accelerations of 5g longitudinally, 1g laterally and 3g vertically. However, FRA has never found the 1g lateral acceleration requirement adequate for the U.S. rail operating environment. See FRA's Passenger Equipment Safety Standards final rule, published May 12, 1999, for a discussion on lateral attachment strength for interior fixtures (64 FR 25540).

Thus, the proposed rule increases this minimum lateral acceleration requirement to 3g, as further discussed in the section-by-section analysis below. FRA notes that the structural vehicle requirements in EN 15227 limit the mean longitudinal deceleration to 5g within certain specified collision scenarios for vehicles designed to operate on international, national, and regional networks (6.4.1). ETF industry members recommended attachment strength requirements consistent with the collision behavior of vehicle structures built to the Euronorm standards and FRA agreed with their recommendation. The specific details on how to apply this alternative international approach are discussed in the section-by-section analysis below.

#### *D. Development of Specific Requirements for Tier III Passenger Equipment*

While the proposed crashworthiness and occupant protection performance requirements for Tier III passenger equipment derive from the work initially conducted by the ETF for alternatively evaluating Tier I passenger equipment, the ETF did focus specifically on a more comprehensive body of requirements for Tier III passenger equipment. These include requirements for brake systems, cab glazing, emergency systems, and cab equipment. An overview of specific proposals for Tier III passenger equipment in these areas is provided below.

### 1. Brake Systems

Brake systems requirements for Tier III trainsets were developed from the recommendations of the RSAC's BTG. This group examined existing brake systems and technologies from around the world, and compared brake system requirements in the U.S. with systems on high-speed trainsets operating internationally. The goal of this task group was to identify common features and determine basic regulatory parameters that considered all types of service-proven braking systems, regardless of the technology employed.

To achieve this goal, the BTG created two sub-groups to examine trainset brake system design philosophies from both Asian and European industries that currently design trainsets to operate at the speeds envisioned for Tier III. The BTG focused on developing technology-neutral, performance-based braking system requirements by selecting the best practices and designs of the international models, while still maintaining the safety intent of the original, pneumatic-based U.S. requirements. This need for a technology-neutral approach was the cornerstone for development of the Tier III brake system recommendations to the ETF, which suggested creating new requirements that would both permit the use of applicable international standards and be performance-driven to allow the development of future technologies.

To accomplish this, the BTG suggested that FRA utilize the proposed Safe Operation Plan for Tier III Passenger Equipment ("Tier III Safe Operation Plan"), and ITM plan, discussed below, to establish and approve technology-specific performance metrics that it could not otherwise define without a prescriptive regulation. This recommendation, ultimately adopted by FRA following the RSAC process, is a fundamental concept reflected in other elements of this proposed rule: to maintain the core safety intent of existing U.S. requirements in a manner that takes into account the inherent safety of service-proven designs, as demonstrated on rail systems around the world.

### 2. Cab Glazing

FRA's original requirements for window and windshield safety glazing on locomotives, passenger cars, and cabooses were established in 49 CFR part 223 on December 31, 1979 (44 FR 77352) to protect railroad employees and passengers from injury due to objects striking windows or windshields. Part 223 specifies a

process for certifying window glazing material, including testing requirements for glazing in both end-facing (FRA Type I) and side-facing (FRA Type II) locations. With the introduction of Tier II requirements in 1999 (64 FR 25686) designed to provide protection at speeds up to 150 mph, FRA established additional requirements for both end-facing (FRA Type IH) and side-facing (FRA Type IIIH) glazing locations in Tier II passenger equipment. FRA amended the large object impact requirements for end-facing glazing locations in 2002 (67 FR 19992) with slight modifications, creating FRA Type IHP glazing. See 49 CFR 238.421.

During the development of the Tier III requirements, the ETF decided a new, large object impact test was necessary for end-facing glazing locations (e.g. windshields) to address optical clarity issues stemming from current requirements (for both Tier I and II) and the need for a test procedure that could be repeated reliably. To address the optical clarity issue, the ETF wanted a methodology to use to evaluate the performance of the end-facing glazing system at its angle of installation (similar to the approach for Type IHP glazing in 49 CFR 238.421(b)(1)). Such a methodology would be more representative of the actual conditions in real-world applications. It would also help alleviate optical clarity issues resulting from thicker glazing as a function of higher operational speeds and perpendicular impact testing requirements in part 223. In addition, given the range of performance typically observed when testing most glazing materials, establishing a test procedure that could be reliably repeated on multiple test specimens was essential to ensure the quality of test results for these high-speed operations. FRA agrees with this approach.

To address these issues the ETF, through its Tier III Cab Glazing Task Group, sought to refine the glazing requirements for high-speed operations by examining current international practice. In particular, it focused on established and proven experience with the application of European standard EN 15152, and its predecessors, including International Union of Railways (UIC) standard UIC 651. It considered these standards together with high-speed rail operating experience involving the prominent modes and causes for glazing failure. These standards and operating experience, together with the existing glazing requirements for Tier I and Tier II operations, served as the basis for the development of the proposed requirements for Tier III operations.

### 3. Emergency Systems

This NPRM includes proposed requirements for passenger train emergency systems specific to Tier III trainsets and takes into account potential design considerations for Tier III trainset operating speeds. These proposed requirements focus particularly on emergency egress and rescue access through windows or alternative openings as part of an emergency window egress and rescue access plan. Sections 238.113 (Emergency window exits) and 238.114 (Rescue access windows) were used as the baseline requirements for the total number of emergency egress and rescue access windows, as well as their acceptable means of removal and their dimensions.

To address Tier III trainsets not designed to comply with the requirements in § 238.113 or § 238.114, the proposed rule would include a means for FRA to consider alternatives based on service-proven approaches that provide an equivalent level of safety. The railroad would submit to FRA for approval an emergency window egress and rescue access plan during the design review stage. This plan would allow consideration of: production challenges unique to high-speed trainsets, such as the need to pressurize compartments; proven international practice; and approaches other modes have taken (e.g., emergency egress window panels/door exits similar to over-wing exit doors on aircraft). Where an appropriate safety case can be made, the proposed rule would allow a railroad to elect to employ an alternative feature or approach if the railroad can demonstrate an equivalent or superior level of safety.

This NPRM also addresses the attachment strength and performance of critical emergency systems. Specifically, it explains the requirements for minimum attachment strength of emergency lighting fixtures and any corresponding emergency power sources to be consistent with the approach we took for all other interior attachments in Tier III equipment. The NPRM would effectively provide a railroad with the option of complying with either the loading requirements currently applicable to Tier I equipment or alternative loading criteria based on an appropriate crash pulse that is justified by the intended vehicle design.

### 4. Cab Equipment

This NPRM contains certain equipment requirements proposed for the cabs of Tier III trainsets. These proposed requirements were developed

by the RSAC's BTG and address alerters (devices installed in the controlling cab of trainsets that promote continuous, active locomotive engineer attentiveness by monitoring select trainset engineer-induced control activities) and sanders (appurtenances on trainsets that provide a means for depositing sand on each rail in front of the first power operated wheel set in the direction of movement to increase wheel-track adhesion). The BTG adopted the same approach it used to develop the braking system proposal for these two cab features, seeking performance-based requirements that could be implemented in a technology-neutral manner wherever possible. FRA intends to propose additional requirements for cab equipment in a future rulemaking based on recommendations developed by the 229/ITM Task Group.

### IV. Section-by-Section Analysis

*Part 236—Rules, Standards, and Instructions Governing the Installation, Inspection, Maintenance, and Repair of Signal and Train Control Systems, Devices, and Appliances*

#### Subpart I—Positive Train Control Systems

##### Section 236.1007 Additional Requirements for High-Speed Service

FRA is proposing to remove paragraph (d) of this section as it is no longer relevant, and to redesignate paragraph (e) as paragraph (d) of this section. Paragraph (d) provides that, in addition to the requirements of paragraphs (a) through (c) of this section, a host railroad that conducts a freight or passenger operation at more than 150 mph shall have an approved Positive Train Control (PTC) Safety Plan (PTCSP) accompanied by an "HSR-125" developed as part of an overall system safety plan approved by the Associate Administrator for Railroad Safety and Chief Safety Officer (Associate Administrator). Paragraph (d) also provides that such an operation would be governed by a rule of particular applicability. Paragraph (c) of this section contains particular requirements for freight and passenger operations at speeds more than 125 mph, and provides that a host railroad have an approved PTCSP accompanied by an HSR-125. Generally, an HSR-125 is a document establishing that the system will be operated at a level of safety comparable to that achieved over the 5-year period prior to the submission of the PTCSP by other train control systems that perform PTC functions required by subpart I to 49 CFR part 236, and which have been utilized on

high-speed rail systems with similar technical and operational characteristics in the U.S. or in foreign service, and that the system has been designed to detect incursions into the right-of-way, including incidents involving motor vehicles diverting from adjacent roads and bridges, where conditions warrant.

The particular treatment in paragraph (d) of operations at speeds over 150 mph is a legacy of FRA regulations from the 1990s concerning high-speed rail. When FRA's Track Safety Standards (49 CFR part 213) were amended on June 22, 1998, to include standards for higher-speed operations, the rule envisioned regulating rail operations at speeds over 150 mph through a rule of particular applicability. See 63 FR 33992. This same approach was codified in the Passenger Equipment Safety Standards when the rule was promulgated in 1999. See 64 FR 25540. Subsequently, however, FRA amended the Track Safety Standards on March 13, 2013, to remove the prescriptive reference to a rule of particular applicability and make clear that operations at speeds above 125 mph require FRA regulatory approval. See 78 FR 16052. In this NPRM, FRA is similarly proposing to remove the prescriptive reference to a rule of particular applicability in the Passenger Equipment Safety Standards and reaffirm that operations at speeds over 125 mph require FRA regulatory approval.

Accordingly, FRA is proposing to modify 49 CFR 236.1007 to remove the prescriptive reference requiring a rule of particular applicability for operations at speeds over 150 mph. Paragraph (c) of this section would continue to require that operations at speeds over 125 mph require FRA regulatory approval. However, there is no further need to prescribe in all cases distinct regulatory treatment through a rule of particular applicability for operations at speeds above 150 mph. Operations in both speed ranges constitute high-speed rail operations and are regulated by FRA as such.

FRA does not intend anything in this proposal to affect any order of particular applicability FRA has issued or may issue. In 1998, FRA issued an order of particular applicability governing certain rail operations on the Northeast Corridor (NEC). See 63 FR 39343, Jul. 22, 1998. The order, as amended, specifies requirements for equipping trains to respond to the Advanced Civil Speed Enforcement System (ACSES) in NEC territory. See 71 FR 33034, Jun. 7, 2006. As delegated by the Secretary, FRA may issue such an order after an investigation requiring a railroad carrier to install, on any part of its line, a signal

system that complies with requirements FRA has established as necessary for safety. See 49 U.S.C. chapter 205 (signal systems). Such an order of particular applicability has a far more limited scope than that envisioned at one time for a rule of particular applicability governing high-speed operations (*i.e.*, a comprehensive rule addressing all aspects of a high-speed rail operation, not just signal systems). To be clear, the order of particular applicability governing certain rail operations on the NEC will not be affected by this rulemaking.

#### *Part 238—Passenger Equipment Safety Standards*

##### Subpart A—General

##### Section 238.5 Definitions

FRA is proposing to add new definitions to this part and revise certain existing definitions to clarify the meaning of important terms and minimize potential for misinterpretation of the rule. FRA requests public comment regarding the terms defined in this section and whether we should also define other terms.

FRA proposes to revise the definitions of “glazing, end-facing” and “glazing, side-facing,” and to make technical revisions to the definitions of “Tier II” and “Train, Tier II passenger” to reflect the proposed change in the maximum authorized speed of Tier II passenger equipment from 150 mph to 160 mph. FRA also proposes to add new definitions for “Associate Administrator,” “Cab,” “Tier III,” “Trainset, Tier I alternative passenger,” “Trainset, Tier III,” and “Trainset unit.” Some of the proposed definitions we added involve new or fundamental concepts which require further discussion.

FRA proposes to define “Associate Administrator” to mean the FRA Associate Administrator for Railroad Safety and Chief Safety Officer, Associate Administrator for Railroad Safety, Associate Administrator for Safety, or the Associate Administrator's delegate. The title of Associate Administrator for purposes of this part has always referred to the same FRA official; only the full description of this official's title has changed since this part was originally promulgated. Because of the use of different titles in this part to refer to the same official, FRA proposes to add this definition to make clear that there is one official who is the Associate Administrator for purposes of this part. In the final rule, FRA may instead update and make consistent each reference to the Associate Administrator in each

individual section of part 238 that refers to the Associate Administrator.

FRA proposes to add the definition “cab” to mean, for purposes of subpart H of this part, a compartment or space in a trainset designed to be occupied by the engineer and contain an operating console from which the engineer exercises control over the trainset. Cab includes a locomotive cab. FRA is adding a more general definition of “cab” to ensure the requirements apply to high-speed trainsets, which do not utilize conventional locomotives. This new definition for “cab” is not intended to impose any new requirement on other types of equipment. This definition presumes there is a typical design of a high-speed trainset where the engineer and operating console are located in the leading end of the trainset. Regardless, FRA would expect the protections of §§ 238.703 through 238.717 (Trainset structure) and § 238.721 (Glazing) to apply, as appropriate, to that leading end whether it is to be occupied by operating crewmembers or passengers, or both. In this regard, and consistent with the definition of “Occupied volume” under § 238.5, the protections mentioned above would apply, as appropriate, for the entire width of a trainset's leading end, irrespective of the occupant(s). In addition, this definition would apply to vehicles designed under appendix G to this part. FRA invites comment on this proposed definition, as well as comment on whether FRA should make more explicit in the rule text the protections that apply to the leading end of a trainset, whether intended to be occupied by crewmembers or passengers, or both.

FRA proposes to revise the definition “glazing, end-facing” to mean any exterior glazing located where a line perpendicular to the plane of the glazing material makes a horizontal angle of 50 degrees or less with the centerline of the vehicle in which the glazing material is installed, except for: The coupled ends of MU locomotives or other equipment that is semi-permanently connected to each other in a train consist; and, end doors of passenger cars at locations other than the cab end of a cab car or MU locomotive. Any glazing location which, due to curvature of the glazing material, can meet the criteria for either end-facing glazing or side-facing glazing would be considered end-facing glazing. This definition makes clear that the glazing location means an “exterior” location and expressly identifies locations that FRA would not consider end-facing glazing locations. Additionally, the definition accounts for the aerodynamic shape of vehicle front-ends and expressly provides that any

window, based on its geometry, that could be either an end-facing glazing location or a side-facing glazing location is considered an end-facing glazing location that must comply with the end-facing glazing requirements. FRA intends for this proposed definition to be substantively the same as the revised definition for “end facing glazing location” in the final rule on Safety Glazing Standards (part 223 of this chapter). See 81 FR 6775, Feb. 9, 2016. This revision is not intended to add any new requirement on glazing installed in passenger vehicles subject to the requirements of part 238. FRA intends this definition and other glazing requirements in the final rule to be consistent with the Safety Glazing Standards rulemaking.

FRA proposes to revise the definition “glazing, side-facing” to mean any glazing located where a line perpendicular to the plane of the glazing material makes a horizontal angle of more than 50 degrees with the centerline of the vehicle in which the glazing material is installed. Side-facing glazing also means glazing located at the coupled ends of MU locomotives or other equipment that is semi-permanently connected to each other in a train consist, and glazing located at end doors other than at the cab end of a cab car or MU locomotive. FRA intends for this proposed revision to be substantively the same as the revised definition for “side facing glazing location” in the final rule on Safety Glazing Standards, see *id.*, and is necessary due to our proposed revision to the definition of “glazing, end-facing” in this part 238. Nonetheless, we do not intend for this revision to add any new requirement on glazing installed in passenger vehicles subject to the requirements of this part. As noted above, FRA intends this definition and other glazing requirements in the final rule to be consistent with the Safety Glazing Standards rulemaking.

As discussed above, FRA proposes to revise the definition of “Tier II” to increase the maximum speed allowable for this tier of passenger equipment from 150 mph to 160 mph. FRA likewise proposes to revise the definition “train, Tier II passenger.” In addition, FRA proposes to add a definition for “Tier III” to add this equipment safety tier to this part with the definition “trainset, Tier III” to apply the proposed Tier III requirements to such equipment. Further, FRA intends for these definitions to make clear that the definitions of Tier I and Tier II do not include Tier III passenger equipment merely because the equipment operates in the Tier I and

Tier II speed ranges. The operation of passenger equipment in both lower- and higher-speed ranges is integral to the definition of Tier III (please see above for a more detailed discussion of these safety tiers). This Tier III definition also makes clear that 125 mph is the maximum speed at which Tier III equipment can operate when sharing the right-of-way with non-Tier III equipment or when highway-rail grade crossings are present along the right-of-way. FRA elected this maximum speed to maintain operational compatibility with non-Tier III equipment based on the safety equivalency of the crashworthiness and occupant protection requirements. Further, this definition makes clear FRA is limiting Tier III operations to an absolute maximum speed of 220 mph, which is the maximum track speed permitted under FRA’s Track Safety Standards (49 CFR part 213). See 78 FR 16052, Mar. 13, 2013. FRA invites comments on the speed and operational restrictions discussed above and whether there are more appropriate alternatives to FRA’s proposal.

FRA proposes to add the definition “trainset, Tier I alternative passenger” to mean a trainset consisting of Tier I passenger equipment designed under the requirements of appendix G to this part. FRA proposes to add this definition to distinguish specific Tier I trainset designs that conform to alternative standards from Tier I equipment that meets the existing Tier I requirements in subpart C but provide an equivalent level of protection by conforming with the proposed requirements of appendix G to this part.

FRA also proposes to add a new definition of “trainset unit” to mean that segment of a trainset located between connecting arrangements (articulations). This definition would clarify that the proposed requirements may apply to individual vehicles within a trainset consist, but not necessarily to the trainset as a whole.

#### Section 238.21 Special Approval Procedure

FRA proposes to amend paragraph (c)(2) of this section to be consistent with the changes proposed to § 238.201(b) for alternative compliance. The proposed applicable elements would be in new § 238.201(b)(1) rather than in § 238.201(b) due to the proposed reorganization of that section. FRA intends to conform paragraph (c)(2) of this section accordingly.

Additionally, FRA is updating the reference to “Associate Administrator for Safety” to read simply “Associate Administrator,” consistent with the

discussion provided above under § 238.5.

#### Subpart B—Safety Planning and General Requirements

##### Section 238.111 Pre-Revenue Service Acceptance Testing Plan

FRA proposes to amend paragraphs (b)(2), (4), (5), and (7), and (c) of this section to require railroads to obtain FRA approval before using Tier III passenger equipment that either has not been used in revenue service in the U.S. or has been used in revenue service in the U.S. and is scheduled for a major upgrade or introduction of new technology that affects a safety system on such equipment. The explicit inclusion of a Tier III notification and approval process is consistent with FRA’s approach to the implementation of high-speed rail technology. It also provides a formal mechanism for FRA to ensure all required elements of this part are satisfactorily addressed and documented.

FRA invites comment on FRA’s proposed changes to this section. Specifically, we invite comment on any additional changes we should make concerning testing and approval requirements for Tier I, Tier II, or Tier III operations.

#### Subpart C—Specific Requirements for Tier I Passenger Equipment

##### Section 238.201 Scope/Alternative Compliance

In this section, FRA is proposing to redesignate existing paragraph (b) as paragraph (b)(1) and to add new paragraph (b)(2) due to the proposed addition of standards for alternative compliance in appendix G to this part.

Proposed paragraph (b)(1) would continue to provide the existing option for railroads to petition FRA’s Associate Administrator for approval to use Tier I passenger equipment designed to alternative crashworthiness standards. This approval remains contingent upon the railroad’s successful demonstration that such standards provide a level of safety at least equivalent to those in subpart C of this part. Although FRA is proposing to add a new appendix G to this part that provides specific alternative crashworthiness standards to those in subpart C, FRA does not intend to limit the flexibility this section currently provides for using other alternative designs.

Proposed new paragraph (b)(2) would explain how Tier I passenger trainsets may comply with the alternative crashworthiness and occupant protection requirements in appendix G to this part instead of the requirements

of §§ 238.203, 238.205, 238.207, 238.209(a), 238.211, 238.213, and 238.219. Railroads would be required to submit test plans and supporting documentation for FRA review and give FRA at least 30 days' notice before commencing any testing, whether partially or in full, to demonstrate compliance with the requirements of proposed appendix G to this part. Railroads would also be required to submit a carbody crashworthiness and occupant protection compliance report based on the analysis, calculations, and test data necessary to demonstrate compliance. After receipt of this report, FRA would deem the submission acceptable, unless FRA stays action within 60 days by written notice. If FRA stays action, then the railroad would be required to correct any deficiencies FRA identified and notify FRA it has corrected the deficiencies before placing the subject equipment into service. FRA may also impose conditions in writing necessary for safely operating the equipment for cause stated.

FRA notes that the proposed approval process would differ from that for Tier II or Tier III passenger equipment, which would require affirmative FRA approval. Tier I trainsets that FRA reviews under this paragraph would be deemed acceptable without further FRA action based on the appropriate submissions to FRA, unless FRA stays approval by written notice to the railroad. If FRA stays approval, FRA would then identify issues for clarification or resolution, as appropriate, which the railroad would be required to address and notify FRA it had corrected prior to placing the equipment into service.

FRA invites comment on the proposed changes to this section.

#### Section 238.203 Static End Strength

FRA proposes to revise this section to include a cross reference to § 238.201(b)(2) to reflect the proposed alternative standards in appendix G to this part for Tier I trainsets. Please note that the existing alternative compliance provision in § 238.201(b), which we propose to redesignate as § 238.201(b)(1), does not apply to the requirements of this section, unlike the other structural requirements. Hence, FRA is not proposing to reference § 238.201(b) generally in this section. However, FRA is not proposing to change the existing requirements of this section.

#### Section 238.205 Anti-Climbing Mechanism

FRA is proposing to revise this section to include a cross reference to

§ 238.201(b) to reflect the proposed alternative standards in appendix G to this part for Tier I trainsets. However, FRA is not proposing to change the existing requirements of this section.

#### Section 238.207 Link Between Coupling Mechanism and Carbody

FRA is proposing to revise paragraph (b) of this section to include a cross reference to § 238.201(b) to reflect the proposed alternative standards in appendix G to this part for Tier I trainsets. However, FRA is not proposing to change the existing requirements of this section.

#### Section 238.209 Forward End Structure of Locomotives, Including Cab Cars and MU Locomotives

FRA is proposing to revise this section to include a cross reference to § 238.201(b) to reflect the proposed alternative standards in appendix G to this part for Tier I trainsets. However, FRA is not proposing to change the existing requirements of this section.

#### Section 238.211 Collision Posts

FRA is proposing to revise this section to include a cross reference to § 238.201(b) to reflect the proposed alternative standards in appendix G to this part for Tier I trainsets. However, FRA is not proposing to change the existing requirements of this section.

#### Section 238.213 Corner Posts

FRA is proposing to revise this section to include a cross reference to § 238.201(b) to reflect the proposed alternative standards in appendix G to this part for Tier I trainsets. However, FRA is not proposing to change the existing requirements of this section.

#### Section 238.219 Truck-to-Car-Body Attachment

FRA is proposing to revise this section to include a cross reference to § 238.201(b) to reflect the proposed alternative standards in appendix G to this part for Tier I trainsets. However, FRA is not proposing to change the existing requirements of this section.

#### Subpart E—Specific Requirements for Tier II Passenger Equipment

##### Section 238.401 Scope

FRA proposes to revise this section to increase the maximum allowable speed for Tier II passenger equipment from 150 mph to 160 mph. This proposal is consistent with FRA's March 13, 2013, final rule amending and clarifying the Track Safety Standards, which affirmed that the maximum allowable speed on Class 8 track is 160 mph. See 78 FR 16052. Further, this proposal would

make the speed range for Tier II passenger equipment consistent with that for Class 8 track in the Track Safety Standards. As specified in § 213.307 of this chapter, Class 8 track encompasses the speed range above 125 mph up to 160 mph—the same speed range for Tier II passenger equipment standards. This change would only increase the maximum operating speed to 160 mph and would still require FRA approval to do so as this part and other FRA safety regulations require.

For example, Amtrak's Acela Express currently operates at a maximum speed of 150 mph and has done so for well over a decade with FRA approval. While the proposed change would neither impose any new requirement on Acela Express, nor alter any aspect of FRA's regulatory approval of Acela Express, the rule would require FRA approval to increase the maximum operating speed to 160 mph.

FRA's Tier II passenger equipment safety standards are based on safety requirements developed for the operation of Amtrak passenger trainsets at speeds up to 150 mph on the Northeast Corridor (NEC). See 64 FR 25629. Amtrak sponsored a risk assessment of high-speed rail operations and FRA sponsored computer modeling to predict the performance of various equipment structural designs and configurations in collisions. The risk assessment found a significant risk of collisions at speeds below 20 mph and a risk of collisions at speeds exceeding 100 mph due to heavy and increasing conventional commuter rail traffic, freight rail traffic, highway-rail grade crossings, moveable bridges, and a history of low speed collisions in or near stations and rail yards. Based on the risk assessment and the results of the computer modeling, FRA determined that full reliance on collision avoidance measures rather than crashworthiness, though the hallmark of safe high-speed rail operations in several parts of the world, could not be implemented in corridors like the north end of the NEC. Traffic density patterns and right-of-way configurations would not permit implementation of the same collision avoidance measures that have proven successful in Europe and Japan. To compensate for the increased risk of a collision, a more crashworthy trainset design was needed. Accordingly, the structural requirements for Tier II passenger equipment are more stringent than those for Tier I passenger equipment or the design practice for North American passenger equipment or for high-speed rail equipment in other parts of the world.

## Subpart F—Inspection, Testing, and Maintenance Requirements for Tier II Passenger Equipment

### Section 238.501 Scope

FRA proposes to revise this section to increase the maximum allowable speed for Tier II passenger equipment from 150 mph to 160 mph. Please see the discussion of § 238.401.

## Subpart H—Specific Requirements for Tier III Passenger Equipment

This proposed subpart would contain specific requirements Tier III passenger equipment must meet. Many of the requirements proposed herein consider Tier III passenger equipment in terms of an integrated trainset, particularly for purposes of crashworthiness and occupant protection requirements. This rule presumes that Tier III trainsets will consist of semi-permanently coupled, articulated, or otherwise “fixed” configurations, that are not intended to operate normally as individual vehicles or in mixed consists (with equipment of another design or operational tier).

The requirements proposed in this subpart are organized into subject areas based on their general applicability: trainset structure, window glazing, brake systems, interior fittings and surfaces, emergency systems, and cab equipment. These proposed requirements are intended to be applied in concert with proposed subparts I and J to establish a set of minimum safety requirements for Tier III passenger equipment that encourages a systemic approach to safety. FRA also intends that the requirements be applied in a manner that is performance-based and technology-neutral, where possible.

FRA intends to supplement these specific requirements in future rulemaking(s). As noted above, the ETF remains active and continues to address safety requirements for Tier III operations. FRA will consider regulatory changes and additions that will help FRA safely and efficiently implement Tier III operations from design, to entry into revenue service, to ongoing inspection and maintenance.

FRA notes that it intends for certain proposed sections of this subpart to be applied as an integrated set of alternative crashworthiness and occupant protection performance requirements for Tier I passenger equipment as delineated in appendix G to this part. We consider this set of proposed requirements to provide an equivalent level of safety to its counterpart set of Tier I requirements in subpart C of this part. As explained in greater detail in the discussion of appendix G below, the proposed rule

clarifies which specific Tier III crashworthiness and occupant protection performance requirement should be applied as an alternative set of Tier I counterpart requirements. Specifically, FRA makes clear that if alternative Tier I compliance is sought under appendix G, then all the requirements in appendix G must be met so the integrity of the alternative requirements is maintained.

### Section 238.701 Scope

This proposed subpart contains specific requirements for railroad passenger equipment operating in a shared right-of-way at speeds not exceeding 125 mph, and in an exclusive right-of-way without grade crossings at speeds exceeding 125 mph but not exceeding 220 mph. FRA believes that in most cases new exclusive rights-of-way designed for Tier III operations will be constructed without highway grade crossings. However, some newly constructed exclusive rights-of-way may include highway grade crossings, but may have long stretches of track without a grade crossing. In these instances, imposing a 125 mph speed restriction on the entire exclusive right-of-way may have greater costs than benefits. Additional net benefits may be achievable, in certain circumstances, by applying the speed restriction only to track at or near each grade crossing instead of the entire exclusive right-of-way. In such cases, FRA would expect the railroad to address the safety considerations surrounding highway grade crossings in the exclusive right-of-way in its Tier III Safe Operation Plan, which is subject to FRA review and approval. However, FRA invites comment on alternative approaches, such as whether the rule should include provisions that explicitly apply the speed restriction only to track located at or near each grade crossing within an exclusive right-of-way.

FRA is proposing to allow passenger seating in the leading unit of a Tier III trainset if safety issues associated with passengers occupying the leading unit are addressed and mitigated through a comprehensive Tier III Safe Operation Plan. Demonstration of compliance with the requirements of this subpart would be subject to FRA review and approval under § 238.111.

### Trainset Structure

#### Section 238.703 Quasi-Static Compression Load Requirements

As discussed above, FRA proposes a two-step approach to OVI in this NPRM. Accordingly, in paragraph (a) of this section, FRA proposes that for it to

consider a Tier III trainset to have sufficient OVI, compliance with the requirements of both paragraph (b) of this section and § 238.705 must be demonstrated. The purpose of applying both requirements is to ensure the integrity of the occupied volume during a collision or other accident. Integrity of the occupied volume is a fundamental requirement of crashworthiness—the primary goal of which is preservation of space to protect occupants during an accident. Additionally, a strong OVI serves as the foundation for other crashworthiness features such as CEM components.

Although the language of this section references only Tier III trainsets, the requirements of this section may also be applied to Tier I trainsets through the application of appendix G, instead of complying with the existing requirements of 49 CFR 238.203, “Static end strength.” Tier I passenger equipment designed to alternative crashworthiness standards may demonstrate an appropriate level of crashworthiness by complying with the quasi-static compression load requirements proposed in § 238.703(b). In general, § 238.203 requires all passenger equipment to support an 800,000-pound compressive load along its line-of-draft without experiencing permanent deformation. This magnitude of load applied to the line-of-draft has been the longstanding practice in the U.S. This evaluation is readily performed on passenger equipment conventionally designed for service in the U.S. For vehicles designed less conventionally or alternatively (e.g., articulated trainsets, full or partial low-floor trainsets, and trainsets utilizing CEM), the structure of the occupied volume may be designed so that collision loads are not transmitted along the line-of-draft. While a rail vehicle may be designed to carry normal, longitudinal service loads along its line-of-draft, the more severe collision loads may be introduced into the structure differently. Below is a discussion of the quasi-static compression load requirements proposed in paragraph (b) that would apply to each vehicle of a Tier III trainset, and, if elected, as an alternative for Tier I trainsets, through application of appendix G.

Proposed paragraph (b)(1) introduces three means of compliance, each consisting of a prescribed load magnitude and a corresponding pass/fail criterion (or pass/fail criteria), and states that each vehicle under evaluation must comply with one of three compression load pass/fail criteria enumerated in paragraphs (b)(1)(i)–(iii). FRA notes that this paragraph (b)(1)

applies to evaluation of individual vehicles of a trainset, not a trainset as a whole. Additionally, FRA is not proposing to require using all three alternatives to evaluate a vehicle; FRA would require only demonstration that the vehicle design complies with one compression load pass/fail criterion. By including three sets of load magnitudes and pass/fail criteria, FRA intends to accommodate quasi-static compression load evaluation for a variety of passenger trainset vehicle designs and ensure that each alternative provides an equivalent level of safety.

For each of the three quasi-static compression load requirements that may be applied, the evaluation loads are introduced not at the line-of-draft, but at the ends of the collision load path through the occupied volume. Introducing the loads along the collision load path permits evaluation of the quasi-static compression resistance of a given design in a manner more representative of the type of loading the occupied volume would experience in a collision. The details of the location(s) of the load points at the ends of the collision load path would be determined on a design-by-design basis.

The proposed quasi-static compression load requirements also permit use of a combination of elastic testing and elastic/plastic computer simulation to demonstrate a trainset's ability to comply with one of the three requirements. While an analysis of a properly-executed, finite-element (FE) computer simulation can demonstrate a design's compliance, some structural testing of the actual occupied volume undergoing evaluation is needed to validate the results the computer simulation produced. The process of validation essentially provides a computer simulation with a foundation in reality.

A detailed FE model of the carbody undergoing evaluation is necessary to properly capture the structural response of the occupied volume to the evaluation compression loads. FRA expects this model will include all the structural members and connections that comprise the occupied volume. If the carbody structure is symmetric from side to side, a symmetry boundary condition may be used to facilitate efficient model evaluation. Certain details of the carbody structure that do not directly affect the OVI, such as couplers and designated CEM components, may be omitted from the OVI model.

FRA also expects the material properties (e.g., stress-strain characteristics) that are used in the model would be derived from either

manufacturer-certified minimum properties or from tests conducted on the actual construction materials. Material properties may be assumed to be independent of the rate of deformation for the purposes of OVI evaluation. Failure modeling of connections (e.g., welds, rivets, bolts, etc.) would not be required if the analysis does not indicate critical stresses or strains near those connections.

Appropriate boundary conditions must be chosen to provide reasonable restraint to the model. FRA expects that vertical support to the model would be provided at the locations in the actual vehicle where it would carry vertical loads. Typically, those locations include the attachments of the secondary suspension components to the underframe and, if the car is so equipped, the articulation. Longitudinal restraint in the model may be accomplished by a rigid wall that is in contact with the reaction-end of the vehicle structure. Lateral restraint may either be introduced through a symmetry boundary condition or by applying a reasonable coefficient of friction between the longitudinal restraint wall and the body structure.

Proposed paragraph (b)(1)(i) provides that the first load magnitude and corresponding pass/fail criterion is an 800,000-pound compression load applied to the collision load path without causing any permanent deformation to the occupied volume. The load magnitude (800,000 pounds) is the same as the evaluation load generally required in existing § 238.203 for Tier I passenger equipment but would be introduced into the occupied volume along the collision load path (whether or not that is the line-of-draft). The pass/fail criterion of no permanent deformation would be the same as the pass/fail criterion in existing § 238.203.

Proposed paragraph (b)(1)(ii) provides that the second load magnitude and corresponding pass/fail test is a 1,000,000-pound compression load applied to the collision load path without exceeding either of two pass/fail criteria. Under this proposal, both pass/fail criteria must be met for a design to successfully meet this quasi-static compression load requirement, which would increase the evaluation load by 25 percent over the conventional 800,000-pound load. As a consequence of applying a more severe load, FRA would relax the pass/fail criteria to permit small areas of plastic strain to develop within the structure. Thus, the first pass/fail criterion in proposed paragraph (b)(1)(ii)(A) states that local plastic strains that may

develop anywhere within a model may not exceed 5 percent. This pass/fail criterion would be applied to the entire structure of the vehicle undergoing evaluation. The second pass/fail criterion in proposed paragraph (b)(1)(ii)(B) states that local shortening (deformation) of the vehicle may not exceed 1 percent over any 15-foot length of the occupied volume. This criterion is intended to prevent localized loss of occupied volume that may occur when the 5-percent plastic strain criterion is not exceeded.

Paragraph (b)(1)(iii) provides that the third load magnitude and corresponding pass/fail criterion is a 1,200,000 pound compression load applied to the collision load path without exceeding the crippling strength of the vehicle. This paragraph would define crippling as the maximum point on the load-versus-displacement characteristic. The load magnitude required by this quasi-static compression load requirement would be 50 percent higher than the 800,000-pound load required by existing § 238.203, which also requires that the carbody must remain elastic to successfully meet the requirement. Because the evaluation load would be increased by 50 percent, the corresponding pass-fail criterion would require that the vehicle being evaluated have an ultimate load carrying capacity (i.e., crippling resistance) equal to or greater than 1.2 million pounds. To determine the adequacy of the proposed ultimate load, in June 2011, FRA performed a series of quasi-static compression tests on passenger railcars compliant with § 238.203 and verified that these cars had an ultimate load capacity of approximately 1.2 million pounds. This testing series established that 1.2 million pounds is a reasonable minimum standard for the crippling strength of passenger equipment compliant with § 238.203. The results of that testing and corresponding FE modeling are summarized in an FRA "Research Results" report,<sup>13</sup> two technical papers,<sup>14</sup> and an FRA final report.<sup>15</sup>

<sup>13</sup> USDOT/FRA, "Occupant Volume Integrity Evaluation in Passenger Railcars." *Research Results—Office of Railroad Policy and Development*, RR 12-01, February 2012.

<sup>14</sup> Carolan, M., Muhlander, M., Perlman, B., and Tyrell, D., "Occupied Volume Integrity Testing: Elastic Test Results and Analyses," American Society of Mechanical Engineers, Paper No. RTDF2011-67010, September, 2011; Carolan, M., Perlman, B., and Tyrell, D., "Crippling Test of a Budd Pioneer Passenger Car," American Society of Mechanical Engineers, Paper No. JRC2012-74087, April 2012.

<sup>15</sup> Carolan, M., Perlman, B., and Tyrell, D., "Alternative Occupied Volume Integrity (OVI) Tests and Analyses," U.S. Department of Transportation, DOT/FRA/ORD-13/46, October 2013.

Demonstration of compliance with any of the quasi-static requirements may be achieved through testing to the specified load or a combination of elastic testing and plastic analysis. Paragraph (b)(2) would establish that, at a minimum, an end compression load of no less than 337,000 pound-force (lbf) must be applied to the carbody structure to validate the plastic analysis. In addition, these requirements would establish the minimum level of model validation to be performed using the results of a test of the same design. Nonetheless, FRA does not intend for these proposed minimum requirements to replace sound engineering judgment that higher force values may be appropriate to obtain valid test results when designing and performing the compression testing and FE modeling.

Because paragraphs (b)(1)(ii) and (iii) would permit permanent deformation to occur in the occupied volume of a vehicle during its evaluation, it is likely a combination of elastic (*i.e.*, non-destructive) testing and elastic-plastic finite element analysis (FEA) would be used to demonstrate a vehicle design's ability to meet either of those two quasi-static compression load requirements. While paragraph (b)(1)(i) would not permit permanent deformation to occur in a design undergoing evaluation, FRA does not intend for the proposed rule to prevent a combination of elastic testing to a load less than 800,000 lbs and FEA up to the target load of 800,000 lbs from being used to demonstrate that a design's OVI complies with this first requirement.

As previously discussed, proposed paragraph (b)(2) states that, no matter which of the three requirements that is chosen for evaluation of a design's OVI is applied, a compression test also must be performed and the applied longitudinal compression load must be at least 337,000 lbf (1500kN). This test is required to ensure the FE computer model that is used to demonstrate alternative compliance can successfully model the response of the carbody to the same loading condition as part of a program of model validation. This value is equal to 1500 kN, which is the compression load placed on the coupler support structures required by European standard EN 12663 for Category P-II passenger equipment. The ETF recommended this minimum value for the validation test's elastic load and FRA adopted this minimum recognizing that sufficient strains must be developed within the tested structure to provide quality measurements necessary for validating a model.

Finally, proposed paragraph (b)(3) states that compliance with paragraph

(b) of this section must be documented and submitted to FRA for review and approval. In particular, we propose several options for compliance with paragraph (b)(1), and FRA review and approval is necessary to evaluate the approach taken to ensure compliance.

#### Section 238.705 Dynamic Collision Scenario

In this section, FRA is proposing to introduce a dynamic collision scenario analysis as the second part of the OVI evaluation of a Tier III passenger trainset. PTC technology cannot protect against all possible collision scenarios, such as collisions with trespassing highway equipment at grade crossings or with other rolling stock (freight or passenger equipment) during manual operations at 20 mph or below. Accordingly, compliance with this requirement is necessary to preserve the occupied volume, protecting all occupants on the trainset.

As mentioned in the discussion of proposed § 238.703 above, each vehicle in the trainset would need to demonstrate it meets both the OVI requirements in proposed paragraph (b) of that section and the dynamic collision scenario requirements in proposed paragraph (b) of this section. Further, as mentioned in the discussion of proposed § 238.703, and as outlined in proposed appendix G, a Tier I passenger trainset designed to alternative crashworthiness standards may comply with this section instead of the requirements currently applicable to Tier I passenger trainsets in § 238.203.

In combination with the quasi-static compression load requirements discussed in proposed § 238.703, the purpose of this proposed dynamic collision scenario requirement is to ensure that survivable space for the passengers and crew is preserved in up to moderately severe accident conditions (*i.e.*, conditions comparable to a head-on collision at a speed of 20 to 25 mph, depending on the type of equipment, into a stationary train). This requirement would also provide a baseline level of protection for scenarios that may be more severe, but less predictable with respect to loading conditions and historical accident data. Although the dynamic collision scenario would be conducted at the trainset level, the requirements described in this section would be evaluated at the level of the trainset's individual vehicles so no vehicle in the trainset may exceed the parameters outlined in proposed paragraph (b) as a result of the dynamic collision scenario.

Proposed paragraph (a) outlines the required conditions under which a

dynamic collision scenario would be performed. Generally, the collision scenario requires a dynamic impact to be simulated between two trains: An initially-moving train and an initially-standing train. The initially-moving train is the trainset undergoing evaluation, either Tier III equipment or, as provided in appendix G, Tier I equipment designed to alternative crashworthiness standards. The initially-standing train is a locomotive-led consist of five conventionally-designed passenger cars. The conventionally-designed passenger cars have a prescribed weight and force-versus-displacement characteristic.<sup>16</sup> The pass/fail criteria for the scenario determine whether there is sufficient preservation of occupied volume for passengers and crew in the trainset undergoing evaluation.

FRA expects the collision scenario would be executed for an impact duration sufficient to capture the most severe portion of the collision event. The actual amount of impact time required to simulate the collision sufficiently would vary based upon the characteristics of the trainset undergoing evaluation. Typically, the collision scenario would be executed until all of the equipment, including the initially-standing and initially-moving consists, is moving in the same direction at approximately the same velocity. If all of the equipment is moving together at approximately the same speed, no further car-to-car impacts would occur, and the simulation would have been executed for a sufficient duration to capture the most severe decelerations.

There are various types of analyses that may be used to evaluate the collision scenario requirements. These analyses include fully-detailed FE models, lumped-parameter analyses, or a hybrid approach where a combination of detailed FE modeling and lumped-parameter techniques are used within the same simulation. An FEA of the scenario is generally a highly-detailed simulation of the actual trainset geometry. The parts making up the trainset are meshed into a large number of elements, with each element having its own mass, stiffness, and connection properties to the adjacent elements. A lumped parameter analysis represents each car or section of a car within a trainset using a small number of masses and a small number of non-linear springs. At its extreme, each car consists

<sup>16</sup> Appropriate weights and force-versus-displacement characteristics for the conventionally-designed passenger cars can be found in the Technical Criteria and Procedures Report.

of a single mass and a single spring characteristic. A hybrid approach may utilize an FE mesh to represent some structures (e.g., CEM structures that undergo large deformations) and lumped-parameter representations of other structures (e.g., cars far from the impacting interface that experience little deformation). Any of the three types of analyses is capable of developing the information needed to verify a trainset's ability to meet the requirements of the collision scenario. Additionally, because the centerlines of the initially-moving and initially-standing trains are aligned with one another during this scenario, a half-symmetric model may be used to represent the colliding vehicles, as appropriate.

Proposed paragraph (a)(1) requires the initially-moving train to be made up of the equipment undergoing evaluation at its empty, ready-to-run (AW0) weight.<sup>17</sup> As highlighted above, this equipment can be either Tier III equipment or, under appendix G, Tier I equipment designed to alternative crashworthiness standards.

Proposed paragraph (a)(2) states that if the length of consists to be used in service can vary, then the longest and shortest consist lengths must both be evaluated under this section. This requirement is intended to ensure the trainset's OVI is satisfactory when operated in both the shortest and longest train consists that will be utilized in service. The trainset undergoing evaluation must successfully meet the collision scenario requirements for both its shortest and longest configurations; it is not required to demonstrate other configurations meet the requirements.

Proposed paragraph (a)(3) states that if the trainset is intended for use in push-pull service, then both the locomotive-led and cab-car-led configurations shall be evaluated separately. This requirement is intended to ensure sufficient OVI for all occupied spaces in the trainset regardless of whether it is led by a cab car or a conventional locomotive.

Proposed paragraph (a)(4) describes the configuration of the initially-standing train of conventional passenger equipment. As provided in paragraph (a)(4)(i), this train is to be led by a rigid locomotive weighing 260,000 pounds and also made up of five identical coaches, each having a weight of 95,000 pounds. Paragraph (a)(4)(ii) provides that the locomotive and each passenger

coach crush in response to applied force as specified in Table 1 to this section. Table 1 provides the non-linear, force-versus-crush relationship for the passenger cars and locomotive comprising the initially-standing train. These relationships are meant to be representative of typical crush responses for passenger equipment; likewise, the weights given for the conventional locomotive and conventional passenger cars are meant to be representative of typical weights for passenger equipment. The weights for the passenger cars and locomotives, the force-versus-crush behavior, and the geometry for the standing locomotive are all provided in the Technical Criteria and Procedures Report. Further detail on the geometry of the locomotive can be found in that Report. In addition, paragraph (a)(4)(iii) provides that the locomotive would be modeled using the data inputs listed in appendix H to this part, so that the locomotive's geometric design is as depicted in Figure 1 to appendix H.

Proposed paragraphs (a)(5) through (10) are meant to ensure that the collision scenario is evaluated under the same conditions by each entity performing this type of evaluation. Proposed paragraph (a)(5) explains that the scenario must be evaluated on tangent, level track.

Proposed paragraph (a)(6) describes the initial velocities to be assigned to the initially-moving consist. If the initially-moving consist is led by a cab car or an MU locomotive, then it must have an initial velocity of 20 mph. If the initially-moving consist is led by a conventional locomotive, it must have an initial velocity of 25 mph. These speeds were chosen based upon estimates of the upper limit of the ability of conventionally-designed Tier I equipment to maintain its occupied volume in a similar collision scenario.

FRA intends for the requirements in proposed paragraphs (a)(7) through (9) to simplify the modeling of the collision scenario and to help ensure the scenario is evaluated consistently by different entities. Paragraph (a)(7) provides that the coupler knuckles on the impacting equipment shall be closed. Paragraph (a)(8) states that the moving and standing consists are not braked. Paragraph (a)(9) states that the initially-standing train is free to move only in the longitudinal direction.

Proposed paragraph (a)(10) would require that the model used to demonstrate compliance with the dynamic collision requirements be validated, and that model validation be documented and submitted to FRA for review and approval. Regardless of the

type of analysis employed to demonstrate a trainset's ability to meet the collision scenario requirements, the analytical model must undergo some level of validation for the results to be considered acceptable. The validation to be performed on the model used in the collision scenario would be in addition to any validation required for a model used to demonstrate the quasi-static OVI of the trainset undergoing evaluation. While full-scale destructive testing of a trainset undergoing evaluation is not expected, FRA expects that any designated energy-absorbing components will be tested at the component-level. The results of these component tests would be used to validate a model of the same type to be used to demonstrate the trainset's ability to meet the dynamic collision scenario. FRA also expects that any components that experience large deflection or permanent deformation during the modeling of the collision must be validated with some type of physical test.

Proposed paragraph (b) would contain the crashworthiness and occupant protection performance requirements the individual vehicles in the initially-moving trainset involved in the dynamic collision scenario must meet as described in paragraph (a)—*i.e.*, the trainset undergoing evaluation. Proposed paragraph (b)(1) outlines two conditions for demonstrating that the initially-moving trainset possesses sufficient crashworthiness to resist a significant loss of occupied volume during the collision scenario. Only one of the two performance conditions would have to be shown to be met to successfully demonstrate compliance: No more than 10 inches of longitudinal, permanent deformation of the occupied volume as a result of the impact, as proposed in paragraph (b)(1)(i); or global vehicle shortening not exceeding 1 percent over any 15-foot length of the occupied volume, as proposed in paragraph (b)(1)(ii). These two performance conditions are meant to permit different analysis techniques (e.g., lumped-parameter or FEA) to be applied to evaluate the collision scenario.

Proposed paragraph (b)(2) provides that if the option to use GM/RT2100 is exercised to demonstrate compliance with any of the requirements in §§ 238.733, 238.735, 238.737, or 238.743, then the average longitudinal deceleration of the center of gravity (CG) of each vehicle during the dynamic collision scenario shall not exceed 5g in any 100-millisecond (ms) time period. A plot of the 100-ms average longitudinal deceleration versus time, in which the

<sup>17</sup> "AW0" is a loading designation that is defined by the manufacturer. Specifically, AW0 refers to the "actual weight" of an empty vehicle. The phrase "empty, ready-to-run weight" is typically how this designation is defined in a technical document.

curve never exceeds  $\pm 5g$ , would suffice to demonstrate compliance with paragraph (b)(2).

Proposed paragraph (b)(3) sets out the criteria that must be met to demonstrate the crashworthiness of the engineer's cab as a result of the dynamic collision impact. Paragraph (b)(3)(i) states that a survival space where there is no intrusion must be maintained around each seat in the cab. Survival space is defined as extending a minimum of 12 inches from each edge of the seat. Walls or other items originally within this defined space, not including the operating console, shall not further intrude more than 1.5 inches towards the seat under evaluation.

In addition, as a result of the impact, under paragraph (b)(3)(ii), there shall be a clear exit path from the cab for the occupants, and, under paragraph (b)(3)(iii), the vertical height of the compartment shall not be reduced by more than 20 percent. FRA intends for proposed paragraph (b)(3)(iii) to prevent loss of occupied volume that occurs either through lifting of the floor or downward buckling of the ceiling.

Further, proposed paragraph (b)(3)(iv) provides that the operating console shall not have moved closer to the engineer's seat by more than 2 inches as a result of the impact. Because portions of the operating console in a given cab may originally be within the 12-inch survival space defined in paragraph (b)(3)(i) before the impact, it is important that the console not move more than 2 inches closer to the engineer's seat and impede the engineer from exiting the cab following the impact. The allowable encroachment for the operating console is one-third larger than the 1.5 inches allowed for walls or other items originally within the 12-inch survival space. This larger allowance assumes the initial configuration is designed so there is sufficient space for the engineer to readily get into and out of his or her seat, as well as space to comfortably situate himself or herself for normal operation of the train. Consequently, console movement of 2 inches or less can be allowed without inhibiting or preventing egress. If the engineer's seat is part of a set of adjacent seats, the requirements of this paragraph (b)(iv) would apply to both seats. This seating arrangement is in the cabs of Amtrak's Acela Express trainsets.

#### Section 238.707 Override Protection

This proposed section would contain the requirements for analyzing the ability of a Tier III passenger trainset to resist vertical climbing or override at its collision interface locations during a dynamic collision scenario. This

proposed section would examine the vertical displacement behavior of colliding equipment under an ideal impact scenario where an initially-moving Tier III trainset and an initially-standing conventional train are aligned. This section would also prescribe an impact scenario where the interface of the colliding equipment is translated both laterally and vertically by 3 inches to ensure that override is resisted during an impact when the two trains are not perfectly aligned. Evaluating the colliding equipment's ability to resist override in an offset impact condition helps to demonstrate that the override features are robust.

FRA clarifies that Tier III passenger trainsets would have to comply with both paragraphs (a) and (b) of this section. FRA also clarifies that under proposed appendix G, a Tier I passenger trainset designed to alternative crashworthiness standards may demonstrate an appropriate level of override protection by complying with the requirements this section proposes instead of complying with the requirements applicable to Tier I passenger trainsets in § 238.205, Anti-climbing mechanism, and § 238.207, Link between coupling mechanism and car body. In general, the requirements proposed in this section were developed as an alternative to demonstrating anti-climbing capabilities in current § 238.205 and the capability of the link between the coupling mechanism and carbody to resist the loads in current § 238.207. While compliance with both §§ 238.205 and 238.207 requires meeting a set of quasi-static, vertical load cases, the requirements proposed in this section were developed as a dynamic performance standard.

Proposed paragraph (a)(1) contains two sets of initial conditions for analyzing the ability of the evaluated trainset to resist vertical climbing or override during a dynamic collision scenario, and states these conditions must be applied using the dynamic collision scenario in proposed § 238.705(a). Criteria for evaluating the dynamic collision scenario for each set of initial conditions are provided in proposed paragraph (a)(2). Because the same model may be used both to demonstrate compliance with the requirements of § 238.705 and the requirements of paragraphs (a) and (b) of this section, the model must be validated with test data in such a way as to provide confidence in the validity of the results of the collision analyses. In this regard, if the components that experience large deflection or permanent deformation in the analysis described in § 238.705 also experience

large deflection or permanent deformation in the analysis described in paragraph (a)(2) of this section, then the same test results may be used to validate the model. If the performance of the components that undergo large deformation in the analysis described in paragraph (a)(2) of this section is not validated with test data as part of the validation of the model used in § 238.705, then additional validation testing must be performed to validate the model being used to demonstrate performance under paragraph (a)(2).

Proposed paragraph (a)(1)(i) describes the first condition to be used in the collision simulation to demonstrate anti-climbing performance. This paragraph provides that all vehicles in both the initially-moving and the initially-standing train consists must be positioned at their nominal running heights with the centerlines of the initially-moving and initially-standing trains aligned. Because the centerlines of the colliding vehicles would be aligned with one another, a longitudinally half-symmetric model may be used to simulate this collision scenario, as appropriate. FRA intends for this initial condition to represent an ideal collision situation where the colliding vehicles are initially aligned with one another.

Proposed paragraph (a)(1)(ii) describes the second condition to be used in the collision simulation as a 3-inch lateral and 3-inch vertical offset of the interface of the colliding equipment. The lateral and vertical offsets must be applied simultaneously in the same simulation. Evaluating the equipment offset in this manner will demonstrate that the anti-climb features are of a robust design, capable of preventing climbing when the colliding vehicles are not perfectly aligned. Because this simulation requires a lateral offset between the initially-standing and initially-moving consists, a symmetric boundary condition may not be employed (*i.e.*, the full width of each consist must be modeled).

Proposed paragraph (a)(2) explains the pass/fail criteria that must be successfully met to demonstrate a trainset possesses adequate anti-climb features for its colliding interface. The criteria must be met for each set of initial conditions in paragraphs (a)(1)(i) and (ii) for demonstrating appropriate resistance to override between colliding equipment. Paragraph (a)(2)(i) would provide that the relative difference in elevation of the underframes between the colliding equipment in the initially-moving and initially-standing train consists may not change by more than 4 inches at any point during the

simulation. Because the initially-standing consist is permitted only longitudinal motion under § 238.705(a)(9), no vehicle in the initially-standing consist will experience any vertical motion. Thus, the change in elevation of the initially-moving trainset's underframe would be measured relative to the underframe of the initially-standing consist. To evaluate this scenario properly, the collision simulation must be run until all vehicles in the initially-moving and the initially-standing consists are moving in the same direction at approximately the same velocity.

Proposed paragraph (a)(2)(ii) contains the second pass/fail criterion to be met to demonstrate resistance to override between colliding equipment. No tread of any wheel of the first vehicle of the initially-moving consist may rise above the top of the rail by more than 4 inches. This condition must be evaluated throughout the duration of the collision simulation, not only at the end of the collision. To evaluate this scenario properly, the collision simulation must be executed until all vehicles in the initially-moving and the initially-standing train consists are moving in the same direction at approximately the same velocity.

Proposed paragraph (b) contains the evaluation methodology for demonstrating the appropriate level of override protection for connected equipment in a Tier III trainset. This paragraph would examine the vertical displacement behavior of coupled equipment under an ideal impact scenario where the vehicles within the initially-moving train are aligned. It also would prescribe an impact scenario where the first coupled interface of the initially-moving train is translated both laterally and vertically by 2 inches. Evaluating the connected equipment's ability to resist override in an offset impact condition is necessary to demonstrate the override features are robust and can resist override during an impact where the coupled vehicles are not perfectly aligned.

Proposed paragraph (b)(1) explains the conditions for analyzing the ability of connected equipment to resist vertical climbing or override at the coupled interfaces during a dynamic collision scenario, using the scenario described in § 238.705(a). Like paragraph (a) of this section, each set of conditions in paragraphs (b)(1)(i) and (ii) must be evaluated independently. Criteria for evaluating the dynamic collision scenario for each set of conditions are in paragraph (b)(2). As noted in the discussion of paragraph (a), because the same model may be used to

demonstrate compliance with the requirements of § 238.705 and the requirements of this section, the model must be validated with test data in a way that provides confidence in the validity of the results of the collision analyses. The discussion of model validation in paragraph (a) applies equally to model validation for purposes of paragraph (b).

Proposed paragraph (b)(1)(i) describes the first condition to be used for collision simulation to demonstrate override protection for connected equipment. This paragraph provides that all vehicles in both the initially-moving and the initially-standing train consists must be positioned at their nominal running heights, with the centerlines of the initially-moving and initially-standing trains aligned. Because the centerlines of the colliding vehicles would be aligned with one another, a longitudinally half-symmetric model may be used to simulate this collision scenario, as appropriate. This initial condition is meant to represent an ideal collision situation where the colliding vehicles are initially aligned with one another.

Proposed paragraph (b)(1)(ii) would explain that the second condition to be used in the collision simulation is a 2-inch lateral and 2-inch vertical offset of the first connected interface between vehicles in the initially-moving train. The lateral and vertical offsets must be applied simultaneously in the same simulation. Evaluating the equipment offset in this manner would demonstrate that the anti-climb features are of a robust design that would prevent climbing when the vehicles in the initially-moving trainset are not perfectly aligned. Because this simulation requires a lateral offset between the vehicles of the initially-moving consist, a symmetric boundary condition may not be used (*i.e.*, the full width of each consist must be modeled).

Proposed paragraph (b)(2) sets out the pass/fail criteria that must be successfully met to demonstrate a Tier III trainset possesses adequate anti-climb features to protect the vehicles connected in the trainset from overriding each other. The criteria must be met for each set of initial conditions provided in paragraphs (b)(1)(i) and (ii) to demonstrate appropriate resistance to override between connected equipment. Proposed paragraph (b)(2)(i) would provide that the relative difference in elevation of the underframes between the connected equipment in the initially-moving train may not change by more than 4 inches at any point during the simulation. To evaluate this scenario properly, the simulation must

be run until all vehicles in the initially-moving and the initially-standing consists are moving in the same direction at approximately the same velocity.

The 4-inch vertical difference in paragraph (b)(2)(i) is a pass/fail criterion and must be measured relative to the initial heights of the connected equipment. A change in underframe height in excess of 4 inches would indicate one of the two connected vehicles has begun to climb and override the other.

Proposed paragraph (b)(2)(ii) contains the second pass/fail criterion to be met to demonstrate resistance to override between connected equipment. No tread of any wheel of the initially-moving train may rise above the top of the rail by more than 4 inches. This condition may not be exceeded at any point during the simulation. To evaluate this scenario properly, the simulation must be executed until all vehicles in the initially-moving and the initially-standing consists are moving in the same direction at approximately the same velocity.

#### Section 238.709 Fluid Entry Inhibition

This section proposes requirements for fluid entry inhibition for the skin covering the forward-facing end of a Tier III trainset. The proposed requirements are largely the same as those in § 238.209(a) for Tier I locomotives, including MU locomotives and cab cars. Section 238.209(a) requires that the front end of a Tier I locomotive be covered by a skin equivalent to a half-inch-thick, 25-kilopound-per-square-inch (ksi) steel plate to prevent the entry of fluids into the locomotive cab in the event of a collision. While that specific requirement is easily applied to conventional designs, many of which may still make use of steel sheets for the outer skin, it is more difficult to apply to the complex, aerodynamic shapes of modern passenger trainset front ends, which often are comprised of various structures, including crash energy management elements. Because the consideration of aerodynamics and crash energy management is significant, this section proposes to account for the use of more modern designs and materials to construct a passenger trainset front end so it can be evaluated effectively.

FRA notes that, while this section focuses on the prevention of fluid entry, it also establishes a minimum level of penetration resistance that may be applied more generally. Because this section is based on § 238.209(a), which identifies two important carbody

characteristics for the protection of cab occupants in conventional equipment designs, material thickness and strength, this section offers protection for more hazards than the entry of fluid alone.

Specifically, proposed paragraph (a)(1) provides that the skin covering the front-end structure of a Tier III trainset must maintain a resistance to penetration into the cab equivalent to that of the half-inch-thick sheet of 25-ksi steel plate, as required by § 238.209(a)(1)(i) for Tier I locomotives. This may be achieved using an outer skin of an equivalent strength; a combination of materials between the engineer and the outside environment; or a composite material of a lesser thickness, if an equivalent level of penetration resistance is maintained. To demonstrate compliance, the sum of the thicknesses and material strength of all elements (*e.g.*, skin and structural elements) may be considered, when measured from the structural leading edge of the trainset up to, and including, the interior structural wall of the cab at its weakest location, when projected onto a vertical plane, just forward of the engineer's normal operating position.

By permitting additional methods to achieve equivalent penetration resistance, FRA recognizes that even though most modern designs may make use of lighter weight materials for aerodynamic skins (*e.g.*, aluminum, fiberglass), it does not imply that the protection provided is any less substantial. In fact, the combination of skin, structure, and crash energy management features in front of the engineer may actually provide more protection than the half-inch-thick, 25-ksi steel plate. It is important to note, however, that FRA intends for the performance requirement in this paragraph to be evaluated laterally across the entire width of the cab, including all carbody structures just forward of the engineer's normal operating position. This would demonstrate protection equivalent to that provided by the referenced steel plate exists across the entire width of the cab when projected in front of the engineer. Non-structural elements or features, such as the operating console and insulation materials, would not be taken into account in demonstrating compliance.

Proposed paragraph (a)(2) is derived from the existing requirement for fluid entry inhibition for Tier I locomotives in § 238.209(a)(1)(ii). It would also be applied so it is consistent with the design of modern passenger trainset front end structures. This recognizes that various techniques may be employed to provide fluid entry

inhibition characteristics, particularly through the use of flexible and impermeable materials.

Proposed paragraph (a)(3) would complement the requirements of paragraph (a)(1) by prescribing that the required front-end protective skin (or its equivalent) be affixed to the main structural members (*e.g.*, collision and corner posts) to ensure the integrity of the overall front-end structure. In this regard, FRA makes clear that the requirement for front-end protective skin (or its equivalent) is independent of the requirements proposed for the other structural features at the front end of the trainset—and indeed provides an additional layer of protection. Proposed paragraph (a)(3) is also derived from the existing requirement for Tier I locomotives in § 238.209(a)(1)(iii).

Since this section expressly provides flexibility to demonstrate compliance, it inherently allows various means of compliance that could be considered acceptable. Consequently, proposed paragraph (b) would require that, at a minimum, detailed structural drawings be submitted for FRA review, with pertinent calculations to demonstrate compliance with the requirements of paragraph (a) of this section. FRA believes it is necessary to provide such detail on how the requirements of paragraph (a) are to be met given the expected use of front-end protection in Tier III trainsets equivalent to the steel plate specified in paragraph (a), and in Tier I trainsets designed to alternative crashworthiness standards, as provided in proposed appendix G.

FRA is not aware of any international standard regarding fluid entry inhibition. These proposed requirements are necessary to protect the occupied volume because of the front end structure of Tier I and Tier III equipment as this location is vulnerable in a highway grade crossing collision if a fuel tank that is part of or being transported by the highway vehicle ruptures. See 64 FR 25540. However, equipment designed to international standards may be able to meet this requirement as designed, without modification, due to the large structure that is usually present on the leading ends of the equipment. FRA invites comment on this proposed section and specifically on whether application of the proposed requirements is clear.

#### Section 238.711 End Structure Integrity of Cab End

In this section, FRA proposes requirements to ensure the structure of cab ends for Tier III trainsets (and Tier I trainsets designed to alternative crashworthiness standards, under

proposed appendix G) provides a minimum level of protection for the engineer and other cab occupants, equivalent to the collision post and corner post requirements for Tier I equipment in subpart C of this part. Accident history shows the occupied volume can be penetrated by large, blunt objects that contact the end structure, particularly in grade crossing collisions, threatening the safety of the crew and other occupants. For such collision scenarios, the end structure can be designed to act as an integrated structure, absorbing energy as it deforms to provide increased occupied volume protection.

Specifically, FRA is proposing to cross-reference the requirements of appendix F to this part, Alternative Dynamic Performance Requirements for Front End Structures of Cab Cars and MU Locomotives. FRA added appendix F to this part in the final rule on Passenger Equipment Safety Standards; Front End Strength of Cab Cars and Multiple-Unit Locomotives. See 75 FR 1180, Jan. 8, 2010. In particular, these dynamic performance requirements facilitate testing of end frame designs without readily identifiable collision or corner post structures. They provide an option to demonstrate the dynamic performance of front end structures when impacting a rigid object, instead of the static load testing requirements prescribed in §§ 238.211 and 238.213 for collision posts and corner posts, respectively. These dynamic performance requirements do not prescribe the strength of the main structural members (*i.e.*, collision posts and corner posts), but rather prescribe energy absorption requirements for the end structure in grade crossing collision scenarios. Instead of focusing on whether an individual collision post or corner post structure is capable of resisting the applied loads, the focus is more appropriately placed on the ability of the end frame structure as an integrated whole to withstand collisions. The collision scenarios can be evaluated through the use of FEA, or testing, or both. The requirements are performance-based and each must be evaluated using a prescribed collision scenario of a rigid object impacting the end structure.

#### Section 238.713 End Structure Integrity of Non-Cab End

In this section, FRA proposes requirements to ensure the structure of the non-cab ends of Tier III trainsets (and Tier I trainsets designed to alternative crashworthiness standards under proposed appendix G to this part) provides a minimum level of protection

for occupants equivalent to that required for Tier I equipment in subpart C of this part. These proposed requirements help ensure the integrity of the components that make up any non-cab end of a passenger trainset unit. The proposed requirements are substantially similar to the Tier I collision and corner post requirements in §§ 238.211 and 238.213, respectively. The proposal would also specifically permit trainsets with particular safety features, such as pushback couplers, the flexibility to demonstrate required safety performance instead of separate collision post structures.

Proposed paragraph (a) explains that the requirements of paragraphs (b) and (c) of this section apply to a Tier III trainset other than at cab ends.

Proposed paragraph (b) contains the requirements for collision post structures at any non-cab end of a trainset unit. The proposed requirements are the same as the requirements for collision post structures in § 238.211(a)(1), which generally apply to the ends of Tier I passenger equipment other than at the cab end of a locomotive. While the heading of this proposed paragraph is "Collision post requirements," FRA intends for these proposed requirements to apply to the structures otherwise located at approximately the one-third points laterally at any non-cab end of the trainset unit, whether or not the structures are identified as collision posts.

Proposed paragraph (b)(1) explains that at least one set of specified requirements must be met. Paragraph (b)(1)(i) is the first set of requirements addressing collision post structural protection. This paragraph provides that there would be two full-height collision posts, located at approximately the one-third points laterally across the width of the end of the trainset unit. Each collision post would be required to have an ultimate longitudinal shear strength of at least 300,000 pounds, with the load applied at the top of the underframe member to which it is attached. This paragraph further states that if reinforcement is used to provide the required shear strength, the reinforcement shall have full value, meaning a width equal to the width of the collision post, for a distance of 18 inches up from the underframe connection and then taper to a location approximately 30 inches above the underframe connection.

Proposed paragraph (b)(1)(ii) provides an alternative to meeting the requirements of paragraph (b)(1)(i). This paragraph states that an equivalent end structure may be used instead of the

specific collision post structures described in paragraph (b)(1)(i). The equivalent end structure would be required to withstand the sum of the forces that would otherwise be applied to each individual post.

Proposed paragraph (b)(2) provides conditions under which collision posts are not required in the non-cab end structure of a Tier III trainset unit. This paragraph explains an exception to the requirements of paragraph (b)(1) for the non-cab end of any unit with push-back couplers and interlocking anti-climbing mechanisms, and for the non-cab ends of a semi-permanently coupled consist. To apply this exception, a non-cab end of a trainset unit must demonstrate that its inter-car connection can prevent disengagement and telescoping to the same extent as equipment satisfying the anti-climbing and collision post requirements of subpart C of this part. The exception in proposed paragraph (b)(2) to the specific collision post requirements for trainset units with certain design features is similar to an exception to the collision post requirements in the existing Tier I requirements in § 238.211(d). Proposed paragraph (b)(2) further specifies that the criteria in proposed § 238.707(b) must be applied to evaluate whether a Tier III trainset unit's inter-car connection can prevent such disengagement and telescoping. Section 238.707 contains the proposed requirements for demonstrating override resistance for connected equipment during a dynamic collision simulation. FRA intends for application of § 238.707(b) to provide clarity and guidance on the type of analysis FRA expects would be used to demonstrate a particular trainset unit fulfills the conditions of the exception when there are no collision posts at the non-cab end.

Proposed paragraph (c) contains the requirements for corner post structures on the non-cab end of a Tier III passenger car. Notably, unlike requirements for collision posts at non-cab ends, requirements for corner posts would not apply to non-cab ends of all units in a Tier III passenger trainset—only Tier III passenger trainset units that are passenger cars. Collision post requirements are necessary for each end of any trainset unit, even if only occupied by crewmembers at one end, to help prevent the uncontrolled crushing or climbing of trainset units that could tend to misalign the trainset or cause telescoping that could endanger the crew and passengers. Corner posts do not protect against the misalignment of trainset units in the same way, and would not be required by

this rule if the end of the trainset unit is not designed to be occupied by crewmembers or passengers. Specifically, for a passenger car that has a cab equipped with one or more control stands or consoles designed for an engineer to operate the trainset, the requirements of § 238.711 would apply to the cab end. Otherwise, the requirements of this paragraph would apply to the non-cab end of a passenger car, including any end of a passenger car without a cab.

Although the proposed heading of this paragraph is "Corner post requirements," FRA makes clear these proposed requirements apply to the corner structures at the non-cab ends of passenger cars, whether or not the structures are identified as corner posts. The majority of the corner structure requirements provided in this section are analogous to the Tier I corner post requirements in § 238.213.

The proposed requirements in paragraph (c)(1) apply to each non-cab end of a passenger car and would require that there be two side structures, placed forward of the occupied volume, capable of resisting the forces specified in paragraphs (c)(1)(i) through (iii). These structures do not necessarily need to be located on the absolute corners of the carbody if they are located in a manner that protects the occupied volume. FRA is not aware of any international standards or requirements for corner posts that are equivalent to the proposed requirements. The proposed requirements are intended to address accident conditions like those of the commuter train derailment and collision in Bridgeport, CT, on May 17, 2013. In that accident, a commuter train derailed toward an adjacent track such that the non-cab end of a passenger car protruded into the right-of-way of an oncoming train. There was structural damage to the protruding corner, but the corner post resisted loss of the occupied volume to avoid fatal injuries.

Proposed paragraph (c)(1)(i) provides the first load case and pass/fail requirement to be applied to the corner structures at non-cab ends. This paragraph states that each corner structure must resist a 150,000-pound horizontal force at the height of the floor without failure. Proposed paragraph (c)(1)(ii) provides the second load case and pass/fail requirement. This paragraph states that each corner structure must resist a 20,000-pound horizontal force at the height of the roof without failure. Proposed paragraph (c)(1)(iii) provides the third load case and pass/fail requirement. This paragraph states that each corner structure must resist a 30,000-pound

horizontal force applied at a point 18 inches above the top of the floor without permanent deformation.

Proposed paragraph (c)(2) states that the orientation of the applied horizontal forces shall range from longitudinal inward to transverse inward, consistent with the Tier I requirements in § 238.213.

Proposed paragraphs (c)(3) and (4) do not have explicit counterparts in the Tier I requirements in § 238.213. FRA intends for each paragraph to address the way to apply the evaluation loads to the structure at non-cab ends. Paragraph (c)(3) states that for each evaluation load, the load shall be applied to an area of the structure sufficient enough to prevent local crippling or punching through the material at the point of load application. Paragraph (c)(4) states that the load area shall be chosen to be appropriate for the particular car design and shall not exceed 10 inches by 10 inches. These two paragraphs, addressing the areas of the corner structure over which the load must be applied, are intended to guide the planning of the tests and analyses undertaken to demonstrate compliance with the corner structure requirements. FRA recognizes that a highly localized load application can result in localized deformation and, as a consequence, result in an evaluation test or analysis that is not descriptive of the entire corner structure's behavior. At the same time, too large a load application area would not result in a proper evaluation of the corner structure at the discrete locations integral to demonstrating the strength of the structure. While FRA provides this guidance, the entities (*e.g.*, manufacturers, testing facilities, consultants) performing the evaluation would use their engineering judgment to determine the selection of the loading mechanism (*i.e.*, physical load application device in the case of a test, or boundary conditions in the case of a computer simulation) and load application area for evaluation purposes consistent with the proposed requirements.

In addition, FRA notes that because two of the three load cases described in paragraph (c)(1) permit permanent deformation to occur during the evaluation (provided the ultimate strength of the post is not reached), FRA envisions that FEA or another appropriate simulation tool would be used to perform the evaluation. FRA also expects any analysis model used to demonstrate compliance with this paragraph and the other structural requirements in this part, would be properly validated using test data to

demonstrate the model's ability to properly reflect the relevant behaviors.

#### Section 238.715 Roof and Side Structure Integrity

FRA is proposing that the roof and side structure integrity requirements for Tier III trainsets (and Tier I trainsets designed to alternative crashworthiness standards under proposed appendix G to this part) equal those requirements in § 238.215, "Rollover strength," and § 238.217, "Side structure."

Section 238.215 currently requires a carbody to be designed so that the weight of the car can be supported by either the roof of the car, or by specified sidewall structural members, without resulting in stresses exceeding one-half of the stress necessary to cause either yielding or buckling. FRA expects that compliance with this requirement would be demonstrated through FEA modeling of the structural carbody. Moreover, FRA expects that the FEA model would have been subjected to a program of model validation to demonstrate the model's ability to accurately represent the structure. Further discussion of § 238.215 is in the original Passenger Equipment Safety Standards final rule. See 64 FR 25607, 25608.

Section 238.217 currently includes design requirements for the sidewall stiffness of Tier I passenger equipment. This section codifies longstanding design practice in the U.S. Compliance with this section may be demonstrated through hand calculations. FRA does not expect compliance to require physical testing or computer simulation, although these methods of evaluation may be used. Further discussion of § 238.217 is in the original Passenger Equipment Safety Standards final rule. 64 FR 25608, 25609.

#### Section 238.717 Truck-to-Carbody Attachment

In this section, FRA proposes requirements to demonstrate the integrity of truck-to-carbody attachments on a Tier III trainset (or a Tier I trainset designed to alternative crashworthiness standards under proposed appendix G to this part) during a dynamic impact. The requirements in either paragraph (a) or (b) may be applied; a given design must demonstrate it complies with only one set of requirements. FRA provided the two sets of requirements to permit different types of analyses to be used to demonstrate the trainset units possess adequate truck attachment strength. If a trainset features more than one type of truck or more than one type of truck-to-carbody attachment, satisfactory truck-

to-carbody attachment strength must be demonstrated for each design.

Paragraph (a) proposes demonstrating truck-to-carbody attachment integrity by showing compliance with the requirements in § 238.219. Discussion of § 238.219 is in the original Passenger Equipment Safety Standards final rule, 64 FR 25609, 25610, May 12, 1999, and in amendments to the final rule, 67 FR 19977, 19978, Apr. 23, 2002.

Proposed paragraph (b) contains the second option for demonstrating truck-to-carbody attachment integrity. In this paragraph, the truck-to-carbody attachment evaluation loads would be applied at the CG of the truck and each load case would be evaluated separately. Additionally, the loads would be applied quasi-statically for each load case. For each of the quasi-static load cases, the applied load may not cause any permanent deformation in the truck attachments or carbody.

Proposed paragraph (b)(1) describes the first of three quasi-static loads that must be evaluated. The load is stated as a 3g vertical load acting downward on the mass of the truck (*i.e.*, pulling the truck toward the ground). Because a 3g vertical load acting upward on the mass of the truck would force the truck into contact with the underside of the carbody, only the 3g downward vertical load case must be evaluated to demonstrate sufficient attachment strength between the truck and carbody.

Proposed paragraph (b)(2) describes the second of the three quasi-static loads to be evaluated. The load is stated as a 1g lateral load acting on the mass of the truck. Because the lateral load must be evaluated at the CG of the truck, this load would generate a moment (or torque) in the truck-to-carbody attachments. Additionally, the vertical reaction that develops as a result of the lateral load must also be considered and evaluated simultaneously with the lateral load itself. FRA expects that if the truck-to-carbody attachments are not symmetric from side to side, the lateral load case would be evaluated for a lateral load acting independently in both the positive lateral and negative lateral (*e.g.*, inward and outward) directions.

Proposed paragraph (b)(3) describes the final three quasi-static loads to be evaluated. The load is stated as a 5g longitudinal load acting on the mass of the truck. Because the longitudinal load must be evaluated at the CG of the truck, this load would also generate a moment (or torque) in the truck-to-carbody attachments. The vertical reaction that develops as a result of the longitudinal load must also be considered and

evaluated simultaneously with the longitudinal load.

Demonstrating the truck can remain attached under a 5g quasi-static longitudinal load is contingent on complying with the proposed requirements in paragraphs (b)(3)(i) and (ii), derived from the dynamic collision scenario results described in § 238.705(a) in which a moving train impacts a standing train under specified conditions. During the collision scenario § 238.705(a) describes, the average longitudinal deceleration at the CG of the vehicle containing the truck under evaluation (and its attachments) may not exceed 5g (paragraph (b)(3)(i)), and the peak longitudinal deceleration of the truck may not exceed 10g (paragraph (b)(3)(ii)). The longitudinal deceleration of the truck must be measured during the collision scenario at the CG of the truck.

Because the initially-moving and initially-standing train consists are aligned with one another in the collision scenario described in proposed § 238.705(a), a half-symmetric model may be used, as appropriate, to demonstrate compliance with proposed paragraph (b)(3) of this section. To use a half-symmetric model properly to demonstrate truck attachment integrity, the truck and its attachments must also be symmetric from side to side (*e.g.*, using the same attachment mechanism(s) in the same position(s) relative to a vertical-longitudinal plane at the center of the vehicle).

Proposed paragraph (c) provides an alternative to demonstrating compliance with paragraph (b)(3). Paragraph (c) would require demonstrating the truck remains attached after a dynamic impact under the nominal conditions in the dynamic collision scenario described in § 238.705(a). Because the requirements of paragraph (b)(3) may only be applied to a truck and carbody meeting the deceleration requirements in paragraphs (b)(3)(i) and (ii), respectively, paragraph (c) may be used to demonstrate truck-to-carbody attachment when the requirements in paragraph (b)(3) are exceeded.

Proposed paragraph (d) states that for the purposes of this section, the mass of the truck includes the axles, wheels, bearings, truck-mounted brake system, suspension system components, and any other component attached to the truck by design. This description of what the mass of the truck includes is the same as that in § 238.219. FRA expects the mass of the truck, including the components attached, would be documented.

Finally, proposed paragraph (e) emphasizes that truck-to-carbody

attachment integrity must be demonstrated using a validated model. If the model employed has not been validated by means like those required to comply with § 238.705, then additional testing must be performed to validate the model being used to demonstrate performance with this requirement.

#### Glazing

##### Section 238.721 Glazing

This section would define the requirements for exterior glazing (*i.e.*, side- and end-facing exterior windows and windshields) to be installed on Tier III trainsets. The requirements of this section outline performance standards for both the cab and non-cab areas of the trainsets. The performance metrics for the non-cab areas adopt the requirements of part 223 of this chapter to maintain compatibility with existing Tier I trainsets. FRA developed the requirements for the cab areas from the recommendations the Tier III Cab Glazing Task Group provided.

The approach FRA used to develop glazing requirements for cab areas, much like its approach to Tier III in general, represents a balance between maintaining compatibility with existing Tier I equipment and the adoption of service-proven techniques to protect against potential risks encountered with high-speed operation. In this respect, it is important to note that, while glazing exposed to the direction of train motion would be more vulnerable due to the speed of the trainset, the right-of-way must also be secured and protected appropriately against potential hazards to the glazing in areas where Tier III trainsets will operate above Tier I speeds. Such hazards include the launching of objects at the train. For example, substantial fencing in conjunction with intrusion detection systems are common protections provided for high-speed systems where an overpass spans the right-of-way (ROW). These additional infrastructure improvements represent a significant increase in ROW protection, which are not typically present on most U.S. rail corridors, but would be expected for Tier III high-speed corridors. Indeed, under FRA's Track Safety Standards, a "right-of-way plan" for Class 8 and 9 track, which corresponds to the speed range for Tier III high-speed corridors, must be submitted to FRA for approval and address the prevention of vandalism, launching of objects from overhead bridges or structures into the path of trains, and intrusion of vehicles from adjacent ROWs. See 49 CFR 213.361.

Risks posed to exterior glazing may differ greatly depending on the location and orientation of the installed glazing. For this reason, cab glazing is further segregated into two distinct categories: One for end-facing locations (*e.g.*, windshields), and one for cab side windows and glazing (if equipped). Since the two locations may present different risks, the definition of "end-facing" is important to establish how cab glazing compliance is evaluated. This subject was discussed on a number of occasions during the task group meetings as both the part 223 definitions and international standards were considered. However, the task group concluded the language in part 223 was generally sufficient, although FRA proposes revisions to this section and the definitions for "glazing, end-facing" and "glazing, side-facing" in § 238.5. FRA agrees with the task group and intends for the proposed revisions to the glazing definitions to clarify that the end-facing glazing requirements do not apply to certain locations in a semi-permanently connected train consist that, while on the end of a vehicle, are exposed to lesser risk.

Proposed paragraph (b) describes the requirements for end-facing cab glazing and represents the most substantial change from the traditional FRA Type I performance requirements in part 223. End-facing cab glazing on Tier III trainsets would be designated as Type IHS. Since the challenge to glazing in this location is directly related to the speed of the trainset, considerable discussion was devoted to this topic within the task group. Although different approaches were discussed, the efforts of the group eventually focused on finding a reliable and repeatable large object impact test procedure, and appropriate performance metrics, to replace the traditional "cinder block test."

Since the windshield of any vehicle must meet several performance criteria to provide adequate protection, durability, and visual clarity, quality assurance and control are imperative. In this respect, the task group widely accepted that the current Type I large object impact test presents too many variables and challenges to reliably and accurately assess the performance of glazing used at very high-speeds. To resolve this issue, the group considered existing international standards and test procedures. In particular, the group focused on the development of criteria, test conditions, procedures, and projectile design based on relevant portions of EN 15152 and UIC 651.

After considerable discussion, the task group reached consensus to adopt

modified criteria based on the relevant elements of EN 15152 and UIC 651 for the Tier III end-facing large object impact test. This is outlined in proposed paragraph (b)(2), which would establish the projectile design, test conditions (e.g., speed, impact angle, sample size, temperature, etc.), the number of representative samples to be tested, and qualification criteria. Additional considerations for the use of representative sample sizes, instead of actual dimensions, are proposed in paragraph (b)(3), and proposed paragraph (b)(4) addresses demonstration of resistance to spalling. Specifically, under the conditions proposed, each sample must show no penetration, no marks on the witness plate, and no failure of the mounting apparatus, which would be representative of the method by which the glazing would be installed. Further, under proposed paragraph (b)(4), materials used specifically to protect the cab occupants from spall (*i.e.*, spall shields) would not be required to meet the flammability and smoke emission performance requirements of appendix B to this part. The task group raised concerns about the availability of spall shields that meet the performance requirements of appendix B to this part, while balancing the protection from spalling to cab occupants that spall shields offer. FRA makes clear, however, that spall shields, like other materials in a cab, would continue to be subject to other requirements for fire safety, *i.e.*, the requirements of § 238.103(c) through (e), which include fire safety analysis requirements.

In addition, proposed paragraph (b) also identifies supplemental considerations for the effects of temperature and curvature, each adopted from EN 15152. These considerations are not expressly detailed in part 223, yet they were widely accepted as necessary to ascertain reliable and accurate glazing performance evaluations. The effects of curvature could not be ignored because most high-speed trainsets now incorporate sophisticated front-end glazing designs to balance visibility with aerodynamics. FRA notes that, although the task group considered a small object impact test, it decided such a requirement was not necessary at this time. The task group considered its value for high-speed trainsets related more to the durability and maintenance of the glazing, whereas the large object impact and ballistic test requirements would provide the more critical performance metrics related to safety.

FRA agrees with the approach taken by the task group.

FRA notes that the cab side glazing, addressed in proposed paragraph (c), presents a different set of challenges and its role in protecting cab occupants is highly dependent on window size and location, which can vary greatly between trainset designs. While initial task group discussions considered adopting traditional Type I requirements for the side glazing, it determined it was not necessary and potentially impractical. Imposing the same requirements established for end-facing glazing would require a substantial increase in size and weight (and the inherent framing and mounting considerations) and may limit the level of available protection by potentially restricting the use of innovative, lightweight transparent materials, which may be well suited for this side-facing location.

Since side-facing cab glazing is not directly exposed to hazards in the direction of travel, the speed-dependent requirements of the proposed Type IHS test requirements may be inappropriate. The glazing task group agreed that the two most important performance metrics for safety in this location are ballistic resistance and mounting strength. Therefore, the group recommended maintaining the same level of ballistic protection as currently provided in part 223 for end-facing glazing as the primary performance metric for side-facing cab glazing. The task group also agreed to continue the current side-facing large object impact test in part 223 to ensure the glazing mounting arrangement would be structurally sufficient. FRA agrees with this approach.

Ballistic protection for cab glazing was discussed in detail during task group meetings. In particular, labor representatives asserted that ballistic protection from a larger diameter projectile, differing from the size required for Type I glazing by part 223, would enhance the overall safety of the cab occupants. Much discussion was focused on this point, but a review of the available information on the impact characteristics of reasonable ballistic scenarios (projectile size and terminal velocity), and a review of the statistics related to glazing failure due to ballistic impact, proved inconclusive. This is one area where the task group could not agree on a consistent approach. Therefore, the task group referred the decision on ballistic requirements for cab glazing to FRA during the development of the task group's final recommendations.

FRA does not have sufficient evidence to suggest a particular risk or hazard exists that would apply to all potential Tier III systems to warrant a change from current ballistic requirements in part 223. However, this does not imply that the conditions of a particular operation may not warrant additional consideration and protection. To be consistent with the aforementioned approach to Tier III safety, elements which may be subject to variables present within a specific operation must be addressed in a manner appropriate to that operation. Since the level of service, operating environment, and operational conditions may vary greatly between Tier III railroads, a single prescriptive requirement that varies from current requirements cannot be justified.

Proposed paragraph (b)(5) describes the approach taken for Tier III ballistic protection. Specifically, Tier III operations must identify risks and hazards specific to their property as part of their Tier III Safe Operation Plan, and provide ballistic penetration resistance sufficient to protect cab occupants from these risks and hazards. This protection shall, at a minimum, meet the requirements of part 223, appendix A.

Proposed paragraph (b)(6) describes options for testing of glazing for Tier III trainsets. Compliance with the requirements may be demonstrated by independent third-party testing or by the glazing manufacturer itself. If the glazing manufacturer is chosen to certify the glazing, the manufacturer must invite FRA to witness the test(s) and provide 30 days' notice to FRA before conducting the test(s).

Paragraph (b)(7) proposes re-certification requirements that would apply when changes to the glazing manufacturing process or mounting arrangement occur which may influence the mechanical properties of the glazing system, and the ability of the glazing to comply with the penetration resistance requirements of this section. This proposed requirement is necessary to ensure that the integrity of the glazing is not compromised by changes occurring after the original certification.

Paragraph (b)(8) proposes that documentation describing any glazing certification or re-certification be made available to FRA upon request.

Proposed paragraph (b)(9) describes the marking requirements for Tier III end-facing cab glazing material. Markings must be clearly visible after the glazing is installed and contain the words "FRA TYPE IHS" (indicating that the glazing is compliant with the requirements in this paragraph (b)), the

name of the manufacturer, and the type of brand identification of the material.

As noted above, proposed paragraph (c) contains the requirements for side-facing exterior cab glazing. Such glazing must comply with the existing large-object impact requirements for Type II glazing described in appendix A to part 223 of this chapter. FRA also proposes that side-facing cab glazing must achieve the same ballistics penetration resistance required of end-facing glazing in paragraph (b)(5) above. For all other areas of the trainset, the non-cab side-facing glazing requirements of paragraph (d) apply. FRA invites comment on the manner and extent to which glazing subject to the requirements of paragraphs (c) or (d) should be specifically marked and identified for Tier III service similar to that proposed for end-facing cab-glazing in paragraph (b)(9). FRA may impose specific marking and identification requirements in the final rule.

The performance aspects of non-cab side-facing glazing were established by consensus agreement of the ETF before creation of the Tier III Cab Glazing Task Group. Overall, the requirements for non-cab glazing maintain the current requirements for Type II glazing in appendix A of part 223 as indicated in paragraph (d)(1). As mentioned earlier, FRA intends for this approach to maintain compatibility with current Tier I requirements to establish commonality for operation with all other equipment types at speeds not exceeding 125 mph, whereas additional systemic safety measures and ROW protections would be required for higher-speed operations.

In regards to emergency egress and rescue access, the ETF recognized that multiple approaches would need to be considered to support the adoption of service-proven technology. More specifically, the methods employed in the manufacturing of high-speed trainsets are often governed by considerations of aerodynamic effects and noise reduction. In some designs, this can have particular influence on the way side-facing glazing is installed and mounted on trainsets. Therefore, the ETF recommended a more performance-oriented requirement rather than a prescriptive one, which is reflected here and in the proposed requirements for emergency window egress and rescue access in proposed § 238.741 discussed below. Proposed paragraph (d)(2) would specifically recognize the design of windows intended to be breakable as an alternative for removing glazing. This would include using a tool or other method to expeditiously and safely remove the glazing if at least the same

level of glazing safety is maintained as the current requirements of part 223. This must be demonstrated by quantitative analysis, full scale demonstration, or other means and be addressed as part of the railroad's Tier III Safe Operation Plan. As noted, requirements for emergency window egress and rescue access would also need to be met, consistent with proposed § 238.741.

Proposed paragraph (e) contains requirements for glazing securement. Paragraph (e)(1) would require designing each exterior window glazing system (the window glazing and its mounting apparatus) to withstand the forces caused by variances in pressure when two trains pass at their maximum authorized speed at their closest distance to each other. This requirement is identical to that currently provided for Tier I and Tier II passenger equipment in §§ 238.221(b)(2) and 238.421(d)(1), respectively, and would help provide assurance that a trainset's exterior window glazing remains in place when passing other objects in close proximity. Proposed paragraph (e)(2) would also require that exterior window glazing be secured so as to withstand the impact forces described in this section. This proposed requirement is virtually identical to that currently provided for Tier I and Tier II passenger equipment in §§ 238.221(b)(1) and 238.421(d)(2), respectively. The requirements proposed in paragraph (e) are common for all exterior glazing installed on a Tier III trainset, and may be demonstrated through testing or analysis.

#### Brake System

##### Section 238.731 Brake System

In this section, FRA is proposing to introduce requirements for brake systems for Tier III passenger trainsets. Development of these requirements was identified as one of the goals for this first Tier III rulemaking to facilitate planned equipment acquisitions. These requirements represent a balance between maintaining compatibility with existing Tier I equipment and the adoption of service-proven techniques to protect against potential risks encountered with high-speed operations. A concerted effort was made to develop technology-neutral requirements.

To develop the proposal for these brake system requirements, the ETF created the BTG. The BTG's charter, established at the group's initial meeting, was to develop performance-based regulations which would accommodate existing high-speed

trainset technology without regard to its design. To achieve this goal, many of the provisions in this proposed section refer to provisions in the railroad's Tier III Safe Operation Plan or ITM plan. This is necessary to address the various ways brake system technology is actually implemented in high-speed passenger trainsets worldwide.

Proposed paragraph (a) describes the requirement for each railroad to identify (through analysis and testing) the maximum safe operating speed for its Tier III trainsets that results in no thermal damage to equipment or infrastructure during normal operations. This is based on the requirements for Tier I and Tier II passenger equipment in §§ 238.231(j)(4) and 238.431(e)(4), respectively, that a train not operate at a speed resulting in thermal damage to wheels or rotor surface temperatures exceeding the manufacturer's recommendation when the friction brake alone is applied to brake the train. Nonetheless, this proposed section acknowledges that, at present, high-speed trainset braking technology relies predominantly on electric (*i.e.*, dynamic or regenerative) braking and that friction braking, by whatever means, is used only at lower speeds. In addition, this proposed section presumes there are extensive on-board diagnostics capable of identifying dynamic brake defects (as specified in § 238.731(n)) present. Moreover, this proposed section extends the scope of existing regulations by considering the potential for a Tier III braking technology that relies on interaction or contact with the rail or guideway.

Proposed paragraph (b) would require the railroad's Tier III Safe Operation Plan to identify the worst-case adhesion conditions under which the brake system must stop the passenger trainset from its maximum operating speed within the prevailing signal spacing. This proposed requirement is derived from its Tier II equivalent at § 238.431(a), which states that a passenger train's brake system shall be capable of stopping the train from its maximum operating speed within the signal spacing existing on the track over which the train is operating under worst-case adhesion conditions. The distinction for Tier III is that the "worst case" conditions would be defined by a railroad in its Tier III Safe Operation Plan. This would help ensure that a railroad relies on a formally-devised definition of worst-case adhesion in its procurement of individual equipment. In recognizing that these elements may vary between operations and geographical locations, allowing a railroad to define these conditions

would provide it the flexibility to tailor its braking system to the actual operating environment.

Proposed paragraph (c) would require Tier III trainsets to be equipped with an emergency brake application feature that is available at any time and produces an irretrievable stop. This proposed paragraph is consistent with the requirements of § 232.103(i) of this chapter for brake systems generally and the requirements of § 238.231(c) and § 238.431(c) for Tier I and II passenger equipment brake systems, respectively. The emergency brake application would also be initiated by an unintentional parting of the train, or by the train crew at locations specified in the railroad's Tier III Safe Operation Plan. Because the locations where a trainset can be safely stopped are operation-specific, the railroad would identify them in its Tier III Safe Operation Plan.

Proposed paragraph (d) would establish requirements for a passenger brake alarm. The BTG invested considerable effort addressing this concept. Generally, the passenger brake alarm enables passengers to alert the engineer of a need to stop the train. However, stopping the train at a random location due to a passenger-initiated brake command can be a highly undesirable event and the BTG believed the engineer should determine the safest location where the train should stop under emergency conditions. Thus, the BTG recommended a set of conditions when the passenger brake alarm is acknowledged and acted upon, which FRA agrees it should adopt for Tier III passenger equipment. Generally, these provisions have been developed in consideration of operating practices associated with present-day high-speed operations in Asia and Europe and relevant requirements currently in part 238.

Proposed paragraph (d)(1) would specify that each trainset unit have two locations equipped with the means to initiate a passenger brake alarm unless a unit is 45 feet or less in length. In that case, one equipped location would be sufficient.

This proposal also derives from the requirements for Tier II passenger equipment in § 238.431(c). Passenger brake alarm locations would be identified in the railroad's Tier III Safe Operation Plan. This paragraph would also require that the words "Passenger Brake Alarm" be legibly stenciled or marked on each device or on an adjacent badge plate, as required for Tier I passenger equipment in § 238.305(c)(5) (as "Emergency Brake Valve") and indirectly required for Tier

II passenger equipment under subpart F of part 238.

Proposed paragraph (d)(2) would require the passenger brake alarm to be designed to minimize the opportunity for accidental activation. The brake alarm may be protected from accidental activation by a cover or screen provided the alarm remains readily accessible to passengers.

Proposed paragraph (d)(3) would require that activation of the passenger brake alarm result in an emergency brake application if the trainset has not cleared the boarding platform. This proposal recognizes in particular that the alarm may be activated due to an urgent safety issue associated with passengers or crewmembers boarding or alighting from the trainset while at the platform, and that the trainset would be traveling at a slower speed as it begins to accelerate away from the platform.

Proposed paragraph (d)(4) would specify the sequence of events when the passenger brake alarm is activated after the trainset has cleared the boarding platform. In this event, the engineer must acknowledge the alarm within a prescribed time period to retain control of the trainset. The railroad's Tier III Safe Operation Plan must specify the time period the engineer has to act, and the Plan must also describe the method used to confirm that the trainset has cleared the boarding platform.

Proposed paragraph (d)(5) would describe the brake system operation when the engineer does not acknowledge a passenger brake alarm with the specified time period. In this event, a full service brake application shall occur automatically unless the engineer intervenes by acknowledging the brake alarm and actively manipulating appropriate trainset controls, as described in proposed paragraph (d)(6), to give the engineer ultimate control over whether to stop the trainset.

Proposed paragraph (e) addresses degraded brake system performance of Tier III trainsets with blended braking systems and is based on requirements for Tier I and Tier II passenger equipment in §§ 238.231(j) and 238.431(e), respectively. A blended brake system consists of a combination of friction and dynamic braking. Proposed paragraph (e)(1) specifies that the allowable stopping distance defined in the railroad's Tier III Safe Operation Plan shall not be exceeded in the event of a power loss or failure of the dynamic or regenerative brake. The Tier III Safe Operation Plan must contain provisions for reducing the maximum allowable train speed, based on feedback from the on-board monitoring and diagnostic

system, specified in proposed § 238.731(n), so the train can be safely stopped using friction braking alone within the allowable stopping distance.

Proposed paragraph (e)(2) would require the railroad's Tier III Safe Operation Plan to define the operating conditions when the available friction braking effort alone can safely stop the Tier III trainset. As a whole, proposed paragraph (e) would require that restrictions be in place (as defined in the Tier III Safe Operation Plan) that prescribe how trainsets without functional electric braking are to be operated to ensure thermal-related damage does not occur, particularly to brake equipment.

Proposed paragraph (e)(3) would require each Tier III trainset to be equipped with diagnostic hardware and software that provides a continuous indication of the brake system status to the engineer in the controlling cab. See also the proposed requirement in § 238.731(n) for an onboard monitoring and diagnostic system.

Proposed paragraph (e)(4) would require the railroad to determine, through analysis and testing, the maximum speed its Tier III trainsets can operate at using the friction brake system alone without causing thermal-related damage to the equipment or infrastructure. This provision is related to proposed paragraphs (e)(1) through (3) of this section because the parameters associated with continued trainset operation under conditions of degraded brake system performance must be developed for the particular trainset technology and operating characteristics, and accommodated in trainset operating procedures, including any software and hardware associated with trainset speed control.

Proposed paragraph (f) addresses main reservoirs for Tier III trainset brake systems and is generally based on safety requirements originally developed for steam locomotives, as found in § 230.72(b) of this chapter. Paragraph (f)(1) would require that main reservoirs be designed and tested using a recognized industry standard specified in the railroad's Tier III Safe Operation Plan, such as the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code for Unfired Pressure Vessel Section VIII, Division I (ASME Code), referenced in § 229.51(a)(2). The actual standard used to qualify main reservoirs for Tier III trainsets must be documented in the railroad's Tier III Safe Operation Plan. This paragraph would specify the working pressure and rated temperature for main reservoirs unless otherwise defined by the designated standard

identified in the railroad's Tier III Safe Operation Plan. Reservoirs would be certified consistent with requirements based on size and volume.

Proposed paragraphs (f)(2) and (3) of this section contain requirements for welded steel main reservoirs that are also based on requirements originally developed for steam locomotives in § 230.72(b) through (d) of this chapter. Proposed paragraph (f)(3) would prohibit welded repairs of Tier III trainset main reservoirs.

Proposed paragraph (g)(1) addresses requirements specifically for aluminum main reservoirs and refers to the existing requirements in § 229.51(a) of this chapter applicable to locomotives.

Proposed paragraph (g)(2) is a new provision and contains a prohibition on welded repairs to aluminum main reservoirs.

Proposed paragraph (h) prescribes requirements for steel and aluminum main reservoir proof tests, which would be performed prior to their installation on a Tier III trainset. These tests may be pneumatic or hydrostatic. The test pressure would be defined in paragraphs (f) or (g) of this section, depending on whether the reservoir is steel or aluminum, unless otherwise established by the railroad's ITM Plan. Records of main reservoir tests must be made and retained for the life of the equipment. In addition, the railroad's ITM Plan shall define periodic inspection requirements for main reservoirs on Tier III trainsets.

Proposed paragraph (i) addresses the requirements for the locations of gauges and devices used by the engineer to aid in the control or braking of a Tier III trainset. Such devices must be placed so that the engineer can conveniently read them from the engineer's normal position during trainset operation. This paragraph is based on the existing requirement in § 229.53 of this chapter.

Proposed paragraph (j) contains requirements for Tier III trainset brake application and release. Paragraph (j)(1) proposes that brake pad and shoe clearance must be present when the brakes are released. Paragraph (j)(2) would require establishing the minimum brake cylinder pressure necessary to adjust from minimum service to full service brake application for proper train operation. This pressure would be approved during the trainset design review and documented in the railroad's Tier III Safe Operation Plan.

Proposed paragraph (k) would require that the railroad specify the ITM requirements for the foundation brake gear in the railroad's ITM plan. The purpose for these requirements derives from § 229.57 of this chapter. However,

due to the variety of possible Tier III braking systems, the prescriptive requirements of § 229.57 may not be appropriate for a given foundation brake system. Defining the requirements in the railroad's ITM plan, which is subject to FRA review and approval, would ensure that appropriate ITM practices are in the foundation brake system on Tier III trainsets.

Proposed paragraph (l) would define limits on brake pipe leakage and also require that the method for inspecting brake pipe leakage be prescribed in the railroad's ITM plan. Leakage rates would be established under either paragraph (l)(1) or paragraph (l)(2) of this section, whichever is more restrictive. Specifically, paragraph (l)(1) would permit leakage limits based on an Air Consumption Analysis in the railroad's Tier III Safe Operation Plan. Paragraph (l)(2) would set prescriptive requirements for brake pipe leakage adopted from § 229.59(b) and (c) of this chapter.

Proposed paragraph (m) describes the requirements for wheel slide protection and alarm. Extensive discussion on this topic occurred during BTG deliberations. For safety reasons, wheel slide must be avoided to prevent overrunning a switch or incursion of the trainset into an area beyond the confines of its operating authority. Nonetheless, the BTG considered wheel slip to be a maintenance concern and did not recommend that FRA address it in this proposed rulemaking. Wheel slip differs from wheel slide because it is caused when the tractive effort on the wheel exceeds the adhesive forces keeping the wheel in normal rotational contact with the rail, whereas wheel slide is caused when the braking effort on the rail exceeds the adhesive forces keeping the wheel in normal rotational contact with the rail. FRA agrees with the task group and has modeled this paragraph after the wheel slide protection and alarm requirements for Tier II passenger equipment in § 238.431(h).

Proposed paragraphs (m)(1) through (3) of this section define the minimum functional requirements for wheel slide protection and alarm. Paragraph (m)(1) would require that an adhesion control system be available to adjust the braking force on each wheel to avoid wheel slide. Paragraph (m)(2) would require that this system be able to alert the engineer, either through visible or audible means, or both, of the presence of a wheel slide condition on any axle in the trainset. Proposed paragraph (m)(3) would address when the wheel slide protection system fails to function within pre-established, allowable parameters as defined in the railroad's

Tier III Safe Operation Plan. To prepare for such an event, the Tier III Safe Operation Plan shall specify operating restrictions (e.g., speed limits) on trainsets whose slide protection devices are not functioning as intended.

Proposed paragraph (n) would require each Tier III trainset to be equipped with a brake system health monitoring and diagnostic system to automatically assess the functionality of the brake system for the entire trainset, both before departure of the trainset and while it is en route. The railroad's Tier III Safe Operation Plan shall document the details of the monitoring and diagnostic system and the means for communicating trainset brake system functionality.

Proposed paragraph (o) would require Tier III equipment to be equipped with a way to secure equipment, when unattended, from unintentional movement. This means of securement must be independent of the pneumatic brake. Since the securement technique may be technology-specific to the trainset, FRA expects the Tier III Safe Operation Plan would identify the procedures and means necessary for securing unattended equipment and the grade conditions when such securement must occur. The Tier III Safe Operation Plan shall also provide evidence demonstrating the effectiveness of the securement method(s). As defined in § 238.231(h)(4), "unattended equipment" means equipment left standing and unmanned in such a manner that a qualified person cannot readily control the brake system of the equipment. FRA notes in particular that, because certain brake system requirements are imposed by Federal statute, 49 U.S.C. ch. 203, the railroad must also ensure those statutory requirements are addressed.

Proposed paragraph (p) would require the design of a Tier III trainset to accommodate coupling to a rescue vehicle (which could be a conventional locomotive) or a rescue trainset. The design must also allow the rescue vehicle or trainset to control the brake system on the disabled Tier III trainset. This proposed paragraph is based on a similar requirement for Tier II passenger equipment in § 238.431(f).

#### Interior Fittings and Surfaces

##### Section 238.733 Interior Fixture Attachment

This proposed section would address requirements for interior fixture attachment strength for Tier III trainsets, principally to help prevent and mitigate hazards associated with secondary collisions (*i.e.*, a collision occurring

inside the trainset as a consequence of a (primary) collision involving external contact with the trainset). It would provide two means of demonstrating compliance.

Proposed paragraph (a)(1) would provide the first means: Interior fixtures must comply with the existing requirements in 49 CFR 238.233, Interior fittings and surfaces, and APTA PR-CS-S-006-98, Rev. 1 (previously designated as SS-C&S-006), "Standard for Attachment Strength of Interior Fittings for Passenger Railroad Equipment," Authorized September 2005. FRA proposes to incorporate by reference this APTA standard into this paragraph and in paragraph (i) of appendix G to this part. APTA PR-CS-S-006-98 addresses fittings used in commuter and intercity railcar and locomotive cab interiors. It specifies the minimum strength and attachment strength for interior sub-systems, including overhead luggage racks, stanchions and handholds, windscreen and partitions, food service equipment, and miscellaneous interior fittings. This standard also contains recommendations for design requirements and design practices for such interior sub-systems. APTA PR-CS-S-006-98 is reasonably available to all interested parties online at [www.apta.com](http://www.apta.com). Additionally, FRA will maintain a copy available for review.

These proposed requirements are based on the applied accelerations of 8g longitudinally, 4g laterally, and 4g vertically, acting on the mass of the fitting (8g/4g/4g). As described in the Technical Background and Overview section of this NPRM, the 1999 Passenger Equipment Safety Standards final rule (64 FR 25540) established these acceleration-based performance requirements after years of industry practice designing interior fittings to withstand the forces due to accelerations of 6g longitudinally, 3g laterally, and 3g vertically (6g/3g/3g), which FRA found to be inadequate to protect against occupant injury. Subsequent accident investigations have revealed that interior fixtures that comply with these requirements, codified for Tier I passenger equipment in § 238.233, perform significantly better than interior fixtures in passenger cars that were exempted from those requirements and thus do not meet the regulations, *i.e.*, generally passenger cars already in service when the 1999 final rule took effect.

However, FRA recognizes some Tier III passenger equipment may not experience accelerations of 8g/4g/4g during the dynamic collision scenario proposed in § 238.705, or at higher-

speed collisions resulting in collapse of the occupied volume. Members of the rail industry contend the 8g/4g/4g requirements are unnecessary for some equipment designed to alternative standards and would add to vehicle weight. FRA acknowledges that equipment that does not experience large decelerations during collisions may not need to be designed to these FRA requirements, which are also reflected in industry safety standards. Accordingly, FRA developed an alternative attachment strength option consistent with international design standards.

Proposed paragraph (a)(2) describes the alternative option for demonstrating adequate attachment strength of interior fixtures in Tier III trainsets. The proposed option requires that interior fixture attachment strength comply with the requirements in Section 6.1.4, "Security of furniture, equipment and features," of GM/RT2100, which FRA proposes to incorporate by reference in this paragraph and § 238.741(b)(2), below. Section 6.1.4 contains requirements for securement of furniture, on-board equipment, and other trainset features to help mitigate against injuries to passengers and crew from secondary impacts within the occupied volume. GM/RT2100 is available to all interested parties online at [www.rgsonline.co.uk/Railway\\_Group\\_Standards](http://www.rgsonline.co.uk/Railway_Group_Standards). Additionally, FRA will maintain a copy available for review.

Certain restrictions govern the option to apply the GM/RT2100 standard. GM/RT2100 is a safety standard that applies to trains operating in the U.K. The standard mandates requirements for the design and integrity of rail vehicle structures, including interior fixtures. The standard requires rail vehicle body structures to comply with the requirements in EN 12663 and EN 15227. The interior fixture attachment strength requirements in GM/RT2100 are consistent with the carbody deceleration limits in EN 12663 and EN 15227.

The structural carbody requirements of particular relevance in EN 12663 specify minimum proof loads for equipment attachment during normal operation of the vehicle. The mass of the fixture is multiplied by specified accelerations. For passenger coach cars, the accelerations in the longitudinal, lateral, and vertical directions are  $\pm 5g$ ,  $\pm 1g$ , and  $+3/-1g$ , as stated in Section 6.5.2, Tables 13, 14, and 15 respectively.

The structural carbody requirements of particular relevance in EN 15227 are associated with a dynamic collision scenario (Section 5, Table 2), in which the mean longitudinal vehicle

decelerations in the survival spaces for power cars and coach cars are limited to 5g for a 36 kph (22.4 mph) collision with a like train (Section 6.4.1).

If the option to use GM/RT2100 is exercised to demonstrate adequate attachment strength of the interior fixtures in Tier III trainsets, then data must be provided to demonstrate that the average longitudinal deceleration of the CG of each vehicle during the dynamic collision scenario does not exceed 5g in any 100-ms time period. Suitable evidence would include a plot of the 100-ms running average deceleration versus time for the duration of the collision scenario. The average deceleration over a 100-ms time period is necessary to account for large decelerations higher than the mean deceleration for sustained periods (*i.e.*, any period lasting more than 100 ms), which could result in interior fitting attachment failure. Without suitable evidence, there is no assurance the less stringent 5g attachment strength requirement is adequate for the particular trainset under evaluation. If the adequacy of the attachment strength is not demonstrated, then the GM/RT2100 option cannot be used and the crashworthiness of interior fittings must comply with the current Tier I requirements in § 238.233 and APTA standard PR-CS-S-006-98.

In addition, if the option to comply with GM/RT2100 is exercised, then this proposed paragraph would require that interior crashworthiness be evaluated based on a minimum lateral acceleration of 3g—not the 1g permitted in GM/RT2100. FRA has never found the 1g lateral acceleration requirement adequate for the U.S. rail operating environment. Thus, the proposed rule would increase the minimum lateral acceleration requirement to 3g. Further, the use of the GM/RT2100 standard must be carried out consistent with any conditions identified in the railroad's FRA-approved Tier III Safe Operation Plan. The Tier III Safe Operation Plan must demonstrate that interior fixtures provide an equivalent level of safety during accidents at any speed as equipment that complies with the requirements in § 238.233 and APTA PR-CS-S-006-98. The Tier III Safe Operation Plan must address the collision consequences associated with interior fixtures designed to withstand acceleration forces of 5g longitudinally, 3g laterally, and 3g vertically (5g/3g/3g) as opposed to 8g/4g/4g. FRA is concerned that interior fixtures designed to withstand average decelerations of less than 5g may not have a sufficient factor of safety to remain attached during collisions

occurring at speeds above the collision design scenario speeds. Accordingly, some evidence must be provided to ensure that the interior fixtures do not detach during collisions at speeds above the collision design scenario speeds, or the likelihood of higher speed collisions has been significantly reduced to provide the same degree of risk for equipment whose interior fixture attachments have been designed to withstand 8g/4g/4g loading.

#### Section 238.735 Seat Crashworthiness (Passenger and Cab Crew)

Proposed paragraph (a) contains the requirements for passenger seating crashworthiness in Tier III trainsets. As in § 238.733 above, FRA proposes two ways to demonstrate adequate attachment strength.

Proposed paragraph (a)(1) provides the first means: Passenger seating must meet the requirements of § 238.233 and APTA PR-CS-S-016-99, Rev. 2 (previously designated as SS-C&S-016, Rev. 2), "Standard for Passenger Seats in Passenger Rail Cars," Authorized October 2010. FRA proposes to incorporate this APTA standard by reference into this paragraph and paragraph (j) of appendix G to this part. APTA PR-CS-S-016-99 addresses design guidelines, recommendations, and requirements for passenger seats installed in passenger equipment that is part of the general railroad system of transportation. APTA PR-CS-S-016-99 is available to all interested parties online at [www.apta.com](http://www.apta.com). Additionally, FRA will maintain a copy available for review. However, the rule would not require compliance with section 6.0 of this APTA standard, "Seat durability testing." Seat durability testing is beyond the scope of this proposal because the testing focuses on the optimal life of the seats—not their crashworthiness performance.

Proposed paragraph (a)(2) describes the second way to demonstrate compliance. This proposed option explains that passenger seating may comply with the requirements in Section 6.2, "Seats for passengers, personnel, or train crew," of GM/RT2100, which FRA proposes to incorporate by reference into this paragraph. Section 6.2 contains design specifications and tolerances for passenger and crew seating. GM/RT2100 is available to all interested parties online at [www.rgsonline.co.uk/Railway\\_Group\\_Standards](http://www.rgsonline.co.uk/Railway_Group_Standards). Additionally, FRA will maintain a copy available for review.

The option proposed in paragraph (a)(2) offers alternative test conditions and performance requirements for

evaluating seat crashworthiness. The applicable dynamic seat test procedures are defined in appendix E to GM/RT2100. GM/RT2100 utilizes Hybrid III 50th-percentile male anthropomorphic test devices (ATDs), and the procedures to prepare the ATDs are defined in appendix G to GM/RT2100. The applicable injury criteria and survival space requirements are defined in appendix H to GM/RT2100. Further, the test conditions and performance requirements in GM/RT2100 are aligned with the structural design requirements in EN 12663 and EN 15227, whereas the seat test conditions and performance requirements in APTA PR-CS-S-016-99, Rev. 2, are aligned with the structural design requirements in subpart C of part 238.

Nonetheless, please note that if paragraph (a)(2) is used for demonstrating compliance with the seat crashworthiness requirements, then this proposed paragraph would require that interior crashworthiness be evaluated based on a minimum lateral acceleration of 3g—not 1g as permitted in GM/RT2100. As noted above, FRA found the 1g lateral acceleration requirement inadequate. Thus, the proposed rule would increase the minimum lateral acceleration requirement to 3g. Moreover, the use of the GM/RT2100 standard must be carried out consistent with any conditions identified in the railroad's FRA-approved Tier III Safe Operation Plan. The Tier III Safe Operation Plan must demonstrate that interior fixtures provide an equivalent level of safety during accidents at any speed as equipment that complies with the requirements in § 238.233 and APTA PR-CS-S-006-98. For further discussion of these requirements, see the discussion in § 238.733, above.

Proposed paragraph (b) describes the requirements for the crashworthiness of seats provided for an employee in the cab of a Tier III trainset. Unlike passenger seating, cab seats must comply with the requirements in § 238.233(e), (f) and (g), and the performance, design, and test criteria of AAR-RP-5104, "Locomotive Cab Seats," April 2008, which FRA proposes to incorporate by reference in this paragraph and paragraph (k)(2) of appendix G to this part. (This AAR publication is found in Section M of AAR's "Manual of Standards and Recommended Practices.") FRA is not proposing an optional alternative compliance demonstration. AAR-RP-5104 covers the performance and design requirements and performance tests for the construction of locomotive cab seats on road locomotives. AAR-RP-5104 is available to all interested parties online

at [www.arrpublications.com](http://www.arrpublications.com) for a fee. Additionally, FRA will maintain a copy available for review.

#### Section 238.737 Luggage Racks

Proposed paragraph (a) contains requirements to constrain the longitudinal and lateral motion of articles stowed in luggage racks. FRA intends for these proposed requirements to maintain luggage accessibility while minimizing the risk of hazardous projectiles. The proposed transverse dividers are intended to limit the longitudinal motion of luggage not only in collisions but also during normal operations. In this regard, the proposed downward slope (from the aisle to the adjacent side-wall) of luggage racks is principally intended to restrain the lateral motion of luggage during normal operations. By inhibiting the distance stowed articles may move, the velocity of such items due to longitudinal and lateral train accelerations is minimized, which also minimizes their associated kinetic energy when striking another object.

Proposed paragraph (b) describes two ways to comply with the structural requirements for luggage racks. The first, in paragraph (b)(1), is to comply with § 238.233 as provided for other interior fixtures. The second, in paragraph (b)(2), is to comply with Section 6.8, "Luggage stowage" of GM/RT2100, which FRA proposes to incorporate by reference in this paragraph. Section 6.8 contains the requirements for luggage stowage, either on the floor or in overhead racks. As noted above, GM/RT2100 is available to all interested parties online at [www.rgsonline.co.uk/Railway\\_Group\\_Standards](http://www.rgsonline.co.uk/Railway_Group_Standards). Additionally, FRA will maintain a copy available for review. This proposed option offers alternative performance requirements for evaluating luggage racks. The luggage attachment strength requirements in GM/RT2100 are aligned with the structural design requirements in EN 12663 and EN15227, whereas the luggage rack attachment strength requirements in § 238.233 are aligned with the structural design requirements of subpart C of this part. A discussion of these requirements is in § 238.733 and in the Technical Background and Overview section of this NPRM above.

#### Emergency Systems

##### Section 238.741 Emergency Window Egress and Rescue Access

Section 238.741 proposes requirements for emergency egress and rescue access through windows or alternative openings in passenger cars as

part of an emergency window egress and rescue access plan for Tier III trainsets. The ETF recognized that any regulation would need to allow multiple approaches to facilitate the adoption of service-proven, high-speed trainset technology. Specifically, the methods used to manufacture high-speed trainsets are often governed by consideration of the effects of aerodynamics and noise; and together with the potential need to pressurize occupied compartments, these can have a particular effect on the way window glazing is installed and mounted in some trainset designs. Therefore, the ETF decided to recommend performance-oriented requirements to allow necessary flexibility where an appropriate safety case can be made.

FRA agrees with the ETF's recommendation. Proposed paragraph (a) would allow a railroad to submit an emergency window egress and rescue access plan during the design review stage for FRA approval if the trainset design is not compatible with the emergency system requirements of §§ 238.113 and 238.114. A railroad may elect to employ an alternative feature or approach that demonstrates an equivalent or superior level of safety. Such an approach might involve use of an emergency egress window panel/door exit similar to the over-wing exits on aircraft and sharing characteristics of a removable panel for vestibule and other interior doors intended for passage through a passenger car, as required by § 238.112(f), rather than an emergency window exit per se.

In addition, proposed paragraph (b) specifically addresses the performance of emergency window exits in Tier III trainsets in terms of ease of operability (e.g., removal). Specifically, paragraph (b) recognizes that alternative removal methods may need to be employed for these types of trainsets. Thus, it would allow alternative methods to remove window glazing, such as use of a conspicuously identified tool, or other mechanism, to expeditiously and safely remove the glazing. The emergency window egress and rescue access plan must document that any alternative method employed is as safe as that provided by the emergency window exit ease of operability requirements in § 238.113(b). In addition, the railroad must include a provision in its Tier III ITM plan to inspect for the presence of the identified tool or other mechanism at least each day the trainset is in service.

FRA notes that requirements for the ease of operating rescue access windows are provided in § 238.114(b). As applied to Tier III trainsets, this paragraph

would require that each rescue access window (or its alternative) be capable of removal without unreasonable delay by an emergency responder using either a provided external mechanism, or tools or implements commonly available to the responder in a passenger train emergency. FRA believes these existing requirements are broad enough to apply to Tier III trainsets and alternative rescue access windows if utilized under an approved emergency window egress and rescue access plan.

Proposed paragraph (c) addresses window opening dimension requirements for both emergency egress and rescue access windows in Tier III trainsets. If the dimensions of window openings do not comply with the minimum requirements in §§ 238.113 or 238.114, then the emergency window egress and rescue access plan must demonstrate use of window openings of different dimensions provides at least an equivalent level of safety. This proposed paragraph acknowledges the size of windows may vary greatly between designs and not necessarily reflect the types of windows found on traditional Tier I passenger cars. Proposed paragraph (d) specifically addresses the use of emergency egress panels or additional door exits in the alternative to emergency window exits or rescue access windows. The railroad would be required to submit a plan demonstrating the means of emergency egress or rescue access employed provides an equivalent, or superior, evacuation time for the same number of occupants, as a layout of comparable size and configuration consistent with §§ 238.113 or 238.114, or both, as appropriate. The plan would also address the location, design, and signage and instructions for the alternative emergency evacuation openings. As discussed in paragraph (a), FRA recognizes that railroads may need to employ alternative features or approaches for evacuating passenger car occupants in Tier III trainsets, and one such approach might involve use of an emergency egress window panel/door exit rather than an emergency window exit per se.

FRA makes clear that its approval of any alternative emergency evacuation arrangement would take into account that emergency window exits themselves provide a supplementary means of emergency egress in life-threatening situations, should doors be rendered inaccessible or inoperable. Accordingly, while door exits serve as the preferred means of egress in an emergency situation, the railroad would be required to demonstrate that use of additional door exits, instead of

emergency window exits or rescue access windows, would not diminish safety. Specifically, the railroad would be required to demonstrate that the risk of carbody distortion and other such risks that could render the door exits inoperable or inaccessible would be addressed so that at least an equivalent level of safety is provided.

#### Section 238.743 Emergency Lighting

With one exception, the proposed emergency lighting requirements for Tier III trainsets would be the same as the existing emergency lighting requirements of § 238.115 for passenger trainsets, as stated in proposed paragraph (a). The exception would be for emergency lighting back-up power systems, permitting alternative crash loadings instead of the requirements in § 238.115(b)(4)(ii). This proposed exception is detailed in paragraph (b), under which a railroad may seek to use the loading requirements defined in Section 6.1.4, "Security of furniture, equipment and features," of GM/RT2100. In particular, these loading requirements are the same as those proposed for alternatively demonstrating adequate attachment strength of interior fixtures in Tier III trainsets discussed in § 238.733, above. Accordingly, both the interior lighting fixtures and their emergency back-up power systems would be subject to the same, proposed alternative loading requirements. As in proposed § 238.733, use of the alternative loading requirements would be carried out consistent with any conditions identified in the railroad's FRA-approved Tier III Safe Operation Plan.

#### Cab Equipment

##### Section 238.751 Alerters

In this section, FRA proposes to introduce requirements for alerters for Tier III passenger trainsets. The current requirements for alerters on Tier I passenger equipment can be found at § 238.237, and those for Tier II passenger equipment can be found principally at § 238.447 as well as at § 238.445. The regulatory text in this proposed section for alerters and in proposed § 238.753 for sanders was developed by the BTG, which was formed by the ETF to address Tier III braking requirements. The BTG mandate was to develop performance-based requirements that would accommodate existing, high-speed trainset technology without regard to its design. Many of the proposed requirements for alerters and sanders make reference to the need for accommodating provisions in the railroad's Tier III Safe Operation Plan.

This is necessary to accommodate the diversity of high-speed trainsets and the various ways in which the specified requirements may actually be implemented. FRA notes that the proposed requirements for alerters and sanders represent only a portion of the cab equipment provisions that would be applicable to Tier III passenger equipment. FRA would specifically address other Tier III cab features in future rulemaking.

Proposed paragraph (a) would require installation of an alerter in the operating cab of each Tier III trainset, unless the trainset is operating in a territory where alternate technology is available to provide the same functions. This provision is proposed to accommodate alternate designs and technologies that would address this safety feature.

Proposed paragraphs (b) through (d) describe the high-level functionality that an alerter, if present, must provide. Upon activation of the alerter, engineer acknowledgment must occur within a prescribed period of time as defined in the railroad's Tier III Safe Operation Plan in order for the engineer to remain in control of the trainset. Failure to acknowledge the alerter within the prescribed time period would result in the automatic initiation of a retrievable, full service brake application; the full service brake application would be recoverable only by intervention of the engineer, who must acknowledge the alerter and actively issue a command for brake application. These proposed requirements are consistent with those for Tier I and Tier II passenger equipment, yet would provide a greater level of specificity.

As noted, this section would allow use of an alternate technology to provide the same function(s) as an alerter. If such alternate technology is used, in whole or in part to provide the required functionality, proposed paragraph (e) would require the railroad to conduct a hazard analysis to be included in the railroad's Tier III Safe Operation Plan. The analysis must demonstrate that the use of any alternate technology to perform the function(s) of an alerter provides at least an equivalent level of safety to the function(s) the alerter would be required to perform.

#### Section 238.753 Sanders

In this section, FRA is proposing the introduction of requirements for sanders for Tier III passenger trainsets. Deliberations of the BTG included discussion of whether sanders would be present on Tier III trainset equipment. The BTG decided that since the use of sanders is not prohibited in any way, proposed regulations should be

developed to accommodate this possibility.

The current requirements for sanders are in § 229.131 of this chapter. Sanders represent only a portion of the regulations residing in 49 CFR part 229, Locomotive Safety Standards, which may be applicable to Tier III passenger equipment. As noted above, the 229/ITM Task Group is undertaking the effort to develop Tier III equivalents of applicable provisions in 49 CFR parts 229 and 238, including inspection, testing, and maintenance requirements for Tier I and Tier II passenger equipment, which may be addressed in future FRA rulemaking(s).

Proposed paragraph (a) addresses the fact that sanders are not required for Tier III trainsets, but acknowledges that the railroad's Tier III Safe Operation Plan may include such requirements. If sanders are present, they must be operational.

Proposed paragraph (b) makes use of existing provisions in 49 CFR part 229, specifically § 229.131(a), (b), and (d) of this chapter, which address where to apply sand, actions to take when sanders become inoperative en route, and how to identify equipment with defective sanders. Nonetheless, the proposed text would make clear that the requirements of § 229.9, Movement of non-complying locomotives, and § 229.23, Periodic inspection: General, do not apply. Instead, the requirements of § 238.17, Movement of passenger equipment with other than power brake defects, would apply to Tier III trainsets with defective sanders. Likewise, instead of the requirements of § 229.23, requirements for the periodic inspection of a Tier III trainset with defective sanders would be defined in the railroad's ITM Plan. In this regard, proposed paragraph (c) would require the railroad's ITM plan to specify the overall inspection, testing and maintenance requirements for Tier III trainsets equipped with sanders.

#### Subpart I—Inspection, Testing, and Maintenance Requirements for Tier III Passenger Equipment

Proposed subpart I would contain ITM requirements for Tier III passenger equipment. Recommendations for ITM requirements specific to the brake system were developed by the BTG and would be codified in §§ 238.803, and 238.805. Recommendations for more comprehensive ITM requirements for Tier III passenger equipment are being developed by the 229/ITM Task Group for future rulemaking. While these recommendations are still being developed, FRA envisions that the requirements of this subpart would be

based largely on the existing requirements for Tier II trainsets in subpart F of this part. This proposed subpart I therefore serves as a placeholder for additional requirements that may be proposed.

#### Section 238.801 Scope

This section would establish the general applicability of the ITM requirements specified in this part for an operation that falls within the definition of Tier III.

#### Section 238.803 Inspection, Testing, and Maintenance Requirements; Brake System

FRA is generally proposing to apply subpart F of this part 238 as the ITM requirements for brake systems of Tier III trainsets, as identified in proposed paragraph (a). FRA nonetheless emphasizes in proposed paragraph (b)(1) that the railroad's ITM plan would be required to contain a description of an appropriate brake test equivalent to that of a Class I brake test described in § 238.313. In addition, FRA proposes exceptions to the application of § 238.15, which would otherwise govern the movement of a Tier III trainset with a power brake defect, as provided in paragraph (b)(2). The BTG found these exceptions necessary for Tier III trainsets to accommodate the advanced technology available on such equipment. FRA agrees, and they would apply in three specific circumstances.

First, paragraph (b)(2)(i) proposes an exception to the requirement in § 238.15 that, in the event of an en route failure that causes power brakes to be cut out or renders them inoperative, would allow for the determination of the percentage of operative brakes in a Tier III trainset to be made by a technological method described in the railroad's Tier III Safe Operation Plan instead of the walking inspection required by § 238.15(c)(4)(iv). FRA expects that such a method would rely on diagnostic equipment on board the trainset, because visual inspection of the brake system may be difficult due to the expected aerodynamic features of the body of the trainset.

Second, to accommodate the variety of braking strategies employed in the design of Tier III trainsets, in paragraph (b)(2)(ii), FRA proposes that the formula for computing the percentage of operative brakes necessary for continued trainset operation in the event of partial brake system failure en route be provided in the railroad's Tier III Safe Operation Plan.

Finally, proposed paragraph (b)(2)(iii) would address implementation of operating restrictions for Tier III

trainsets, depending on whether they are in a shared right-of-way or not. When a Tier III trainset is operating in a right-of-way shared with Tier I passenger equipment or freight equipment, operating restrictions would be determined by the percentage of operative power brakes in the trainset based on the requirements of § 238.15. When a Tier III trainset is operating in a right-of-way exclusively for Tier III passenger equipment, operating restrictions would be defined in the railroad's Tier III Safe Operation Plan.

#### Section 238.805 Periodic Tests; Brake System

In this section FRA is proposing to specify periodic testing requirements for brake systems of Tier III trainsets. The proposed requirements in this section were derived from corresponding requirements in §§ 229.25 and 229.29 of this chapter deemed relevant to Tier III trainsets by the BTG and represent minimum requirements with which FRA agrees. To render them appropriate for Tier III technology, FRA's proposal avoids prescriptive standards and allows for particular details of the testing requirements (frequency, scope, etc.) to be determined by the railroad's FRA-approved ITM plan.

#### Subpart J—Specific Requirements for the Safe Operation Plan for Tier III Passenger Equipment

FRA proposes to add and reserve this subpart, which would contain the requirements for the Safe Operation Plan for Tier III Passenger Equipment. The actual requirements will be introduced in a subsequent rulemaking. While certain requirements of this proposed rule do make reference to the Safe Operation Plan for Tier III Passenger Equipment, FRA has elected not to include any general requirements for this plan in this NPRM. The ETF had not discussed such requirements in depth when FRA prepared this NPRM and FRA seeks the ETF's input on such requirements before addressing them in a future rulemaking. In the interim, FRA would work with any proposed Tier III operation to ensure that the specific requirements referencing a Safe Operation Plan for Tier III Passenger Equipment are properly addressed and documented.

#### Appendix B to Part 238—Test Methods and Performance Criteria for the Flammability and Smoke Emission Characteristics of Materials Used in Passenger Cars and Locomotive Cabs

To clarify the application of the floor fire test to Tier III passenger equipment, FRA proposes to add text to Note 16 of

the table of "Test Procedures and Performance Criteria for the Flammability and Smoke Emission Characteristics of Materials Used in Passenger Cars and Locomotive Cabs" in paragraph (c) of appendix B to this part. FRA intends for this addition to address how the floor fire test method requirements of ASTM E-119-00a would apply to the undercarriage design common to most high-speed trainsets. Unlike most conventional passenger equipment, most modern high-speed trainsets employ a material cowling that fully encloses the underframe of the vehicle, including any underfloor equipment, to improve aerodynamics and reduce noise. This material may be considered part of the floor assembly for the purposes of this test when the evaluation is considering a fire source that is under and external to this material. To apply the requirement in this manner, the railroad must also conduct a fire hazard analysis that includes the considerations in Note 17 of this table, to protect against a fire source within the space between the undercarriage and the cowling.

#### Appendix F to Part 238—Alternative Dynamic Performance Requirements for Front End Structures of Cab Cars and MU Locomotives.

FRA is amending appendix F to part 238 to apply this appendix to Tier III passenger equipment. As noted in the discussion of § 238.711, FRA proposes that the cab ends of Tier III trainsets comply with the requirements of appendix F to this part to demonstrate the integrity of the end structure. FRA added appendix F to this part to provide dynamic performance alternatives to the collision post and corner post requirements in §§ 238.211 and 238.213 for Tier I passenger equipment. See 75 FR 1180. Because appendix F would continue to contain alternative requirements for Tier I passenger equipment, and also apply as the mandatory requirements for Tier III passenger equipment, FRA may make additional conforming changes to this appendix at the final rule stage if necessary to clarify the application of this appendix to both Tier I and Tier III passenger equipment. FRA also notes that appendix F would apply to Tier I alternative passenger trainsets under proposed appendix G to demonstrate the integrity of the end structure at the cab ends of these trainsets. While appendix G would itself contain alternative requirements, all the requirements of appendix G are intended to apply as a whole. Accordingly, FRA may make additional conforming changes to this appendix F

at the final rule stage necessary to clarify application of this appendix F to Tier I alternative passenger trainsets.

#### Appendix G to Part 238—Alternative Requirements for Evaluating the Crashworthiness and Occupant Protection Performance of a Tier I Passenger Trainset

FRA is proposing to add appendix G to part 238 to provide alternative crashworthiness and occupant protection performance requirements for Tier I passenger trainsets instead of the conventional requirements of §§ 238.203, 238.205, 238.207, 238.209(a), 238.211, 238.213, and 238.219 in subpart C of this part. The technical contents of proposed appendix G remain materially unchanged from those developed for the original Technical Criteria and Procedures Report.

FRA intends for these alternative requirements to be applied to a Tier I trainset as a whole. Accordingly, compliance must be demonstrated either through application of the conventional requirements in subpart C, or through application of the requirements in this appendix G, not a combination of both. They also apply in addition to the requirements of §§ 238.209(b), 238.215, 238.217, and 238.233, APTA standards for occupant protection, and an AAR recommended practice for locomotive cab seats, as specified in this appendix. While the appendix may refer to specific units of rail equipment in a trainset, the alternative requirements in this appendix would apply only to a Tier I trainset as a whole, as noted above.

In general, where alternatives to the conventional Tier I requirements are given in this appendix G, those requirements are also identified in the Tier III requirements in subpart H—Specific Requirements for Tier III Passenger Equipment. See the discussion in the section-by-section analysis for subpart H.

Use of this appendix to demonstrate alternative crashworthiness and occupant protection performance for Tier I passenger trainsets is subject to FRA review and approval under § 238.201.

Proposed paragraphs (a) through (d) provide alternatives to the Tier I requirements for occupied volume integrity, override protection, and fluid entry inhibition and associated penetration resistance. The referenced alternatives are identified in the proposed Tier III requirements in subpart H. The alternatives are intended to be applied to the individual units, such as the individual cars, making up

a Tier I alternative passenger trainset, as specified.

Proposed paragraph (e) is intended to be applied to each cab end of a Tier I alternative passenger trainset. This paragraph states that each cab end must comply with the requirements given in appendix F to this part. Further, this paragraph explains that while appendix F uses specific language to refer to “corner posts” and “collision posts,” alternative designs may not necessarily contain these discrete structures. Accordingly, this paragraph provides that the requirements of appendix F apply at the specified locations, regardless of whether the structure at the specified locations is a post. Overall, this paragraph is intended to require an equivalent level of performance from an alternative Tier I design to that of a conventionally-designed, Tier I compliant vehicle, without overly constraining the design of the cab end structure.

Proposed paragraph (f) provides alternatives to the end structure integrity requirements for each non-cab end of each unit of a Tier I trainset. The referenced alternatives are identified in the proposed Tier III requirements in subpart H.

As proposed in paragraph (g), a Tier I alternative passenger trainset is subject to the conventional requirements for roof and side structure integrity in §§ 238.215 and 238.217. These requirements are sufficiently broad to apply to Tier I passenger trainsets of alternative designs. Accordingly, no regulatory alternatives are needed.

Proposed paragraph (h) provides alternatives to the truck attachment requirements for each unit of a Tier I alternative trainset. The referenced alternatives are identified in the proposed Tier III requirements in subpart H.

Proposed paragraphs (i), (j), and (k) provide that a Tier I alternative passenger trainset must comply with the conventional Tier I regulations and industry safety standards for interior fixture attachment, passenger seat crashworthiness, and crew seat crashworthiness, respectively.

Notably, in paragraph (i), FRA is proposing to incorporate by reference APTA standard PR-CS-S-034-99, Rev. 2, “Standard for the Design and Construction of Passenger Railroad Rolling Stock,” Authorized June 2006, for interior fixtures. The standard is intended to address forces applied to the carbody and truck structures during collisions, derailments, and other accident conditions. APTA PR-CS-S-034-99 is available to all interested parties online at [www.apta.com](http://www.apta.com).

Additionally, FRA will maintain a copy available for review.

Further, in paragraph (j), FRA proposes to incorporate by reference APTA standard PR-CS-S-016-99, Rev. 2, “Standard for Passenger Seats in Passenger Rail Cars,” Authorized October 2010, with the exception of Section 6 of the standard, which is related to the durability testing of seats. FRA considers the durability testing of seats to be beyond the scope of this proposed regulation for the same reasons discussed above, under § 238.735.

Appendix H to Part 238—Rigid Locomotive Design Computer Model Input Data and Geometrical Depiction

FRA proposes to add this appendix to formally provide input data and a geometrical depiction necessary to create a computer model of the rigid (conventional) locomotive design proposed in § 238.705(a)(4) to use to evaluate the OVI of a Tier III trainset (and a Tier I alternative passenger trainset under proposed appendix G) in a dynamic collision scenario. Proposed § 238.705(a) outlines the required conditions under which a dynamic collision scenario would be performed involving an initially-moving train impacting an initially-standing train having the rigid (conventional) locomotive leading its consist. As proposed in § 238.705(a)(4), the initially-standing train would be made up of a rigid locomotive and five identical passenger coaches having the following characteristics: The locomotive weighs 260,000 pounds and each coach weighs 95,000 pounds; the locomotive and each coach crush in response to applied force as specified in Table 1 to § 238.705; and the locomotive has a geometric design as depicted in Figure 1 to this appendix H.

This appendix is intended to establish a consistent definition for locomotive geometry to be used to conduct dynamic computer simulations. The input data, in the form of an input file, contains the geometry for approximately the first 12 feet of the rigid locomotive design. Because this input file is for a half-symmetric model, a locomotive mass corresponding to 130,000 pounds of weight is provided for modeling purposes—half the 260,000 pounds of weight specified for the locomotive in § 238.705(a)(4). Figure 1 to this appendix provides two views of the locomotive’s geometric depiction. FRA invites comment on whether the proposed approach is the best means to provide the data inputs necessary for the regulated community.

## V. Regulatory Impact and Notices

### A. Executive Orders 12866 and 13563 and DOT Regulatory Policies and Procedures

This proposed rule has been evaluated in accordance with existing policies and procedures, and determined to be significant under Executive Order 12866, Executive Order 13563, and DOT policies and procedures. 44 FR 11034 (Feb. 26, 1979). The proposed rule is “economically significant” rule as defined by Section 3(f)(1) of Executive Order 12866 because it is likely to have an effect of \$100 million or more in a single year. FRA has prepared and placed in the docket a Regulatory Impact Analysis addressing the economic impacts of this proposed rule. The RIA presents estimates of the quantifiable costs likely to occur over the next 30 years of the rule as proposed, as well as estimates of quantifiable benefits that would be generated by the rule as proposed. Informed by its analysis, FRA believes that this proposed rule would result in positive net benefits. The proposed rule would help address several limitations in the CFR pertaining to passenger equipment.

FRA is amending its passenger equipment (passenger locomotives (power units), coaches and train sets) safety regulations. This proposed rule would add a new equipment tier (Tier III) to facilitate the safe implementation of HSR up to 220 mph on dedicated rail lines. The proposal would also establish alternative crashworthiness performance standards to qualify passenger rail equipment for Tier I operations (Tier I alternative). In addition, FRA proposes to increase the maximum allowable speed for Tier II operations from 150 mph to 160 mph. The ETF developed the technical requirements and RSAC approved them. This proposal attempts to address several limitations in the CFR pertaining to passenger equipment. Existing passenger equipment safety standards in 49 CFR part 238 do not address safety requirements for passenger rail equipment at speeds above 150 mph. Furthermore, the current regulatory framework establishes Tier I safety compliance by providing equipment design requirements. Existing regulations for Tier I equipment limit the application of contemporary design techniques and recent technology that can improve safety. Additionally, the NPRM would increase the allowable speed for Tier II equipment making it consistent with recent changes in 49 CFR parts 213 and 238 relative to

Vehicle/Track Interaction (VTI) Safety Standards.

FRA believes that approximately \$4.6 billion in quantifiable costs would be borne by the industry over a future 30-year period, with a present value of \$2 billion (when discounted at a 7-percent rate) or \$3.2 billion (when discounted at a 3-percent rate). The identified quantified costs are related to testing to demonstrate compliance with either the proposed Tier I alternative or Tier III

standards, inspection, testing and maintenance of brakes, and to expected trainset modifications. The proposed Tier I standards would provide only an option for railroads to use a different type or design of passenger equipment in Tier I service and would not impose any cost on existing rolling stock or new equipment qualifying under existing regulations. The proposed Tier III standards would provide an option to FRA's existing regulatory approach for

permitting railroads to operate equipment in new Tier III service, which is by issuing rules of particular applicability. The proposed Tier III requirements would not impose any cost on existing rolling stock or new equipment qualifying under existing regulations (existing passenger rolling stock is Tier I and II; there is no Tier III in the U.S. as of yet).

REGULATORY COST SUMMARY

[Quantified estimates using a future 30-year time horizon]

Section	Description	Undiscounted	3%	7%
<b>Equipment Related</b>				
3.2.1	Trainset Tests (Tier I)	\$2,976,600	\$1,993,277	\$1,310,701
3.2.1	Trainset Tests (Tier III)	2,928,000	2,008,213	1,334,302
3.2.2	Trainset Maintenance (Tier I)	36,000,000	23,520,529	14,890,849
3.1.4	Costs Related to ITM Brake Requirements for Tier III	17,150,722	10,147,114	5,548,586
3.2.3	Trainset Modifications	88,111,000	66,100,340	48,147,529
	<b>Equipment Total</b>	<b>147,166,322</b>	<b>103,769,473</b>	<b>71,231,967</b>
<b>Infrastructure Related</b>				
3.2.3	Infrastructure Upgrade (Tier I)	400,000,000	253,653,516	154,394,117
3.2.3	Infrastructure Upgrade (Tier III)	3,960,000,000	2,737,015,815	1,700,773,286
3.2.4	Track Maintenance (Tier I)	14,577,720	8,082,124	4,044,953
3.2.4	Track Maintenance (Tier III)	101,750,000	54,984,200	25,785,984
	<b>Infrastructure Total</b>	<b>4,476,327,720</b>	<b>3,053,735,655</b>	<b>1,884,998,340</b>
	<b>Total (Equipment and Infrastructure)<sup>18</sup></b>	<b>4,623,494,042</b>	<b>3,157,505,130</b>	<b>1,956,230,309</b>
	<b>Annualized</b>	<b>154,116,468</b>	<b>161,093,573</b>	<b>157,645,5645</b>

The proposed rule would have a positive effect on society and the safety performance of the passenger railroad system. Some of the identified safety benefits are due to the ability to adopt safe equivalent technology and best practices to better the current safety environment, and to apply future technological advancements for the improvement of rail safety. Infrastructure-related benefits dwarf other quantified benefits (i.e., safety, equipment design and engineering, and manufacturing benefits). Infrastructure benefits would be generated by the ability of railroad operators to take advantage of a blended operating environment, avoiding costly new construction and maintenance of

dedicated track and right-of-way acquisition. This benefit is especially attractive to railroad operators that provide service in areas with high population density because right of way acquisition and new railroad construction is significantly more expensive and complex. This alternative would increase the probability that new services are introduced and reduce the need for new construction in densely populated areas.

The U.S. market would benefit from the regulatory proposal because the new safety standards would allow more manufacturers to supply rolling stock and would allow operators to take advantage of a wider variety of trainsets. Furthermore, the proposal would allow

Tier I alternative and Tier III operations to use service-proven platforms with the latest technology available. These benefits would be achieved by ensuring that foreign technology meets FRA's safety requirements and that all equipment suppliers comply with the same safety standards. This RIA estimated a range in total benefits that is between \$8.7 billion and \$16.8 billion over the next 30 years. Of the total, \$1.2 billion to \$2.1 billion can be allocated to equipment benefits while the remainder is infrastructure related (\$7.5 billion to \$14.7 billion). Table 2 provides more detailed benefit estimates and their discounted values at the 3- and 7-percent levels.<sup>19</sup>

<sup>18</sup>For the purposes of demonstrating a range of costs, the lower end of the range for total Equipment and Infrastructure is estimated to be approximately \$4.6 billion. Discounted cost estimates are approximately \$3.1 billion at the 3-percent level and \$1.9 billion at the 7-percent level.

<sup>19</sup>Tier III benefits are uncertain because they are based on assumptions regarding the future growth of high-speed rail operations and how those operations will be incorporated into the U.S. rail

network. It is possible in the extreme, benefits for Tier III equipment, including infrastructure benefits, will be zero, which would occur if no high-speed rail projects come to fruition over the forecast horizon. Similarly, the estimated infrastructure benefits hinge on the assumption of not having to build dedicated HSR track for the whole system (i.e., they represent savings from being able to operate HSR using shared infrastructure). If the baseline is shared

infrastructure, then these benefits will not be realized. Tier III benefits, including infrastructure benefits, are provided for expository purposes. Similarly, Tier I benefits from having performance standards are challenging to quantify, as is always the case for such benefits. However, given that they provide an option to design standards, operators would only comply with such standards, voluntarily making investments, if they found it beneficial to do so.

**REGULATORY BENEFIT RANGE SUMMARY**  
[Quantified estimates use a future 30-year time horizon]

Section	Description	Undiscounted	3%	7%
<b>High Range</b>				
4.1.4	Trainset Components (Tier I alternative)	\$575,000,000	\$370,129,150	\$229,818,248
4.1.4	Trainset Component <sup>20</sup> (Tier III)	1,023,760,569	791,314,162	591,529,134
4.1.5	Trainset Engineering <sup>21</sup> (Tier I alternative)	47,250,000	30,414,961	18,885,064
4.1.5	Trainset Engineering (Tier III)	221,130,000	170,728,740	127,624,437
4.1.7	Safety (Tier I alternative)	52,597,299	33,483,989	20,553,470
4.1.8	Manufacturing Certainty (Tier I alternative and Tier III)	114,912,792	86,204,443	62,789,786
4.1.9	Trainset Maintenance (Tier I alternative and III)	38,304,264	28,734,814	20,929,929
	Equipment Subtotal	2,072,704,774	1,511,010,260	1,072,130,069
4.1.6	Infrastructure Subtotal	14,680,000,000	9,735,682,060	5,991,665,872
	Total	16,752,704,774	11,246,692,320	7,063,795,941
	Annualized	854,710,589	573,797,912	569,245,910
<b>Low Range</b>				
4.1.4	Trainset Components (Tier I alternative)	115,000,000	74,025,830	45,963,650
4.1.4	Trainset Component (Tier III)	761,257,859	585,392,942	433,067,170
4.1.5	Trainset Engineering (Tier I alternative)	9,450,000	6,082,992	3,777,013
4.1.5	Trainset Engineering (Tier III)	164,243,990	126,300,532	93,435,725
4.1.7	Safety (Tier I alternative)	52,597,299	33,483,989	20,553,470
4.1.8	Manufacturing Certainty (Tier I alternative and Tier III)	55,830,211	42,551,847	31,246,952
4.1.9	Trainset Maintenance (Tier I alternative and III)	17,389,930	9,336,581	4,475,199
	Equipment Subtotal	1,175,769,289	877,174,713	632,519,178
4.1.6	Infrastructure Subtotal	7,480,000,000	5,169,918,763	3,212,571,763
	Total	8,655,769,289	6,047,093,477	3,845,090,941
	Annualized	288,525,643	308,518,230	309,862,050
151	Net Benefits—High	12,129,210,732	8,089,187,192	5,107,565,634
	Net Benefits—Low	4,063,300,247	2,912,179,307	1,905,057,812

As shown on Table 2, undiscounted net regulatory benefits would be substantial and would be between \$4.1 billion and \$12.1 billion. Discounted net benefits would be between \$2.9 billion (low range) and \$8.1 billion (high range) at the 3-percent level. And net benefits would be between \$1.9 billion (low range) and \$5.1 billion (high range) at the 7-percent level.

**Alternatives Considered**

One of the main purposes of the proposed regulation is to provide a set of minimum Federal safety requirements to determine whether passenger equipment platforms designed to contemporary standards outside of the U.S. are safe for operation in the U.S. rail environment. Traditionally, U.S. railroad safety regulations evolved as a consequence of specific accidents scenarios, which have led to the identification of specific risks in the operating environment. While FRA seeks to continue ensuring the safety risks are adequately addressed for the operating environment, the proposed rule places special emphasis

on measures to avoid those risks rather than simply mitigating them.

Importantly, the proposed rule does not intend to adopt or incorporate by reference a specific international design standard. Doing so may preclude certain equipment manufacturers from competing in the U.S. market and FRA intends that, to the greatest extent possible, the U.S. passenger rail market be open to global manufacturers.

The alternatives FRA considered in establishing the proposed safety requirements for Tier III trainsets, are the European and Japanese industry standards. These options provide a continuum of safety requirements for a range of aspects such as: Varying levels of regulatory requirements; market accessibility; benefits and costs; and operational efficiency and safety.

FRA prepared a high-level cost comparison of those options based on the key attributes of the alternatives and the effect of those attributes on societal welfare and the regulatory purpose. However, it is important to note this is not a direct comparison between comparable requirements/standards. FRA is comparing the technical requirements of other established high-speed rail standards to illustrate the primary differences. FRA expects service-proven equipment produced to these international standards can

comply with the proposed regulation with no significant changes to the underlying design platform.

**European Platform**

Passenger rail equipment crashworthiness and occupant protection design standards have been largely standardized by Euronorms (EN) 12663 and 15227. These European “norms”<sup>22</sup> or standards were developed and established by the European Committee for Standardization (CEN). These “norms” are not only intended to serve as safety standards, but also to ensure efficiency and performance of products and services and improve the function of markets by removing barriers to trade.

FRA estimated the costs required to modify European trainsets to meet the proposed Tier III requirements in this rule. FRA concludes that there are no significant differences between trains built to the design standards contained in ENs 12663 and 15227 and trains built to meet the crashworthiness and occupant protection requirements in the proposed rule. FRA estimates that on average trainset prices would increase \$310,250 or 0.62 percent, per trainset. These modifications would be justified

<sup>20</sup> Trainset components are the parts of the trainsets, e.g. bogies for the coaches, traction motor for the power unit, etc.

<sup>21</sup> Trainset Engineering is the design and implementation of how the trainsets will be put together and constructed.

<sup>22</sup> “Standard” means “norme” in French and “norm” in German. <https://www.cen.eu/work/ENdev/whatisEN/Pages/default.aspx>.

because they represent a nominal increase in cost while maintaining a level of occupant protection appropriate for the U.S. passenger rail operating environment.

#### Japanese Platform

Japan introduced the Shinkansen high-speed passenger rail system about 50 years ago. Railroad safety regulation is governed by the Railway Bureau, Ministry of Land, Infrastructure and Transport (MLIT) and is codified in the Technical Regulatory Standards on Railways.<sup>23</sup> These technical standards are primarily performance based and railways have the obligation to conform its operations, equipment and infrastructure to these standards. In the case of the Shinkansen, the railway is passenger-only and the rail line is entirely dedicated to high-speed rail passenger service. This is the substantial difference in the design of Shinkansen trainsets operating in Japan and passenger rail trainsets currently operating in the U.S. The key to the Japanese high-speed rail network's ongoing safety and reliability is the "principle of crash avoidance." Unlike the typical operating environment in the U.S., no conventional train service runs on the Japanese system and it has full grade separation.

Although FRA believes that the proposed Tier III requirements would allow Japanese trainsets to be modified for use in the U.S. market and be interoperable, it is also expected that those required modifications would be costly. Indeed, modifying advanced Japanese high-speed trainsets would likely be cost prohibitive to be interoperable on the U.S. system; FRA estimates \$4.7 million per train set.

#### B. Regulatory Flexibility Act and Executive Order 13272

FRA developed the proposed rule in accordance with Executive Order 13272 ("Proper Consideration of Small Entities in Agency Rulemaking") and DOT's procedures and policies to promote compliance with the Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) to ensure potential impacts of rules on small entities are properly considered.

The Regulatory Flexibility Act requires an agency to review regulations to assess their impact on small entities. An agency must conduct a regulatory flexibility analysis unless it determines and certifies that a rule is not expected to have a significant economic impact on a substantial number of small entities.

<sup>23</sup> [http://www.mlit.go.jp/english/2006/h\\_railway\\_bureau/Laws\\_concerning/14.pdf](http://www.mlit.go.jp/english/2006/h_railway_bureau/Laws_concerning/14.pdf).

Existing Passenger Equipment Safety Standards in this part 238 do not specifically address safety requirements for passenger rail equipment at speeds above 150 mph. Furthermore, the current regulatory framework generally sets Tier I safety compliance through equipment design requirements, which limit the application of recent technology. The proposed regulation would change the existing passenger rail equipment safety regulatory framework by introducing a high-speed rail equipment category (Tier III) and establishing alternative compliance requirements for conventional train equipment (Tier I) that are more performance-based. Additionally, the NPRM would increase the maximum allowable speed for Tier II equipment to make it consistent with the corresponding speed range in FRA's Track Safety Standards for the track over which the equipment operates. This Initial Regulatory Flexibility Analysis is presented to comply with Executive Order 13272 and with the Regulatory Flexibility Act as part of the formal rulemaking process required by law.

FRA has initiated the proposed rulemaking using recommendations by FRA's RSAC. The proposed regulation would amend part 238 of chapter II, subtitle B of title 49, Code of Federal Regulations, to reflect new or modified safety requirements for Tier I and Tier III equipment, and to increase the authorized speed limit for Tier II equipment.

#### 1. Description of Regulated Entities and Impacts

The "universe" of the entities under consideration includes only those small entities that can reasonably be expected to be directly affected by the provisions of this rule as proposed. For the proposed rule, there is only one type of small entity that would be affected: Small passenger railroads.

"Small entity" is defined in 5 U.S.C. 601(3) as having the same meaning as "small business concern" under section 3 of the Small Business Act. This includes any small business concern that is independently owned and operated, and is not dominant in its field of operation. 5 U.S.C. 601(5) defines "small entities" as governments of cities, counties, towns, townships, villages, school districts, or special districts with populations less than 50,000.

The U.S. Small Business Administration (SBA) stipulates "size standards" for small entities. It provides that industry sectors relevant for the proposed rulemaking must not exceed

the limits listed below (and still classify as a "small entity"):<sup>24</sup>

- 1,000 employees for railroad rolling stock manufacturing.
- 1,500 employees for line haul operating railroads.
- 500 employees for motor and generator manufacturing.
- 500 employees for switching and terminal establishments.

Federal agencies may adopt their own size standards for small entities in consultation with SBA, and in conjunction with public comment. Under the authority provided to it by SBA, FRA published a final policy, which formally establishes small entities as railroads that meet the line haulage revenue requirements of a Class III railroad.<sup>25</sup> Currently, the revenue requirements are \$20 million or less in annual operating revenue, adjusted annually for inflation. The \$20 million limit (adjusted annually for inflation) is based on the Surface Transportation Board's threshold of a Class III railroad, which is adjusted by applying the railroad revenue deflator adjustment.<sup>26</sup> FRA is proposing to use this definition for this NPRM. Any comments received pertinent to its use will be addressed in the final rule.

#### Railroads

For purposes of this analysis, there are only two intercity passenger railroads, Amtrak and the Alaska Railroad. Neither is considered a small entity. Amtrak is a Class I railroad and the Alaska Railroad is a Class II railroad. The Alaska Railroad is owned by the State of Alaska, which has a population well in excess of 50,000. There are currently 28 commuter or other short-haul passenger railroad operations in the U.S., most of which are part of larger transportation organizations that receive Federal funds and serve major metropolitan areas with populations greater than 50,000. However, two of these passenger railroads do not fall in this category and are considered small entities: The Hawkeye Express and the Saratoga & North Creek Railway. The Hawkeye Express provides service to Iowa City, Iowa, and is owned by a Class III railroad, a small entity. The Saratoga & North Creek Railway started operations in 2011, serving several stations between North Creek and Saratoga Springs, New York, and meets

<sup>24</sup> U.S. Small Business Administration, "Table of Small Business Standards Matched to North American Industry Classification System Codes," effective November 5, 2010.

<sup>25</sup> See 68 FR 24891, May 9, 2003.

<sup>26</sup> For further information on the calculation of the specific dollar limit, please see 49 CFR part 1201.

the criteria to be considered a small entity.

It is important to note that the two railroads being considered in this analysis use passenger rolling stock that is different from the equipment covered by the proposed rulemaking. Furthermore, the Hawkeye Express and the Saratoga & North Creek Railway would be able to find their current trainset types in the market if they decided to acquire new rolling stock over the next 30 years.

This proposal does not increase costs for these small passenger railroads. FRA expects the cost to acquire passenger rail equipment would drop as a result of the proposed rulemaking. These two railroads would have more variety in trainset models available for passenger operations and options in companies supplying equipment in the U.S. market. Additionally, small railroads would enjoy lower prices as the U.S. passenger rail market is enlarged by the proposed rulemaking, enhancing economies of scale and increasing predictability for equipment orders.

Passenger Railroad Rolling Stock Manufacturing

The passenger rail and urban rapid transit equipment manufacturing sector in the United States has a fairly small number of firms with no more than 15 Original Equipment Manufacturers (OEM) and a few hundred component and subcomponent suppliers.<sup>27</sup> However, for this flexibility analysis, FRA is taking a broader approach by assessing the effect of the regulation as proposed on the railroad rolling stock manufacturing sector as defined by the North American Classification System (NAICS), which includes the passenger rail and urban rapid transit equipment manufacturing industry, but goes beyond by also covering freight and maintenance-of-way vehicles. This approach includes firms that currently do not manufacture passenger rail equipment, but can potentially enter the

market. Based on data from the U.S. Census Bureau, employment on these industries is as follows:

- NAICS code 336510, Railroad rolling stock manufacturing, 159 firms in the industry, and 137 firms with less than 500 employees.
- NAICS code 335312, Motor and generator manufacturing, 428 firms in the industry, and 384 firms with less than 500 employees.

The main impact affecting these industries from the rule as proposed would be the qualification costs for Tier I alternative and Tier III trainsets. As noted in the Regulatory Impact Analysis, companies supplying trainsets covered by the rulemaking would be required to submit test and analysis results to demonstrate compliance with the safety requirements. However, in the case of rolling stock manufacturing, this cost would only be incurred by the OEM when submitting a qualification package, which would include details regarding the performance of the trainset model in the required tests and analyses. Therefore, small and very small firms supplying OEMs are not expected to be required to submit that information. Small firms could be expected to benefit from existing requirements for minimum domestic content as more trainsets are purchased by U.S. railroad operators. Small business would have the opportunity to supply OEMs with domestic inputs and to partner with larger firms to allow small domestic producers to meet the needs of the market being created by the regulatory proposal. This means that FRA expects the proposed rulemaking to have only a positive impact on these small entities as more of them are provided with the opportunity to enter the passenger railroad equipment manufacturing industry.

Significant Economic Impact Criteria

Previously, FRA sampled small railroads and found that revenue averaged approximately \$4.7 million (not discounted) in 2006. One percent of

average annual revenue per small railroad would be \$47,000. FRA realizes that some railroads will have revenue than lower \$4.7 million. However, FRA estimates that small railroads would not have any additional expenses over the next ten years to comply with the requirements as proposed in this NPRM. Based on this, FRA concludes that the expected burden of this rule as proposed would not have a significant impact on the competitive position of small entities, or on the small entity segment of the railroad industry as a whole.

Substantial Number Criteria

This final rule would likely burden all small railroads that are not exempt from its scope or application (See 49 CFR 238.3). Thus, as noted above this proposed rule would impact a substantial number of small railroads.

2. Certification

Pursuant to the Regulatory Flexibility Act (5 U.S.C. 605(b)), FRA certifies that this proposed rule would not have a significant economic impact on a substantial number of small entities. FRA invites all interested parties to submit data and information regarding the potential economic impact that would result from adoption of the proposals in this NPRM. FRA will consider all comments received in the public comment process when making a final determination for certification of the final rule.

C. Paperwork Reduction Act

The information collection requirements in this proposed rule are being submitted to the Office of Management and Budget (OMB) for review and approval in accordance with the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 *et seq.*). The sections that contain the new, revised, and current information collection requirements and the estimated time to fulfill each requirement are as follows:

CFR section	Respondent universe	Total annual responses	Average time per response	Total annual burden hours
229.47—Emergency Brake Valve—Marking Brake Pipe Valve as such. —DMU, MU, Control Cab Locomotives— Marking Emergency Brake Valve as such.	30 railroads .....	30 markings .....	1 minute .....	1
	30 railroads .....	5 markings .....	1 minute .....	.08
238.7—Waivers .....	30 railroads .....	5 waivers .....	2 hours .....	10
238.15—Movement of passenger equipment with power brake defect. —Movement of passenger equipment—defective en route. Conditional requirement—Notice .....	30 railroads .....	1,000 tags .....	3 minutes .....	50
	30 railroads .....	288 tags .....	3 minutes .....	14
	30 railroads .....	144 notices .....	3 minutes .....	7

<sup>27</sup> Lowe, M., Tokuoka, S., Dubai, K., and Gereffi, G., "U.S. Manufacture of Rail Vehicles for Intercity

Passenger Rail and Urban Transit: A Value Chain

Analysis," Center on Globalization, Governance & Competitiveness, June 24, 2010.

CFR section	Respondent universe	Total annual responses	Average time per response	Total annual burden hours	
238.17—Limitations on movement of passenger equipment—defects found at calendar day insp. & on movement of passenger equipment—develops defects en route. —Special requisites—movement—passenger equip.—saf. appl. defect. —Crew member notifications .....	30 railroads .....	200 tags .....	3 minutes .....	10	
	30 railroads .....	76 tags .....	3 minutes .....	4	
	30 railroads .....	38 radio notifications ..	30 seconds .....	.32	
238.21—Petitions for special approval of alternative standards. —Petitions for special approval of alternative compliance. —Petitions for special approval of pre-revenue service acceptance testing plan. —Comments on petitions .....	30 railroads .....	1 petition .....	16 hours .....	16	
	30 railroads .....	1 petition .....	120 hours .....	120	
	30 railroads .....	10 petitions .....	40 hours .....	400	
	Public/RR Industry ....	4 comments .....	1 hour .....	4	
238.103—Fire Safety .....	2 new railroads .....	2 analyses .....	150 hours .....	300	
	30 railroads .....	1 analysis .....	40 hours .....	40	
	30 railroads/ .....	3 analyses .....	20 hours .....	60	
	APTA .....				
—Procuring New Pass. Equipment—Fire Safety Analysis. —Existing Equipment—Final Fire Safety Analysis. —Transferring existing equipment— .....	Revised Fire Safety Analysis .....				
238.107—Inspection/testing/maintenance plans—Review by railroads.	30 railroads .....	30 reviews .....	60 hours .....	1,800	
238.109—Employee/Contractor Tr .....	7,500 employees/ .....	2,500 empl./ .....	1.33 hours .....	3,458	
	100 trainers .....	100 trainers .....	3 minutes .....	125	
	30 railroads .....	2,500 record .....			
238.111—Pre-revenue service acceptance testing plan: Passenger equipment that has previously been used in service in the U.S.. —Passenger equipment that has not been previously used in revenue service in the U.S.. —Subsequent Equipment Orders .....	9 equipment manufacturers.	2 plans .....	16 hours .....	32	
	9 equipment manufacturers.	2 plans .....	192 hours .....	384	
	9 equipment manufacturers.	2 plans .....	60 hours .....	120	
	9 equipment manufacturers.	1 report .....	60 hours .....	60	
	9 equipment manufacturers.	1 plan .....	20 hours .....	20	
	30 railroads .....				
—Tier II & Tier III Passenger Equipment: Report of Test Results to FRA ( <i>revised requirement</i> ). —Plan submitted to FRA for Tier II or Tier III equipment before being placed in service ( <i>revised requirement</i> ).	30 railroads .....				
238.201— <i>New Requirements</i> .....	30 railroads .....	1 plan .....	40 hours .....	40	
	30 railroads .....	1 notice .....	30 minutes .....	1	
Alternative Compliance: Tier I Passenger equipment—Test plans + supporting documentation demonstrating compliance. —Notice of Tests sent to FRA 30 days prior to commencement of operations.					
238.213—Corner Posts—Plan to meet section's corner post requirements for cab car or MU locomotives.	30 railroads .....	10 plans .....	40 hours .....	400	
238.229—Safety Appliances .....	30 railroads .....	30 lists .....	1 hour .....	30	
	30 railroads .....	30 lists .....	1 hour .....	30	
	30 railroads .....	4 tags .....	3 minutes .....	.20	
	30 railroads .....	2 notices .....	1 minute .....	.0333	
	30 railroads .....	30 plans .....	16 hours .....	480	
	30 railroads .....	60 workers .....	4 hours .....	240	
	30 railroads .....	1 record .....	2.25 hours .....	2	
	30 railroads .....	15 petitions .....	4 hours .....	60	
	30 railroads .....	3,060 records .....	12 minutes .....	612	
	—Welded safety appliances considered defective: lists. —Lists Identifying Equip. w/Welded Saf. App. —Defective Welded Saf. Appliance—Tags —Notification to Crewmembers about Non-Compliant Equipment. —Inspection plans .....	—Inspection Personnel—Training .....			
	—Remedial action: Defect/crack in weld—record. —Petitions for special approval of alternative compliance—impractical equipment design. —Records of inspection/repair of welded safety appliance brackets/supports/Training.				

CFR section	Respondent universe	Total annual responses	Average time per response	Total annual burden hours
238.230—Safety Appliances—New Equipment—Inspection Record of Welded Equipment by Qualified Employee. —Welded safety appliances: Documentation for equipment impractically designed to mechanically fasten safety appliance support.	30 railroads .....	100 records .....	6 minutes .....	10
	30 railroads .....	15 document .....	4 hours .....	60
238.231—Brake System—Inspection and repair of hand/parking brake: Records. —Procedures Verifying Hold of Hand/Parking Brakes.	30 railroads .....	2,500 forms .....	21 minutes .....	875
	30 railroads .....	30 procedures .....	2 hours .....	60
238.237—Automated monitoring .....	30 railroads .....	3 documents .....	2 hours .....	6
	30 railroads .....	25 tags .....	3 minutes .....	1
238.303—Exterior calendar day mechanical inspection of passenger equipment: Notice of previous inspection. —Dynamic brakes not in operating mode: Tag. —Conventional locomotives equipped with inoperative dynamic brakes: Tagging. —MU passenger equipment found with inoperative/ineffective air compressors at exterior calendar day inspection: Documents. —Written notice to train crew about inoperative/ineffective air compressors. —Records of inoperative air compressors —Record of exterior calendar day mechanical inspection.	30 railroads .....	30 notices .....	1 minute .....	1
	30 railroads .....	50 tags .....	3 minutes .....	3
	30 railroads .....	50 tags .....	3 minutes .....	3
	30 railroads .....	4 documents .....	2 hours .....	8
	30 railroads .....	100 notices .....	3 minutes .....	5
	30 railroads .....	100 records .....	2 minutes .....	3
	30 railroads .....	1,959,620 .....	10 minutes + 1 minute records .....	359,264
	30 railroads .....	1,959,620 records .....	10 minutes + 1 minute records .....	359,264
238.305—Interior calendar day mechanical inspection of passenger cars—Tagging of defective end/side doors. —Records of interior calendar day inspection.	30 railroads .....	540 tags .....	1 minute .....	9
	30 railroads .....	1,959,620 records .....	5 minutes + 1 minute	359,264
238.307—Periodic mechanical inspection of passenger cars and unpowered vehicles—Alternative inspection intervals: Notifications. —Notice of seats/seat attachments broken or loose. —Records of each periodic mechanical inspection. —Detailed documentation of reliability assessments as basis for alternative inspection interval.	30 railroads .....	2 notices/notifications	5 hours .....	10
	30 railroads .....	200 notices .....	2 minutes .....	7
	30 railroads .....	19,284 records .....	200 hours/ .....	3,857,443
	30 railroads .....	5 documents .....	2 minutes .....	500
238.311—Single car test .....	30 railroads .....	50 tags .....	3 minutes .....	3 hours
	30 railroads .....	50 tags .....	3 minutes .....	3 hours
238.313—Class I Brake Test .....	30 railroads .....	15,600 records .....	30 minutes .....	7,800
	30 railroads .....	15,600 records .....	30 minutes .....	7,800
238.315—Class IA brake test .....	30 railroads .....	18,250 notices .....	5 seconds .....	25
	30 railroads .....	365,000 test .....	15 seconds .....	1,521
238.317—Class II brake test .....	30 railroads .....	365,000 test .....	15 seconds .....	1,521
	30 railroads .....	365,000 test .....	15 seconds .....	1,521
238.321—Out-of-service credit—Passenger Car: Out-of-use notation.	30 railroads .....	1,250 notes .....	2 minutes .....	42
238.445—Automated Monitoring .....	1 railroad .....	10,000 alerts .....	10 seconds .....	28
	1 railroad .....	21,900 notices .....	20 seconds .....	122
238.503—Inspection, testing, and maintenance requirements—Plans.	1 railroad .....	1 plan .....	1,200 hours .....	1,200

CFR section	Respondent universe	Total annual responses	Average time per response	Total annual burden hours
238.505—Program approval procedures—Submission of program/plans and Comments on programs.	Rail Industry .....	3 comments .....	3 hours .....	9
238.703—Quasi-static Load Requirements—Document/analysis Tier III Trainsets showing compliance with this section ( <i>new requirement</i> ).	2 railroads .....	1 analysis .....	40 hours .....	40
238.705—Dynamic Collision Scenario—Demonstration of Occupied Volume Integrity Tier III Trainsets—Model Validation document ( <i>new requirement</i> ).	2 railroads .....	1 analysis .....	40 hours .....	40
238.707—Override Protection—Anti-climbing Performance Tests/Analyses Tier III Trainsets—( <i>new requirement</i> ).	2 railroads .....	1 analysis .....	40 hours .....	40
238.709—Fluid Entry Inhibition—Information to demonstrate compliance with this section Tier III Trainsets—( <i>new requirement</i> ).	2 railroads .....	1 analysis .....	20 hours .....	20
238.721— <i>New Requirements</i> —Safe Operation Plans Tier III Trainsets—Addressing Glazing Safety and Other Subpart G Issues:—End-Facing Document/Analysis for Exterior Windows of Tier III Trainsets.	2 railroads .....	1 analysis .....	480 hours .....	480
—30-Day Advance Notice to FRA by glazing manufacturer inviting agency representatives to witness all tests Tier III Passenger Equipment.	5 Glass Manufacturers	1 analysis .....	60 hours .....	60
—Glazing Material Recertification .....	5 Glass Manufacturers	1 written notice .....	30 minutes .....	1
—Marking of End-facing exterior windows Tier III Trainsets.	5 Glass Manufacturers	1 recert. ....	1 second .....	0
—Cab Glazing; Side Facing Exterior Window in Tier III Cab—document showing compliance Type II glaze.	5 Glass Manufacturers	120 markings .....	2 minutes .....	6
—Marking of Side-facing exterior windows Tier III Trainsets.	5 Glass Manufacturers	1 analysis .....	10 hours .....	10
—Non-Cab Glazing; Side Facing Exterior Window Tier III—compliance document Type II glaze.	5 Glass Manufacturers	240 markings .....	2 minutes .....	8
—Marking of Side-facing exterior windows Tier III Trainsets Non-cab cars.	5 Glass Manufacturers	1 analysis .....	20 hours .....	20
—Alternative standard to FRA for side-facing exterior window intended to be breakable and serve as an emergency window exit in accordance with railroad's Tier III Safe Operation Plan.	5 Glass Manufacturers	1, 200 markings .....	2 minutes .....	40
	2 railroads .....	1 alternative standard	5 hours .....	5
238.731— <i>New Requirements</i> —Brake Systems—RR Analysis and testing Tier III trainsets maximum safe operating speed.	2 railroads .....	1 analysis/testing .....	480 hours .....	480
—Tier III trainsets passenger brake alarm—legible stenciling/markings of devices with words "Passenger Brake Alarm".	2 railroads .....	40 stencils/markings ..	20 minutes .....	13
—Inspection, testing and maintenance plan (ITM)—Periodic inspection for main reservoirs.	2 railroads .....	1 ITM plan .....	480 hours .....	480
238.741— <i>New Requirement</i> —Emergency window egress and rescue plan to FRA for passenger cars in Tier III trainsets not in compliance with sections 238.113 or 238.114.	2 railroads .....	1 plan .....	60 hours .....	60
238.743— <i>New Requirements</i> —Emergency Lighting—Tier III trainsets—Testing/Analysis.	2 railroads .....	1 analysis/testing .....	60 hours .....	60
238.751— <i>New Requirements</i> —Alerters—Tier III trainsets—Testing/Analysis.	2 railroads .....	1 analysis/testing .....	200 hours .....	200

All estimates include the time for reviewing instructions, searching existing data sources, gathering or maintaining the needed data, and reviewing the information. Under 44

U.S.C. 3506(c)(2)(B), FRA solicits comments concerning: (1) Whether these information collection requirements are necessary for the proper performance of the functions of

FRA, including whether the information has practical utility; (2) the accuracy of FRA's estimates of the burden of the information collection requirements; (3) the quality, utility, and clarity of the

information to be collected; and (4) whether the burden of collection of information on those who are to respond, including through the use of automated collection techniques or other forms of information technology, may be minimized. For information or a copy of the paperwork package submitted to OMB, contact Mr. Robert Brogan, Information Clearance Officer, Federal Railroad Administration, at 202-493-6292, or Ms. Kimberly Toone, Records Management Officer, Federal Railroad Administration, at 202-493-6139.

Organizations and individuals desiring to submit comments on the collection of information requirements should direct them to Mr. Robert Brogan or Ms. Kimberly Toone, Federal Railroad Administration, 1200 New Jersey Avenue SE, 3rd Floor, Washington, DC 20590. Comments may also be submitted via email to Mr. Brogan at [Robert.Brogan@dot.gov](mailto:Robert.Brogan@dot.gov), or to Ms. Toone at [Kim.Toone@dot.gov](mailto:Kim.Toone@dot.gov).

OMB is required to make a decision concerning the collection of information requirements contained in this proposed rule between 30 and 60 days after publication of this document in the **Federal Register**. Therefore, a comment to OMB is best assured of having its full effect if OMB receives it within 30 days of publication. The final rule will respond to any OMB or public comments on the information collection requirements contained in this proposal.

FRA is not authorized to impose a penalty on persons for violating information collection requirements which do not display a current OMB control number, if required. FRA intends to obtain current OMB control numbers for any new information collection requirements resulting from this rulemaking action prior to the effective date of the final rule. The OMB control number, when assigned, will be announced by separate notice in the **Federal Register**.

#### D. Federalism Implications

Executive Order 13132, "Federalism" (64 FR 43255, Aug. 10, 1999), requires FRA to develop an accountable process to ensure "meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications." "Policies that have federalism implications" are defined in the Executive Order to include regulations that 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." Under Executive

Order 13132, the agency may not issue a regulation with federalism implications that imposes substantial direct compliance costs and that is not required by statute, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by State and local governments, or the agency consults with State and local government officials early in the process of developing the regulation. Where a regulation has federalism implications and preempts State law, the agency seeks to consult with State and local officials in the process of developing the regulation.

This proposed rule has been analyzed under the principles and criteria contained in Executive Order 13132. This proposed rule will not have a substantial effect on the States or their political subdivisions, and it will not affect the relationships between the Federal government and the States or their political subdivisions, or the distribution of power and responsibilities among the various levels of government. In addition, FRA has determined that this regulatory action will not impose substantial direct compliance costs on the States or their political subdivisions. Therefore, the consultation and funding requirements of Executive Order 13132 do not apply.

However, the final rule arising from this rulemaking could have preemptive effect by operation of law under certain provisions of the Federal railroad safety statutes, specifically the former Federal Railroad Safety Act of 1970, repealed and recodified at 49 U.S.C. 20106, and the former Locomotive Boiler Inspection Act (LIA) at 45 U.S.C. 22-34, repealed and re-codified at 49 U.S.C. 20701-20703. Section 20106 provides that States may not adopt or continue in effect any law, regulation, or order related to railroad safety or security that covers the subject matter of a regulation prescribed or order issued by the Secretary of Transportation (with respect to railroad safety matters) or the Secretary of Homeland Security (with respect to railroad security matters), except when the State law, regulation, or order qualifies under the "essentially local safety or security hazard" exception to section 20106. Moreover, the former LIA has been interpreted by the Supreme Court as preempting the field concerning locomotive safety. See *Napier v. Atlantic Coast Line R.R.*, 272 U.S. 605 (1926).

#### E. International Trade Impact Assessment

The Trade Agreements Act of 1979 (Public Law 96-39, 19 U.S.C. 2501 *et*

*seq.*) prohibits Federal agencies from engaging in any standards or related activities that create unnecessary obstacles to the foreign commerce of the United States. Legitimate domestic objectives, such as safety, are not considered unnecessary obstacles. The statute also requires consideration of international standards and, where appropriate, that they be the basis for U.S. standards.

FRA has assessed the potential effect of this rulemaking on foreign commerce and believes that its proposed requirements are consistent with the Trade Agreements Act. The proposed requirements are safety standards, which, as noted, are not considered unnecessary obstacles to trade. Moreover, FRA has sought, to the extent practicable, to state the proposed requirements in terms of the performance desired, rather than in more narrow terms restricted to a particular design or system.

#### F. Environmental Impact

FRA has evaluated this NPRM in accordance with the National Environmental Policy Act (NEPA; 42 U.S.C. 4321 *et seq.*), other environmental statutes, related regulatory requirements, and its "Procedures for Considering Environmental Impacts" (FRA's Procedures) (64 FR 28545, May 26, 1999). FRA has determined that this NPRM is categorically excluded from detailed environmental review pursuant to section 4(c)(20) of FRA's Procedures, which concerns the promulgation of railroad safety rules and policy statements that do not result in significantly increased emissions of air or water pollutants or noise or increased traffic congestion in any mode of transportation. See 64 FR 28547, May 26, 1999. Categorical exclusions (CEs) are actions identified in an agency's NEPA implementing procedures that do not normally have a significant impact on the environment and therefore do not require either an environmental assessment (EA) or environmental impact statement (EIS). See 40 CFR 1508.4.

In analyzing the applicability of a CE, the agency must also consider whether extraordinary circumstances are present that would warrant a more detailed environmental review through the preparation of an EA or EIS. *Id.* In accordance with section 4(c) and (e) of FRA's Procedures, the agency has further concluded that no extraordinary circumstances exist with respect to this proposed regulation that might trigger the need for a more detailed environmental review. The purpose of

this rulemaking is to propose amendments to FRA's Passenger Equipment Safety Standards. This proposed rulemaking would add safety standards to facilitate the safe implementation of high-speed rail at speeds up to 220 mph (Tier III). The proposal also would establish crashworthiness and occupant protection performance requirements in the alternative to those currently specified for passenger trainsets operated at speeds up to 125 mph (Tier I). In addition, the proposal would increase from 150 mph to 160 mph the maximum speed allowable for the tier of railroad passenger equipment currently operated at the Nation's highest train speeds (Tier II). FRA does not anticipate any environmental impacts from the proposed requirements and finds that there are no extraordinary circumstances present in connection with this NPRM.

#### *G. Executive Order 12898 (Environmental Justice)*

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, and DOT Order 5610.2(a) (91 FR 27534, May 10, 2012) require DOT agencies to achieve environmental justice as part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects, including interrelated social and economic effects, of their programs, policies, and activities on minority populations and low-income populations. The DOT Order instructs DOT agencies to address compliance with Executive Order 12898 and requirements within the DOT Order in rulemaking activities, as appropriate. FRA has evaluated this proposed rule under Executive Order 12898 and the DOT Order and has determined that it would not cause disproportionately high and adverse human health and environmental effects on minority populations or low-income populations.

#### *H. Executive Order 13175 (Tribal Consultation)*

FRA has evaluated this proposed rule in accordance with the principles and criteria contained in Executive Order 13175, Consultation and Coordination with Indian Tribal Governments, dated November 6, 2000. The proposed rule would not have a substantial direct effect on one or more Indian tribes, would not impose substantial direct compliance costs on Indian tribal governments, and would not preempt tribal laws. Therefore, the funding and consultation requirements of Executive

Order 13175 do not apply, and a tribal summary impact statement is not required.

#### *I. Unfunded Mandates Reform Act of 1995*

Under section 201 of the Unfunded Mandates Reform Act of 1995 (Pub. L. 104-4, 2 U.S.C. 1531), each Federal agency "shall, unless otherwise prohibited by law, assess the effects of Federal regulatory actions on State, local, and tribal governments, and the private sector (other than to the extent that such regulations incorporate requirements specifically set forth in law)." Section 202 of the Act (2 U.S.C. 1532) further requires that "before promulgating any general notice of proposed rulemaking that is likely to result in the promulgation of any rule that includes any Federal mandate that may result in expenditure by State, local, and tribal governments, in the aggregate, or by the private sector, of \$100,000,000 or more (adjusted annually for inflation) in any 1 year, and before promulgating any final rule for which a general notice of proposed rulemaking was published, the agency shall prepare a written statement" detailing the effect on State, local, and tribal governments and the private sector. This proposed rule will not result in the expenditure, in the aggregate, of \$100,000,000 or more (as adjusted annually for inflation) in any one year, and thus preparation of such a statement is not required.

#### *J. Energy Impact*

Executive Order 13211 requires Federal agencies to prepare a Statement of Energy Effects for any "significant energy action." See 66 FR 28355, May 22, 2001. Under the Executive Order, a "significant energy action" is defined as any action by an agency (normally published in the **Federal Register**) that promulgates or is expected to lead to the promulgation of a final rule or regulation, including notices of inquiry, advance notices of proposed rulemaking, and notices of proposed rulemaking: (1)(i) That is a significant regulatory action under Executive Order 12866 or any successor order, and (ii) is likely to have a significant adverse effect on the supply, distribution, or use of energy; or (2) that is designated by the Administrator of the Office of Information and Regulatory Affairs as a significant energy action.

FRA has evaluated this proposed rule in accordance with Executive Order 13211. FRA has determined that this proposed rule is not likely to have a significant adverse effect on the supply, distribution, or use of energy.

Consequently, FRA has determined that this regulatory action is not a "significant energy action" within the meaning of the Executive Order.

#### *K. Privacy Act*

In accordance with 5 U.S.C. 553(c), DOT solicits comments from the public to better inform its rulemaking process. DOT posts these comments, without edit, including any personal information the commenter provides, to [www.regulations.gov](http://www.regulations.gov), as described in the system of records notice (DOT/ALL-14 FDMS), which can be reviewed at [www.dot.gov/privacy](http://www.dot.gov/privacy).

#### *L. Analysis Under 1 CFR Part 51*

As required by 1 CFR 51.5, FRA has summarized the standards it is proposing to incorporate by reference and shown the reasonable availability of those standards in the section-by-section analysis of this rulemaking document.

#### **List of Subjects**

*49 CFR Part 236*

Railroad safety.

*49 CFR Part 238*

Incorporation by reference, Passenger equipment, Railroad safety, Reporting and recordkeeping requirements.

#### **The Proposed Rule**

For the reasons discussed in the preamble, FRA proposes to amend parts 236 and 238 of chapter II, subtitle B of title 49, Code of Federal Regulations as follows:

#### **PART 236—[AMENDED]**

■ 1. The authority citation for part 236 continues to read as follows:

**Authority:** 49 U.S.C. 20102–20103, 20107, 20133, 20141, 20157, 20301–20303, 20306, 20701–20703, 21301–21302, 21304; 28 U.S.C. 2461, note; and 49 CFR 1.89.

#### **Subpart I—Positive Train Control Systems**

##### **§ 236.1007 [Amended]**

■ 2. In § 236.1007, remove paragraph (d), and redesignate paragraph (e) as paragraph (d).

#### **PART 238—[AMENDED]**

#### **Subpart A—General**

■ 3. The authority citation for part 238 continues to read as follows:

**Authority:** 49 U.S.C. 20103, 20107, 20133, 20141, 20302–20303, 20306, 20701–20702, 21301–21302, 21304; 28 U.S.C. 2461, note; and 49 CFR 1.89.

■ 4. Section 238.5 is amended by revising the definitions of "glazing, end-

facing”, “glazing, side-facing”, “Tier II”, and “Train, Tier II passenger”, and adding in alphabetical order definitions of “Associate Administrator”, “Cab”, “Tier III”, “Trainset, Tier I alternative passenger”, “Trainset, Tier III”, and “Trainset unit” to read as follows:

§ 238.5 Definitions.

\* \* \* \* \*

Associate Administrator means Associate Administrator for Railroad Safety and Chief Safety Officer, Associate Administrator for Railroad Safety, Associate Administrator for Safety.

\* \* \* \* \*

Cab means, for the purposes of subpart H of this part, a compartment or space in a trainset designed to be occupied by the engineer and contain an operating console from which the engineer exercises control over the trainset. This term includes a locomotive cab.

\* \* \* \* \*

Glazing, end-facing means any exterior glazing located where a line perpendicular to the plane of the glazing material makes a horizontal angle of 50 degrees or less with the centerline of the vehicle in which the glazing material is installed, except for: The coupled ends of multiple-unit (MU) locomotives or other equipment semi-permanently connected to each other in a train consist; and end doors of passenger cars at locations other than the cab end of a cab car or MU locomotive. Any location which, due to curvature of the glazing material, can meet the criteria for either an end-facing glazing location or a side-facing glazing location shall be considered an end-facing glazing location.

\* \* \* \* \*

Glazing, side-facing means any glazing located where a line perpendicular to the plane of the glazing material makes a horizontal angle of more than 50 degrees with the centerline of the vehicle in which the glazing material is installed. Side-facing glazing also means glazing located at the coupled ends of MU locomotives or other equipment semi-permanently connected to each other in a train consist and glazing located at end doors other than at the cab end of a cab car or MU locomotive.

\* \* \* \* \*

Tier II means operating at speeds exceeding 125 mph but not exceeding 160 mph.

Tier III means operating in a shared right-of-way at speeds not exceeding 125 mph and in an exclusive right-of-way without grade crossings at speeds

exceeding 125 mph but not exceeding 220 mph.

\* \* \* \* \*

Train, Tier II passenger means a short-distance or long-distance intercity passenger train providing service at speeds exceeding 125 mph but not exceeding 160 mph.

\* \* \* \* \*

Trainset, Tier I alternative passenger means a trainset consisting of Tier I passenger equipment designed under the requirements of appendix G to this part.

Trainset, Tier III means an intercity passenger train that provides service in a shared right-of-way at speeds not exceeding 125 mph and in an exclusive right-of-way without grade crossings at speeds exceeding 125 mph but not exceeding 220 mph.

Trainset unit means a trainset segment located between connecting arrangements (articulations).

\* \* \* \* \*

■ 5. In § 238.21 revise paragraphs (c)(2) and (d)(2) to read as follows:

§ 238.21 Special approval procedure.

\* \* \* \* \*

(c) \* \* \*

(2) The elements prescribed in §§ 238.201(b)(1), 238.229(j)(2), and 238.230(d); and

\* \* \* \* \*

(d) \* \* \*

(2) Each petition for special approval of the pre-revenue service acceptance testing plan shall be submitted to the Associate Administrator, Federal Railroad Administration, 1200 New Jersey Avenue SE., Mail Stop 25, Washington, DC 20590.

Subpart B—Safety Planning and General Requirements

■ 6. In § 238.111 revise paragraphs (b)(2), (4), (5), and (7), and (c) to read as follows:

§ 238.111 Pre-revenue service acceptance testing plan.

\* \* \* \* \*

(b) \* \* \*

(2) Submit a copy of the plan to FRA at least 30 days before testing the equipment and include with that submission notification of the times and places of the pre-revenue service tests to permit FRA observation of such tests. For Tier II and Tier III passenger equipment, the railroad shall obtain FRA approval of the plan under the procedures specified in § 238.21.

\* \* \* \* \*

(4) Document in writing the results of the tests. For Tier II and Tier III passenger equipment, the railroad shall

report the results of the tests to the Associate Administrator at least 90 days prior to its intended operation of the equipment in revenue service.

(5) Correct any safety deficiencies identified in the design of the equipment or in the ITM procedures uncovered during testing. If safety deficiencies cannot be corrected by design changes, the railroad shall impose operational limitations on the revenue service operation of the equipment designed to ensure the equipment can operate safely. For Tier II and Tier III passenger equipment, the railroad shall comply with any operational limitations the Associate Administrator imposes on the revenue service operation of the equipment for cause stated following FRA review of the results of the test program. This section does not restrict a railroad from petitioning FRA for a waiver of a safety regulation under the procedures specified in part 211 of this chapter.

\* \* \* \* \*

(7) For Tier II or Tier III passenger equipment, obtain approval from the Associate Administrator before placing the equipment in revenue service. The Associate Administrator will grant such approval if the railroad demonstrates compliance with the applicable requirements of this part.

(c) If a railroad plans a major upgrade or introduction of new technology to Tier II or Tier III passenger equipment that has been used in revenue service in the United States and that affects a safety system on such equipment, the railroad shall follow the procedures in paragraph (b) of this section before placing the equipment in revenue service with the major upgrade or introduction of new technology.

\* \* \* \* \*

Subpart C—Specific Requirements for Tier I Passenger Equipment

■ 7. In § 238.201, redesignate paragraph (b) as (b)(1), revise the first sentence of newly redesignated (b)(1), and add paragraph (b)(2) to read as follows:

§ 238.201 Scope/alternative compliance.

\* \* \* \* \*

(b)(1) Passenger equipment of special design shall be deemed to comply with this subpart, other than § 238.203, for the service environment the petitioner proposes to operate the equipment in if the Associate Administrator determines under paragraph (c) of this section that the equipment provides at least an equivalent level of safety in such environment for the protection of its occupants from serious injury in the case of a derailment or collision. \* \* \*

(2)(i) Tier I passenger trainsets may comply with the alternative crashworthiness and occupant protection requirements in appendix G to this part instead of the requirements in §§ 238.203, 238.205, 238.207, 238.209(a), 238.211, 238.213, and 238.219.

(ii) To assess compliance with the alternative requirements, the railroad shall submit the following documents to the Associate Administrator, for review:

(A) Test plans, and supporting documentation for all tests intended to demonstrate compliance with the alternative requirements and to validate any computer modeling and analysis used, including notice of such tests, 30 days before commencing the tests; and

(B) A carbody crashworthiness and occupant protection compliance report based on the analysis, calculations, and test data necessary to demonstrate compliance.

(iii) The carbody crashworthiness and occupant protection compliance report shall be deemed acceptable unless the Associate Administrator stays action by written notice to the railroad within 60 days after receipt of those submissions.

(A) If the Associate Administrator stays action, the railroad shall correct any deficiencies FRA identified and notify FRA it has corrected the deficiencies before placing the subject equipment into service.

(B) FRA may also impose written conditions necessary for safely operating the equipment, for cause stated.

\* \* \* \* \*

■ 8. Revise § 238.203(a)(1) to read as follows:

**§ 238.203 Static end strength.**

(a)(1) Except as further specified in this paragraph, paragraph (d) of this section, and § 238.201(b)(2), on or after November 8, 1999, all passenger equipment shall resist a minimum static end load of 800,000 pounds applied on the line of draft without permanent deformation of the body structure.

\* \* \* \* \*

■ 9. Revise the first sentence of § 238.205(a) to read as follows:

**§ 238.205 Anti-climbing mechanism.**

(a) Except as provided in paragraph (b) of this section, and § 238.201(b), all passenger equipment placed in service for the first time on or after September 8, 2000, and prior to March 9, 2010, shall have at both the forward and rear ends an anti-climbing mechanism capable of resisting an upward or downward vertical force of 100,000 pounds without failure. \* \* \*

\* \* \* \* \*

■ 10. Revise § 238.207 to read as follows:

**§ 238.207 Link between coupling mechanism and carbody.**

Except as specified in § 238.201(b), all passenger equipment placed in service for the first time on or after September 8, 2000, shall have a coupler carrier at each end designed to resist a vertical downward thrust from the coupler shank of 100,000 pounds for any normal horizontal position of the coupler, without permanent deformation. Passenger equipment connected by articulated joints that complies with the requirements of § 238.205(a) also complies with the requirements of this section.

■ 11. Amend § 238.209 by adding paragraph (a) introductory text to read as follows:

**§ 238.209 Forward end structure of locomotives, including cab cars and MU locomotives.**

(a) Except as specified in § 238.201(b)—

\* \* \* \* \*

■ 12. Revise § 238.211(a) introductory text to read as follows:

**§ 238.211 Collision posts.**

(a) Except as further specified in this paragraph, paragraphs (b) through (d) of this section, § 238.201(b), and § 238.209(b)—

\* \* \* \* \*

■ 13. Revise § 238.213(a)(1) to read as follows:

**§ 238.213 Corner posts.**

(a)(1) Except as further specified in paragraphs (b) and (c) of this section, § 238.201(b), and § 238.209(b), each passenger car shall have at each end of the car, placed ahead of the occupied volume, two full-height corner posts, each capable of resisting together with its supporting car body structure:

\* \* \* \* \*

■ 14. Revise the first sentence of § 238.219 to read as follows:

**§ 238.219 Truck-to-car-body attachment.**

Except as provided in § 238.201(b), passenger equipment shall have a truck-to-carbody attachment with an ultimate strength sufficient to resist without failure the following individually applied loads: 2g vertically on the mass of the truck; and 250,000 pounds in any horizontal direction on the truck, along with the resulting vertical reaction to this load. \* \* \*

**Subpart E—Specific Requirements for Tier II Passenger Equipment**

■ 15. Revise the first sentence of § 238.401 to read as follows:

**§ 238.401 Scope.**

This subpart contains specific requirements for railroad passenger equipment operating at speeds exceeding 125 mph but not exceeding 160 mph. \* \* \*

**Subpart F—Inspection, Testing, and Maintenance Requirements for Tier II Passenger Equipment**

■ 16. Revise § 238.501 to read as follows:

**§ 238.501 Scope.**

This subpart contains inspection, testing, and maintenance requirements for railroad passenger equipment that operates at speeds exceeding 125 mph but not exceeding 160 mph.

■ 17. Add subpart H to part 238 to read as follows:

**Subpart H—Specific Requirements for Tier III Passenger Equipment**

Sec.

238.701 Scope.

Trainset Structure

238.703 Quasi-static compression load requirements.

238.705 Dynamic collision scenario.

238.707 Override protection.

238.709 Fluid entry inhibition.

238.711 End structure integrity of cab end.

238.713 End structure integrity of non-cab end.

238.715 Roof and side structure integrity.

238.717 Truck-to-carbody attachment.

Glazing

238.721 Glazing.

Brake System

238.731 Brake system.

Interior Fittings and Surfaces

238.733 Interior fixture attachment.

238.735 Seat crashworthiness (passenger and cab crew).

238.737 Luggage racks.

Emergency Systems

238.741 Emergency window egress and rescue access.

238.743 Emergency lighting.

Cab Equipment

238.751 Alerters.

238.753 Sanders.

Figure 1 to Subpart H of Part 238—Cylindrical Projectile for Use in § 238.721 End-Facing Cab-Glazing Testing

**§ 238.701 Scope.**

This subpart contains specific requirements for railroad passenger equipment operating in a shared right-of-way at speeds not exceeding 125 mph

and in an exclusive right-of-way without grade crossings at speeds exceeding 125 mph but not exceeding 220 mph. Passenger seating is permitted in the leading unit of a Tier III trainset, if safety issues associated with passengers occupying the leading unit are addressed and mitigated through a comprehensive Safe Operation Plan for Tier III Passenger Equipment. Demonstration of compliance with the requirements of this subpart is subject to FRA review and approval under § 238.111.

**Trainset Structure**

**§ 238.703 Quasi-static compression load requirements.**

(a) *General.* To demonstrate resistance to loss of occupied volume, Tier III trainsets shall comply with both the quasi-static compression load requirements in paragraph (b) of this section and the dynamic collision requirements in § 238.705.

(b) *Quasi-static compression load requirements.* (1) Each individual vehicle in a Tier III trainset shall resist a minimum quasi-static end load applied on the collision load path of:

- (i) 800,000 pounds without permanent deformation of the occupied volume; or
- (ii) 1,000,000 pounds without exceeding either of the following two conditions:

- (A) Local plastic strains no greater than 5 percent; and
- (B) Vehicle shortening no greater than 1 percent over any 15-foot length of the occupied volume; or

(iii) 1,200,000 pounds without crippling the body structure. Crippling of the body structure is defined as reaching the maximum point on the load-versus-displacement characteristic.

(2) To demonstrate compliance with this section, each type of vehicle shall be subjected to an end compression load (buff) test with an end load magnitude no less than 337,000 lbf (1500 kN).

(3) Compliance with the requirements of paragraph (b) of this section shall be documented and submitted to FRA for review and approval.

**§ 238.705 Dynamic collision scenario.**

(a) *General.* In addition to the requirements of § 238.703, occupied volume integrity (OVI) shall also be demonstrated for each individual vehicle in a Tier III trainset through an evaluation of a dynamic collision scenario in which a moving train impacts a standing train under the following conditions:

(1) The initially-moving train is made up of the equipment undergoing

evaluation at its AWO ready-to-run weight;

(2) If trains of varying consist lengths are intended for use in service, then the shortest and longest consist lengths shall be evaluated;

(3) If the initially-moving train is intended for use in push-pull service, then, as applicable, both the configurations as led by a locomotive and as led by a cab car shall be evaluated separately;

(4) The initially-standing train is led by a rigid (conventional) locomotive and also made up of five identical passenger coaches having the following characteristics:

(i) The locomotive weighs 260,000 pounds and each coach weighs 95,000 pounds;

(ii) The locomotive and each passenger coach crush in response to applied force as specified in Table 1 to this section; and

(iii) The locomotive shall be modeled using the data inputs listed in appendix H to this part so that it has a geometric design as depicted in Figure 1 to appendix H to this part;

(5) The scenario shall be evaluated on tangent, level track;

(6) The initially-moving train shall have an initial velocity of 20 mph if the consist is led by a cab car or MU locomotive, or an initial velocity of 25 mph if the consist is led by a conventional locomotive;

(7) The coupler knuckles on the colliding equipment shall be closed and centered;

(8) The initially-moving and initially-standing train consists are not braked;

(9) The initially-standing train has only one degree-of-freedom (longitudinal displacement); and

(10) The model used to demonstrate compliance with the dynamic collision requirements must be validated. Model validation shall be documented and submitted to FRA for review and approval.

(b) *Dynamic collision requirements.* As a result of the impact described in paragraph (a) of this section—

(1) One of the following two conditions must be met for the occupied volume of the initially-moving train:

(i) There shall be no more than 10 inches of longitudinal permanent deformation; or

(ii) Global vehicle shortening shall not exceed 1 percent over any 15-foot length of occupied volume.

(2) If Railway Group Standard GM/RT2100, Issue Four, “Requirements for Rail Vehicle Structures,” Rail Safety and Standards Board Ltd., December 2010, is used to demonstrate compliance with any of the requirements in §§ 238.733,

238.735, 238.737, or 238.743, then the average longitudinal deceleration of the center of gravity (CG) of each vehicle in the initially-moving train during the dynamic collision scenario shall not exceed 5g during any 100-millisecond (ms) time period.

(3) Compliance with each of the following conditions shall also be demonstrated for the cab of the initially-moving train after the impact:

(i) For each seat provided for an employee in the cab, and any floor-mounted seat in the cab, a survival space shall be maintained where there is no intrusion for a minimum of 12 inches from each edge of the seat. Walls or other items originally within this defined space, not including the operating console, shall not further intrude more than 1.5 inches towards the seat under evaluation;

(ii) There shall be a clear exit path for the occupants of the cab;

(iii) The vertical height of the cab (floor to ceiling) shall not be reduced by more than 20 percent; and

(iv) The operating console shall not have moved closer to the engineer’s seat by more than 2 inches; if the engineer’s seat is part of a set of adjacent seats, the requirements of this paragraph apply to both seats.

**TABLE 1—FORCE-VERSUS-CRUSH RELATIONSHIPS FOR PASSENGER COACH AND CONVENTIONAL LOCOMOTIVE**

Vehicle	Crush (in)	Force (lbf)
Passenger Coach .....	0	0
	3	80,000
	6	2,500,000
Conventional Locomotive .....	0	0
	2.5	100,000
	5	2,500,000

**§ 238.707 Override protection.**

(a) *Colliding equipment.* (1) Using the dynamic collision scenario described in § 238.705(a), anti-climbing performance shall be evaluated for each of the following sets of initial conditions:

(i) All vehicles in the initially-moving and initially-standing train consists are positioned at their nominal running heights; and

(ii) The lead vehicle of the initially-moving train shall be perturbed laterally and vertically by 3 inches at the colliding interface.

(2) For each set of initial conditions specified in paragraph (a)(1) of this section, compliance with the following conditions shall be demonstrated after a dynamic impact:

(i) The relative difference in elevation between the underframes of the colliding equipment in the initially-moving and initially-standing train consists shall not change by more than 4 inches; and

(ii) The tread of any wheel of the first vehicle of the initially-moving train shall not rise above the top of the rail by more than 4 inches

(b) *Connected equipment override.* (1) Using the dynamic collision scenario described in § 238.705(a), anti-climbing performance shall be evaluated for each of the following sets of initial conditions:

(i) All vehicles in the initially-moving and initially-standing train consists are positioned at their nominal running heights; and

(ii) One vehicle is perturbed laterally and vertically by 2 inches, relative to the adjacent vehicle, at the first vehicle-to-vehicle interface in the initially-moving train.

(2) For each set of initial conditions specified in paragraph (b)(1) of this section, compliance with the following conditions shall be demonstrated after a dynamic impact:

(i) The relative difference in elevation between the underframes of the connected equipment in the initially-moving train shall not change by more than 4 inches; and

(ii) The tread of any wheel of the initially-moving train shall not rise above the top of rail by more than 4 inches.

#### § 238.709 Fluid entry inhibition.

(a) The skin covering the forward-facing end of a Tier III trainset shall be—

(1) Equivalent to a 1/2-inch steel plate with yield strength of 25,000 pounds per square inch. Material of higher yield strength may be used to decrease the required thickness of the material provided at least an equivalent level of strength is maintained. The sum of the thicknesses of elements (*e.g.*, skin and structural elements) from the structural leading edge of the trainset to a point, when projected onto a vertical plane, just forward of the engineer's normal operating position, may also be used to satisfy this requirement;

(2) Designed to inhibit the entry of fluids into the cab; and

(3) Affixed to the collision posts or other main structural members of the forward end structure so as to add to the strength of the end structure.

(b) Information used to demonstrate compliance with the requirements of this section shall at a minimum include a list and drawings of the structural elements considered in satisfying the

requirement of this section, and calculations showing that the thickness-strength requirement is satisfied.

#### § 238.711 End structure integrity of cab end.

The cab ends of Tier III trainsets shall comply with the requirements of appendix F to this part to demonstrate the integrity of the end structure. For those units of Tier III trainsets without identifiable corner or collision posts, the requirements of appendix F apply to the end structure at each location specified, regardless of whether the structure is a post.

#### § 238.713 End structure integrity of non-cab end.

(a) *General.* Tier III trainsets shall comply with the requirements in paragraphs (b) and (c) of this section to demonstrate the integrity of the end structure for other than the cab ends.

(b) *Collision post requirements.* (1) Each unit of a Tier III trainset shall have at each non-cab end of the unit either:

(i) Two full-height collision posts, located at approximately the one-third points laterally. Each collision post shall have an ultimate longitudinal shear strength of not less than 300,000 pounds at a point even with the top of the underframe member to which it is attached. If reinforcement is used to provide the shear value, the reinforcement shall have full value for a distance of 18 inches up from the underframe connection and then taper to a point approximately 30 inches above the underframe connection; or

(ii) An equivalent end structure that can withstand the sum of forces that each collision post in paragraph (b)(1)(i) of this section is required to withstand. For analysis purposes, the required forces may be assumed to be evenly distributed at the locations where the equivalent structure attaches to the underframe.

(2) Collision posts are not required for the non-cab ends of any unit with push-back couplers and interlocking anti-climbing mechanisms in a Tier III trainset, or the non-cab ends of a semi-permanently coupled consist of trainset units, if the inter-car connection is capable of preventing disengagement and telescoping to the same extent as equipment satisfying the anti-climbing and collision post requirements in subpart C of this part. For demonstrating that the inter-car connection is capable of preventing such disengagement (and telescoping), the criteria in § 238.707(b) apply.

(c) *Corner post requirements.* (1) Each passenger car in a Tier III trainset shall have at each non-cab end of the car,

placed ahead of the occupied volume, two side structures capable of resisting a:

(i) 150,000-pound horizontal force applied at floor height without failure;

(ii) 20,000-pound horizontal force applied at roof height without failure; and

(iii) 30,000-pound horizontal force applied at a point 18 inches above the top of the floor without permanent deformation.

(2) For purposes of this paragraph, the orientation of the applied horizontal forces shall range from longitudinal inward to transverse inward.

(3) For each evaluation load, the load shall be applied to an area of the structure sufficient to not locally cripple or punch through the material.

(4) The load area shall be chosen to be appropriate for the particular car design and shall not exceed 10 inches by 10 inches.

#### § 238.715 Roof and side structure integrity.

To demonstrate roof and side structure integrity, Tier III trainsets shall comply with the requirements in §§ 238.215 and 238.217.

#### § 238.717 Truck-to-carbody attachment.

To demonstrate the integrity of truck-to-carbody attachments, each unit in a Tier III trainset shall:

(a) Comply with the requirements of § 238.219; or

(b) Have a truck-to-carbody attachment with strength sufficient to resist, without yielding, the following individually applied, quasi-static loads on the mass of the truck at its CG:

(1) 3g vertically downward;

(2) 1g laterally, along with the resulting vertical reaction to this load; and

(3) Except as provided in paragraph (c) of this section, 5g longitudinally, along with the resulting vertical reaction to this load, provided that for the conditions in the dynamic collision scenario described in § 238.705(a):

(i) The average longitudinal deceleration at the CG of the equipment during the impact does not exceed 5g; and

(ii) The peak longitudinal deceleration of the truck during the impact does not exceed 10g.

(c) As an alternative to demonstrating compliance with paragraph (b)(3) of this section, the truck shall be shown to remain attached after a dynamic impact under the conditions in the collision scenario described in § 238.705(a).

(d) For purposes of paragraph (b) of this section, the mass of the truck includes axles, wheels, bearings, truck-

mounted brake system, suspension system components, and any other component attached to the truck by design.

(e) Truck attachment shall be demonstrated using a validated model.

## Glazing

### § 238.721 Glazing.

(a) *General.* Glazing safety issues associated with operating in a Tier III environment shall be identified and addressed through a comprehensive analysis in the railroad's Safe Operation Plan for Tier III Passenger Equipment that considers right-of-way access control, intrusion detection, and safety devices to contain thrown or dropped objects.

(b) *Cab glazing; end-facing.* (1) Each end-facing exterior window in a cab of a Tier III trainset shall comply with the requirements for Type I glazing in appendix A to part 223 of this chapter, except as provided in paragraphs (b)(2) through (4) of this section.

(2) Instead of the large object impact test specified in appendix A to part 223, each end-facing exterior window in a cab shall demonstrate compliance with the following requirements of this paragraph:

(i) The glazing article shall be impacted with a cylindrical projectile that complies with the following design specifications as depicted in Figure 1 to this subpart:

(A) The projectile shall be constructed of aluminum alloy such as ISO 6362-2:1990, grade 2017A, or its demonstrated equivalent;

(B) The projectile end cap shall be made of steel;

(C) The projectile assembly shall weigh 2.2 lbs (-0, +0.044 lbs) or 1 kilogram (kg) (-0, +0.020 kg) and shall have a hemispherical tip. Material may be removed from the interior of the aluminum portion to adjust the projectile mass according to the prescribed tolerance. The hemispherical tip shall have a milled surface with 0.04 inch (1 mm) grooves; and

(D) The projectile shall have an overall diameter of 3.7 inches (94 mm) with a nominal internal diameter of 2.76 inches (70 mm).

(ii) The test of the glazing article shall be deemed satisfactory if the test projectile does not penetrate the windscreen, the windscreen remains in its frame, and the witness plate is not marked by spall.

(iii) A new projectile shall be used for each test.

(iv) The glazing article to be tested shall be that which has the smallest area for each design type. For the test, the

glazing article shall be fixed in a frame of the same construction as that mounted on the vehicle.

(v) A minimum of four tests shall be conducted and all must be deemed satisfactory. Two tests shall be conducted with the complete glazing article at 32 °F;  $\pm 9$  °F (0 °C  $\pm$  5 °C) and two tests shall be conducted with the complete glazing article at 68 °F  $\pm$  9 °F (20 °C  $\pm$  5 °C). For the tests to be valid they shall demonstrate that the core temperature of the complete glazing article during each test is within the required temperature range.

(vi) The test glazing article shall be mounted at the same angle relative to the projectile path as it will be to the direction of travel when mounted on the vehicle.

(vii) The projectile's impact velocity shall equal the maximum operating speed of the Tier III trainset plus 100 mph (160 km/h). The projectile velocity shall be measured within 13 feet (4 m) of the point of impact.

(viii) The point of impact shall be at the geometrical center of the glazing article.

(3) Representative samples for large object impact testing of large Tier III end-facing cab glazing articles may be used instead of the actual design size provided that the following conditions are met:

(i) Testing of glazing articles having dimensions greater than 39.4 by 27.6 inches (1,000 mm by 700 mm), excluding framing, may be performed using a flat sample having the same composition as the glazing article for which compliance is to be demonstrated. The glazing manufacturer shall provide documentation containing its technical justification that testing a flat sample is sufficient to verify compliance of the glazing article with the requirements of this paragraph.

(ii) Flat sample testing is permitted only when no surface of the full size glazing article contains curvature with a radius less than 98 inches (2,500 mm), and when a complete, finished glazing article is laid (convex side uppermost) on a flat horizontal surface, the distance, (measured perpendicularly to the flat surface) between the flat surface and the inside face of the glazing article is not greater than 8 inches (200 mm).

(4) End-facing glazing shall demonstrate sufficient resistance to spalling, as verified by the large impact projectile test under the following conditions:

(i) An annealed aluminum witness plate of maximum thickness 0.006 inches (0.15 mm) and of dimension 19.7 by 19.7 inches (500 mm by 500 mm) is placed vertically behind the sample

under test, at a horizontal distance of 500 mm from the point of impact in the direction of travel of the projectile or the distance between the point of impact of the projectile and the location of the engineer's eyes in the engineer's normal operating position, whichever is less. The center of the witness plate is aligned with the point of impact.

(ii) Spalling performance shall be deemed satisfactory if the aluminum witness plate is not marked.

(iii) For the purposes of this part, materials used specifically to protect the cab occupants from spall (*i.e.*, spall shields) shall not be required to meet the flammability and smoke emission performance requirements of appendix B to this part.

(5) Each end-facing exterior window in a cab shall provide ballistic penetration resistance sufficient to protect cab occupants from risks and hazards identified by the railroad as part of its Safe Operation Plan for Tier III Equipment. This protection shall, at a minimum, meet the requirements of part 223, appendix A.

(6) Tests performed on glazing materials for demonstration of compliance with this section shall be certified by either:

(i) An independent third-party (laboratory, facility, underwriter); or

(ii) The glazing manufacturer, by providing FRA the opportunity to witness all tests by written notice at least 30 days prior to testing.

(7) Any glazing material certified to meet the requirements of this section shall be re-certified by the same means (as originally certified) if any changes are made to the glazing that may affect its mechanical properties or its mounting arrangement on the vehicle.

(8) All certification/re-certification documentation shall be made available to FRA upon request.

(9) Each end-facing exterior window in a cab shall be permanently marked, before installation, in such a manner that the marking is clearly visible after the material has been installed. The marking shall include:

(i) The words "FRA TYPE IHS" to indicate that the material has successfully passed the testing requirements specified in this paragraph (b);

(ii) The name of the manufacturer; and

(iii) The type or brand identification of the material.

(c) *Cab glazing; side-facing.* Each side-facing exterior window in a cab of a Tier III trainset shall—

(1) Comply with the requirements for Type II glazing contained in appendix A

to part 223 of this chapter, for large-object impact; and

(2) Maintain the minimum ballistics penetration resistance as required for end-facing glazing in paragraph (b)(5) of this section.

(d) *Non-cab glazing; side-facing.*

(1) Except as provided in paragraph (d)(2) of this section, each side-facing exterior window in other than a cab shall comply with the requirements for Type II glazing contained in appendix A to part 223 of this chapter.

(2) Instead of the requirements specified in paragraph (d)(1) of this section, a side-facing exterior window intended to be breakable and serve as an emergency window exit under the railroad's Tier III Safe Operation Plan may comply with an alternative standard that provides an equivalent level of safety and is approved for use by FRA.

(e) *Glazing securement.* Each exterior window shall remain in place when subjected to:

(1) The forces due to air pressure differences caused when two trains pass at the minimum separation for two adjacent tracks, while traveling in opposite directions, each train traveling at the maximum authorized speed; and

(2) The impact forces that the exterior window is required to resist as specified in this section.

## Brake System

### § 238.731 Brake system.

(a) *General.* Each railroad shall demonstrate through analysis and testing the maximum safe operating speed for its Tier III trainsets that results in no thermal damage to equipment or infrastructure during normal operation of the brake system.

(b) *Minimum performance requirement for brake system.* Each Tier III trainset's brake system shall be capable of stopping the trainset from its maximum operating speed within the signal spacing existing on the track over which the trainset is operating under the worst-case adhesion conditions defined in the railroad's Safe Operation Plan for Tier III Passenger Equipment.

(c) *Emergency brake system.* A Tier III trainset shall be provided with an emergency brake application feature that produces an irremovable stop. An emergency brake application shall be available at any time, and shall be initiated by either of the following:

(1) An unintentional parting of the trainset; or

(2) The train crew at locations specified in the railroad's Safe Operation Plan for Tier III Passenger Equipment.

(d) *Passenger brake alarm.* (1) A means to initiate a passenger brake alarm shall be provided at two locations in each unit of a Tier III trainset that is over 45 feet in length. When a unit of the trainset is 45 feet or less in length, a means to initiate a passenger brake alarm need only be provided at one location in the unit. These locations shall be identified in the railroad's Safe Operation Plan for Tier III Passenger Equipment. The words "Passenger Brake Alarm" shall be legibly stenciled or marked on each device or on an adjacent badge plate.

(2) All passenger brake alarms shall be installed so as to prevent accidental activation.

(3) During departure from the boarding platform, activation of the passenger brake alarm shall result in an emergency brake application.

(4) A passenger brake alarm activation that occurs after the trainset has safely cleared the boarding platform shall be acknowledged by the engineer within the time period specified in the railroad's Safe Operation Plan for Tier III Passenger Equipment for train operation to remain under the full control of the engineer. The method used to confirm that the trainset has safely cleared the boarding platform shall be defined in the railroad's Safe Operation Plan for Tier III Passenger Equipment.

(5) If the engineer does not acknowledge the passenger brake alarm as specified in paragraph (d)(4) of this section, at a minimum, a retrievable full service brake application shall be automatically initiated until the trainset has stopped unless the engineer intervenes as described in paragraph (d)(6) of this section.

(6) To retrieve the full service brake application described in paragraph (d)(5) of this section, the engineer must acknowledge the passenger brake alarm and activate appropriate controls to issue a command for brake application as specified in the railroad's Safe Operation Plan for Tier III Passenger Equipment.

(e) *Degraded performance of blended brake system.* The following requirements of this paragraph (e) apply to operation of Tier III trainsets with blended braking systems to address degraded brake system performance:

(1) Loss of power or failure of the dynamic or regenerative brake shall not result in exceeding the allowable stopping distance defined in the railroad's Safe Operation Plan for Tier III Passenger Equipment;

(2) The available friction braking shall be adequate to stop the trainset safely under the operating conditions defined

in the railroad's Safe Operation Plan for Tier III Passenger Equipment;

(3) The operational status of the trainset brake system shall be displayed for the engineer in the operating cab; and

(4) The railroad shall demonstrate through analysis and testing the maximum speed for safely operating its Tier III trainsets using only the friction brake portion of the blended brake with no thermal damage to equipment or infrastructure.

(f) *Main reservoir system.* (1) The main reservoirs in a Tier III trainset shall be designed and tested to meet the requirements of a recognized standard specified in the railroad's Safe Operation Plan for Tier III Passenger Equipment, such as the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code for Unfired Pressure Vessel Section VIII, Division I (ASME Code). The working pressure shall be 150 psig (10.3 bar) and the corresponding rated temperature shall be 150 °F (65 °C) unless otherwise defined in the railroad's Safe Operation Plan for Tier III Passenger Equipment. Reservoirs shall be certified based on their size and volume requirements.

(2) Each welded steel main reservoir shall be drilled in accordance with the requirements of a recognized standard specified in the railroad's Safe Operation Plan for Tier III Passenger Equipment, such as paragraph UG-25(e) of Section VIII of the ASME Boiler and Pressure Vessel Code. With the drain opening located at the low point of the reservoir, one row of holes shall be drilled lengthwise on the reservoir on a line intersecting the drain opening and sloped to the drain opening.

(3) A breach of a welded steel main reservoir at any of the drilled holes described in paragraph (f)(2) of this section shall be cause for the reservoir to be condemned and withdrawn from service. Any type of welded repair to a steel main reservoir is prohibited.

(g) *Aluminum main reservoirs.* (1) Aluminum main reservoirs used in a Tier III trainset shall conform to the requirements of § 229.51 of this chapter.

(2) Any type of welded repair to an aluminum main reservoir is prohibited.

(h) *Main reservoir tests.* Prior to initial installation, each main reservoir shall be subjected to a pneumatic or hydrostatic pressure test based on the maximum working pressure defined in paragraph (f) or (g) of this section, as appropriate, unless otherwise established by the railroad's inspection, testing, and maintenance (ITM) plan. Records of the test date, location, and pressure shall be maintained by the railroad for the life of the equipment. Periodic inspection

requirements for main reservoirs shall be defined in the railroad's ITM plan.

(i) *Brake gauges.* All mechanical gauges and all devices providing electronic indication of air pressure that are used by the engineer to aid in the control or braking of a Tier III trainset shall be located so they may be conveniently read from the engineer's normal position during operation of the trainset.

(j) *Brake application/release.* (1) Brake actuators shall be designed to provide brake pad and shoe clearance when the brakes are released.

(2) The minimum brake cylinder pressure shall be established to provide adequate adjustment from minimum service to full service for proper train operation. The brake cylinder pressure shall be approved as part of the design review process described in the railroad's Safe Operation Plan for Tier III Passenger Equipment.

(k) *Foundation brake gear.* The railroad shall specify requirements in its ITM plan for the inspection, testing, and maintenance of the foundation brake gear.

(l) *Leakage.* (1) If a Tier III trainset is equipped with a brake pipe, the leakage rates shall not exceed the limits defined in either paragraph (l)(2) of this section, or those defined in the Air Consumption Analysis included in the railroad's Safe Operation Plan for Tier III Passenger Equipment, whichever is more restrictive. The method of inspection for main reservoir pipe leakage shall be prescribed in the railroad's ITM plan.

(2) Brake pipe leakage may not exceed 5 p.s.i. per minute; and with a full service application at maximum brake pipe pressure and with communication to the brake cylinders closed, the brakes shall remain applied for at least 5 minutes.

(m) *Slide protection and alarm.* (1) A Tier III trainset shall be equipped with an adhesion control system designed to automatically adjust the braking force on each wheel to prevent sliding during braking.

(2) A wheel-slide alarm that is visual or audible, or both, shall alert the engineer in the operating cab to wheel-slide conditions on any axle of the trainset.

(3) If this system fails to prevent wheel slide within preset parameters specified in the railroad's Safe Operation Plan for Tier III Passenger Equipment, then operating restrictions for a trainset with slide protection devices that are not functioning as intended shall be specified in the railroad's Safe Operation Plan for Tier III Passenger Equipment.

(n) *Monitoring and diagnostics.* Each Tier III trainset shall be equipped with a monitoring and diagnostic system that is designed to automatically assess the functionality of the brake system for the entire trainset. Details of the system operation and the method of communication of brake system functionality prior to the departure of the trainset and while en route shall be described in detail in the railroad's Safe Operation Plan for Tier III Passenger Equipment.

(o) *Train securement.* Independent of the pneumatic brakes, Tier III equipment shall be equipped with a means of securing the equipment against unintentional movement when unattended (as defined in § 238.231(h)(4)). The railroad shall specify in its Safe Operation Plan for Tier III Passenger Equipment the procedures used to secure the equipment and shall also demonstrate that those procedures effectively secure the equipment on all grade conditions identified by the railroad.

(p) *Rescue operation; brake system.* A Tier III trainset's brake system shall be designed to allow a rescue vehicle or trainset to control its brakes when the trainset is disabled.

#### Interior Fittings and Surfaces

##### § 238.733 Interior fixture attachment.

(a) Tier III trainsets shall comply with the interior fixture attachment requirements referenced in either of the following paragraphs:

(1) Section 238.233 and APTA PR-CS-S-006-98.

(2) Section 6.1.4, "Security of furniture, equipment and features," of GM/RT2100, provided that—

(i) The conditions of § 238.705(b)(2) are met;

(ii) Interior fixture attachment strength is based on a minimum of 5g longitudinal, 3g lateral, and 3g vertical acceleration resistance; and

(iii) Use of the standard is carried out in accordance with any conditions identified in the railroad's Safe Operation Plan for Tier III Passenger Equipment, as approved by FRA.

(b) The standards required in this section are incorporated by reference into this section with the approval of the Director of the Federal Register under 5 U.S.C. 552(a) and 1 CFR part 51. All approved material is available for inspection at Federal Railroad Administration, Docket Clerk, 1200 New Jersey Avenue SE., Washington, DC and is available from the sources indicated below. It is also available for inspection at the National Archives and Records Administration (NARA). For

information on the availability of this material at NARA, call 202-741-6030 or go to [http://www.archives.gov/federal-register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal-register/code_of_federal_regulations/ibr_locations.html).

(1) American Public Transportation Association, 1666 K Street NW., Washington, DC 20006, [www.aptastandards.com](http://www.aptastandards.com).

(i) APTA PR-CS-S-006-98 Rev. 1, "Standard for Attachment Strength of Interior Fittings for Passenger Railroad Equipment," Authorized September 2005.

(ii) [Reserved.]

(2) Communications, RSSB, Block 2 Angel Square, 1 Torrens Street, London, England EC1V 1NY, [www.rgsonline.co.uk](http://www.rgsonline.co.uk).

(i) Railway Group Standard GM/RT2100, Issue Four, "Requirements for Rail Vehicle Structures," Rail Safety and Standards Board Ltd., December 2010.

(ii) [Reserved.]

##### § 238.735 Seat crashworthiness (passenger and cab crew).

(a) Passenger seating in Tier III trainsets shall comply with the requirements referenced in either of the following paragraphs:

(1) Section 238.233 and APTA PR-CS-S-016-99 excluding Section 6.0, "Seat durability testing;" or

(2) Section 6.2, "Seats for passengers, personnel, or train crew," of Railway Group Standard GM/RT2100, provided that—

(i) The conditions of 238.705(b)(2) are met;

(ii) Seat attachment strength is based on a minimum of 5g longitudinal, 3g lateral, and 3g vertical acceleration resistance; and

(iii) Use of the standard is carried out under any conditions identified in the railroad's Safe Operation Plan for Tier III Passenger Equipment, as approved by FRA.

(b) Each seat provided for an employee in the cab of a Tier III trainset, and any floor-mounted seat in the cab, shall comply with the requirements in both of the following paragraphs:

(1) Sections 238.233 (e), (f), and (g), including the loading requirements of 8g longitudinally, 4g laterally, and 4g vertically; and

(2) The performance, design, and test criteria of AAR-RP-5104.

(c) The standards required in this section are incorporated by reference into this section with the approval of the Director of the Federal Register under 5 U.S.C. 552(a) and 1 CFR part 51. All approved material is available for inspection at Federal Railroad Administration, Docket Clerk, 1200 New Jersey Avenue SE., Washington, DC and

are available from the sources indicated below. They are also available for inspection at NARA. For information on the availability of this material at NARA, call 202-741-6030 or go to [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html).

(1) American Public Transportation Association, 1666 K Street NW., Washington, DC 20006, [www.aptastandards.com](http://www.aptastandards.com).

(i) APTA PR-CS-S-016-99, Rev. 2, "Standard for Passenger Seats in Passenger Rail Cars," Authorized October 2010.

(ii) [Reserved.]

(2) Communications, RSSB, Block 2 Angel Square, 1 Torrens Street, London, England EC1V 1NY, [www.rgsonline.co.uk](http://www.rgsonline.co.uk).

(i) Railway Group Standard GM/RT2100, Issue Four, "Requirements for Rail Vehicle Structures," Rail Safety and Standards Board Ltd., December 2010.

(ii) [Reserved.]

(3) AAR-RP-5104, "Locomotive Cab Seats," April 2008.

(i) Association of American Railroads, 425 3rd Street SW., Washington, DC 20024, [aarpublishations.com](http://aarpublishations.com).

(ii) [Reserved.]

#### § 238.737 Luggage racks.

(a) Overhead storage racks shall provide longitudinal and lateral restraint for stowed articles. These racks shall incorporate transverse dividers at a maximum spacing of 10 ft. (3 m) to restrain the longitudinal movement of luggage. To restrain the lateral movement of luggage, these racks shall also slope downward in the outboard direction at a minimum ratio of 1:8 with respect to a horizontal plane.

(b) Luggage racks shall comply with the requirements in either of the following paragraphs:

(1) Section 238.233; or

(2) Section 6.8, "Luggage stowage," of Railway Group Standard GM/RT2100, provided that—

(i) The conditions of 238.705(b)(2) are met;

(ii) Attachment strength is based on a minimum of 5g longitudinal, 3g lateral, and 3g vertical acceleration resistance; and

(iii) Use of the standard is carried out under any conditions identified in the railroad's Safe Operation Plan for Tier III Passenger Equipment, as approved by FRA. In particular, the railroad shall determine the maximum allowable weight of the luggage stowed for purposes of evaluating luggage rack attachment strength.

(c) Railway Group Standard GM/RT2100, Issue Four, "Requirements for

Rail Vehicle Structures," Rail Safety and Standards Board Ltd., December 2010 is incorporated by reference into this section with the approval of the Director of the Federal Register under 5 U.S.C. 552(a) and 1 CFR part 51. All approved material is available for inspection at Federal Railroad Administration, Docket Clerk, 1200 New Jersey Avenue SE., Washington, DC and is available from Communications, RSSB, Block 2 Angel Square, 1 Torrens Street, London, England EC1V 1NY, [www.rgsonline.co.uk](http://www.rgsonline.co.uk). It is also available for inspection at NARA. For information on the availability of this material at NARA, call 202-741-6030 or go to [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html)

#### Emergency Systems

##### § 238.741 Emergency window egress and rescue access.

(a) *Emergency window egress and rescue access plan.* If a passenger car in a Tier III trainset is not designed to comply with the requirements in §§ 238.113 or 238.114, the railroad shall submit to FRA for approval an emergency window egress and rescue access plan during the design review stage. The plan must include, but is not limited to, the elements in this section.

(b) *Ease of operability.* If an emergency window exit in a passenger car requires the use of a tool, other implement (e.g., hammer), or a mechanism to permit removal of the window panel from the inside of the car during an emergency situation, then the plan must demonstrate the use of the device provides a level of safety equivalent to that provided by § 238.113(b). In particular, the plan must address the location, design, and signage and instructions for the device. The railroad shall also include a provision in its Tier III ITM plan to inspect for the presence of the device at least each day the car is in service.

(c) *Dimensions.* If the dimensions of a window opening in a passenger car do not comply with the requirements in §§ 238.113 or 238.114, then the plan must demonstrate that at least an equivalent level of safety is provided.

(d) *Alternative emergency evacuation openings.* If a passenger car employs the use of emergency egress panels or additional door exits instead of emergency window exits or rescue access windows, then the plan must demonstrate that such alternative emergency evacuation openings provide a level of safety at least equivalent to that required by § 238.113 or § 238.114, or both. The plan must address the

location, design, and signage and instructions for the alternative emergency evacuation openings.

##### § 238.743 Emergency lighting.

(a) Except as provided in paragraph (b) of this section, Tier III trainsets shall comply with the emergency lighting requirements specified in § 238.115.

(b) Emergency lighting back-up power systems shall, at a minimum, be capable of operating after experiencing the individually applied accelerations defined in either of the following paragraphs:

(1) § 238.115(b)(4)(ii); or

(2) Section 6.1.4, "Security of furniture, equipment and features," of Railway Group Standard GM/RT2100, provided that—

(i) The conditions of § 238.705(b)(2) are met;

(ii) Attachment strength is based on a minimum of 5g longitudinal, 3g lateral, and 3g vertical acceleration resistance; and

(iii) Use of the standard is carried out under any conditions identified in the railroad's Safe Operation Plan for Tier III Passenger Equipment, as approved by FRA. (c) Railway Group Standard GM/RT2100, Issue Four, "Requirements for Rail Vehicle Structures," Rail Safety and Standards Board Ltd., December 2010 is incorporated by reference into this section with the approval of the Director of the Federal Register under 5 U.S.C. 552(a) and 1 CFR part 51. All approved material is available for inspection at Federal Railroad Administration, Docket Clerk, 1200 New Jersey Avenue SE., Washington, DC and is available from Communications, RSSB, Block 2 Angel Square, 1 Torrens Street, London, England EC1V 1NY, [www.rgsonline.co.uk](http://www.rgsonline.co.uk). It is also available for inspection at NARA. For information on the availability of this material at NARA, call 202-741-6030 or go to [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html).

#### Cab Equipment

##### § 238.751 Alerters.

(a) An alerter shall be provided in the operating cab of each Tier III trainset, unless in accordance with paragraph (e) of this section the trainset operates in a territory where an alternate technology providing equivalent safety, such as redundant automatic train control or redundant automatic train stop system, is installed.

(b) Upon initiation of the alerter, the engineer must acknowledge the alerter within the time period and according to the parameters specified in the railroad's Safe Operation Plan for Tier

III Passenger Equipment in order for train operation to remain under the full control of the engineer.

(c) If the engineer does not acknowledge the alerter as specified in paragraph (b) of this section, at a minimum a retrievable full service brake application shall occur until the train has stopped, unless the crew intervenes as described in paragraph (d) of this section.

(d) To retrieve the full service brake application described in paragraph (c) of this section, the engineer must acknowledge the alerter and activate appropriate controls to issue a command for brake application as

specified in the railroad's Safe Operation Plan for Tier III Passenger Equipment.

(e) If an alternate technology to the alerter is used, the railroad shall conduct a hazard analysis that confirms the ability of the technology to provide an equivalent level of safety. This analysis shall be included in the railroad's Safe Operation Plan for Tier III Passenger Equipment.

**§ 238.753 Sanders.**

(a) A Tier III trainset shall be equipped with operative sanders, if required by the railroad's Safe Operation Plan for Tier III Passenger Equipment.

(b) Sanders required under this section shall comply with § 229.131(a), (b), and (d) of this chapter, except that instead of the requirements of §§ 229.9 and 229.23 of this chapter:

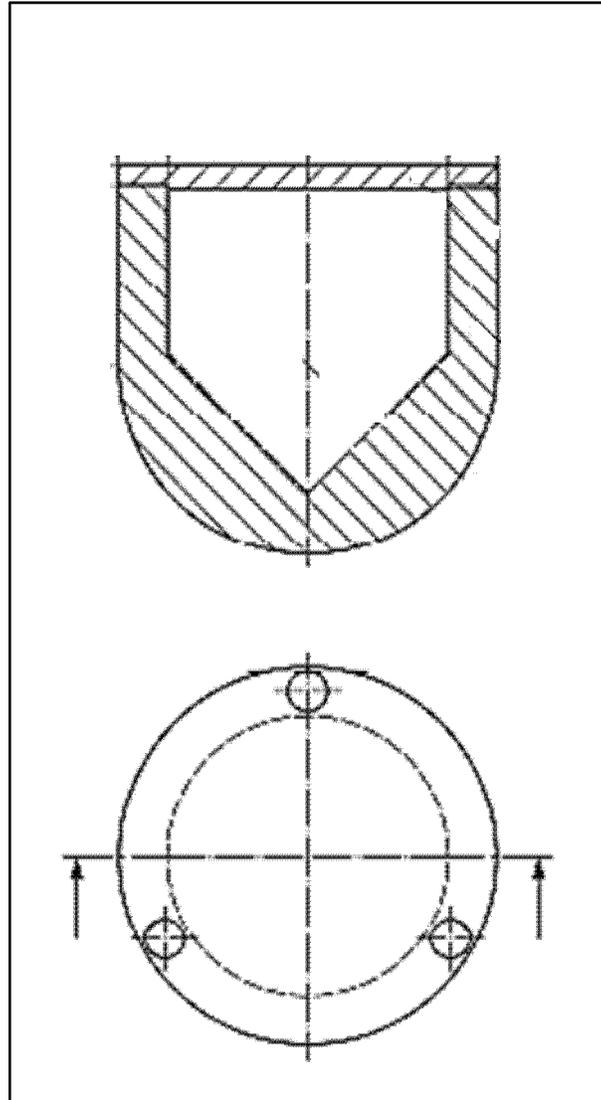
(1) The requirements of § 238.17 shall apply to the tagging and movement of a Tier III trainset with defective sanders; and

(2) The requirements of the railroad's ITM plan shall apply to the next periodic inspection of such a trainset.

(c) In addition to the requirements in paragraph (b) of this section, the railroad's ITM plan shall specify the ITM requirements for Tier III trainsets equipped with sanders.

**Figure 1 to Subpart H of Part 238—Cylindrical Projectile for Use in § 238.721**

**End-Facing Cab-Glazing Testing**



■ 18. Add subpart I to part 238 to read as follows:

**Subpart I—Inspection, Testing, and Maintenance Requirements for Tier III Passenger Equipment**

- Sec.
- 238.801 Scope.
- 238.803 Inspection, testing, and maintenance requirements; brake system.
- 238.805 Periodic tests; brake system.

**§ 238.801 Scope.**

This subpart contains specific requirements for railroad passenger equipment operating in a shared right-of-way at speeds not exceeding 125 mph and in an exclusive right-of-way without grade crossings at speeds exceeding 125 mph but not exceeding 220 mph.

**§ 238.803 Inspection, testing, and maintenance requirements; brake system.**

(a) Except as provided in paragraph (b) of this section, Tier III trainsets shall be subject to the ITM requirements of subpart F of this part.

(b)(1) The equivalent of a Class I brake test contained in § 238.313 shall be developed for use where required by this part, and shall be defined in the railroad’s ITM plan.

(2) Movement of a trainset with a power brake defect as defined in § 238.15 shall be conducted in accordance with § 238.15, with the following exceptions:

(i) The confirmation of the percentage of operative power brakes required by § 238.15(c)(4)(iv) may be by a technological method specified in the railroad’s Safe Operation Plan for Tier III Passenger Equipment;

(ii) The computation of the percentage of operative power brakes required by § 238.15(c)(1) shall be determined by a formula specified in the railroad’s Safe Operation Plan for Tier III Passenger Equipment; and

(iii) Operating restrictions determined by the percentage of operative power brakes in a trainset shall be based upon the requirements of § 238.15 when the trainset operates in a shared right-of-way; operating restrictions shall be based upon a percentage of operative brakes as defined in the railroad’s Safe Operation Plan for Tier III Passenger Equipment when the trainset operates in a right-of-way exclusively for Tier III passenger equipment.

**§ 238.805 Periodic tests; brake system.**

(a) Each Tier III trainset shall be subject to the tests and inspections prescribed in the railroad’s ITM plan, as approved by FRA. All testing required under this section shall be performed at

the intervals specified in the ITM plan. The railroad’s ITM plan shall include, but not be limited to, the following requirements:

(1) The filtering devices or dirt collectors located in the main reservoir supply line to the air brake system shall be cleaned, repaired, and replaced under the ITM plan.

(2) All brake control equipment and truck brake equipment shall be cleaned, repaired, and tested under the ITM plan.

(3) The date and place of cleaning, repairing, or testing shall be recorded in the railroad’s data management system, and the person performing the work and that person’s supervisor shall sign the form electronically. A record of the components of the air brake system that are cleaned, repaired, or tested shall be kept in the railroad’s electronic files.

(b) Each periodic inspection shall include, but not be limited to, the following requirements:

(1) All mechanical gauges used by the engineer to aid in the control or braking of the trainset shall be tested by comparison with a dead-weight tester or a test gauge designed for this purpose. A gauge or device shall not be in error more than five percent, or three p.s.i., whichever is less.

(2) All electrical devices and visible insulation shall be inspected.

(3) All cable connections between cars and jumpers that are designed to carry 600 volts or more shall be thoroughly cleaned, inspected, and tested for continuity. A microprocessor-based self-monitoring event recorder, if installed, is exempt from periodic inspection.

■ 19. Add and reserve subpart J to part 238.

**Subpart J—Specific Requirements for the Safe Operation Plan for Tier III Passenger Equipment [Reserved]**

■ 20. Amend paragraph (c) of Appendix B to part 238 by adding a sentence to the end of note 16 of the table of “Test Procedures and Performance Criteria for the Flammability and Smoke Emission Characteristics of Materials Used in Passenger Cars and Locomotive Cabs” to read as follows:

**Appendix B to Part 238—Test Methods and Performance Criteria for the Flammability and Smoke Emission Characteristics of Materials Used in Passenger Cars and Locomotive Cabs**

\* \* \* \* \*

(c) \* \* \*  
16 \* \* \* For purposes of this Note, the floor assembly of a vehicle in a Tier III trainset may be tested together with undercar design features that separate the vehicle from the fire source, *i.e.*, skirts and bottom covers, to protect against a fire source under and

external to the vehicle. To assess the safety associated with testing the floor assembly in this manner, and to protect against a fire source under the floor assembly but internal to the vehicle, safety must also be demonstrated by conducting a fire hazard analysis that includes the considerations in Note 17.

\* \* \* \* \*

■ 21. Revise the introductory text of appendix F to part 238 by adding a third paragraph to read as follows:

**Appendix F to Part 238—Alternative Dynamic Performance Requirements for Front End Structures of Cab Cars and MU Locomotives**

\* \* \* \* \*

Although the requirements of this appendix are stated in terms applicable to Tier I passenger equipment, they are also applicable to Tier III passenger trainsets under § 238.711. Specifically, the cab ends of Tier III trainsets shall comply with the requirements of this appendix to demonstrate the integrity of the end structure.

\* \* \* \* \*

■ 22. Add appendix G to part 238 to read as follows:

**Appendix G to Part 238—Alternative Requirements for Evaluating the Crashworthiness and Occupant Protection Performance of a Tier I Passenger Trainset**

**General**

This appendix applies to Tier I alternative passenger trainsets, as described below. While the appendix may refer to specific units of rail equipment in a trainset, the alternative requirements in this appendix apply only to a trainset as a whole.

This appendix specifies alternatives to the crashworthiness and occupant protection performance requirements for Tier I passenger equipment in §§ 238.203, Static end strength; 238.205, Anti-climbing mechanism; 238.207, Link between coupling mechanism and car body; 238.209(a), Forward end structure of locomotives, including cab cars and MU locomotives; 238.211, Collision posts; 238.213, Corner posts; and 238.219, Truck-to-carbody attachment. To maintain their integrity, these requirements apply as a whole. They also apply in addition to the requirements of §§ 238.209(b); 238.215, Rollover strength; 238.217, Side structure; and 238.233, Interior fittings and surfaces; and with APTA standards for occupant protection and an AAR recommended practice for locomotive cab seats, as specified in this appendix.

For ease of comparison with the Tier I requirements in subpart C of this part, this appendix is arranged in order by the Tier I section referenced.

Use of this appendix to demonstrate alternative crashworthiness and occupant protection performance for Tier I passenger equipment is subject to FRA review and approval under § 238.201.

**Occupied Volume Integrity**

(a) Instead of the requirements of § 238.203, the units of a Tier I alternative passenger trainset may demonstrate their occupied volume integrity (OVI) by complying with both the quasi-static compression load and dynamic collision requirements in §§ 238.703(b) and 238.705, respectively.

**Override Protection**

(b) *Colliding equipment.* Instead of the requirements of § 238.205, the units of a Tier I alternative passenger trainset may demonstrate their ability to resist vertical climbing and override at each colliding interface during a train-to-train collision by complying with the dynamic collision requirements in § 238.707(a).

(c) *Connected equipment.* Instead of the requirements of §§ 238.205 and 238.207, when connected, the units of a Tier I alternative passenger trainset may demonstrate their ability to resist vertical climbing and override by complying with the dynamic collision requirements in § 238.707(b).

**Fluid Entry Inhibition**

(d) Instead of the requirements of § 238.209(a), each cab end of a Tier I alternative passenger trainset may demonstrate its ability to inhibit fluid entry and provide other penetration resistance by complying with the requirements in § 238.709.

**End Structure Integrity of Cab End**

(e) Each cab end of a Tier I alternative passenger trainset is subject to the requirements of appendix F to this part to demonstrate cab end structure integrity. For those cab ends without identifiable corner or collision posts, the requirements of appendix

F apply to the end structure at the specified locations, regardless of whether the structure at the specified locations is a post.

**End Structure Integrity of Non-Cab End**

(f) Instead of the applicable requirements of §§ 238.211 and 238.213, the units of a Tier I alternative trainset may demonstrate end structure integrity for other than a cab end by complying with the requirements in § 238.713(b) and (c).

**Roof and Side Structure Integrity**

(g) A Tier I alternative passenger trainset is subject to the requirements of §§ 238.215 and 238.217 to demonstrate roof and side structure integrity.

**Truck Attachment**

(h) Instead of the requirements of § 238.219, the units of a Tier I alternative passenger trainset may demonstrate their truck-to-carbody attachment integrity by complying with the requirements in § 238.717 (b) through (e).

**Interior Fixture Attachment**

(i) A Tier I alternative passenger trainset is subject to the interior fixture requirements in § 238.233. Interior fixtures must also comply with APTA PR-CS-S-006-98, Rev. 1, "Standard for Attachment Strength of Interior Fittings for Passenger Railroad Equipment," Authorized September 2005, and those portions of APTA PR-CS-S-034-99, Rev. 2, "Standard for the Design and Construction of Passenger Railroad Rolling Stock," Authorized June 2006, relating to interior fixtures.

**Seat Crashworthiness (Passenger and Crew)**

(j) *Passenger seating.* Passenger seating in a Tier I alternative passenger trainset is subject to the requirements for seats in § 238.233 and must also comply with APTA

PR-CS-S-016-99, Rev. 2, "Standard for Passenger Seats in Passenger Rail Cars," Authorized October 2010, with the exception of Section 6.0, Seat Durability Testing.

(k) *Crew seating.* Each seat provided for an employee regularly assigned to occupy the cab of a Tier I alternative passenger trainset, and any floor-mounted seat in the cab, must comply with the following:

(1) Section 238.233(e), (f), and (g), including the loading requirements of 8g longitudinally, 4g laterally, and 4g vertically; and

(2) The performance, design, and test criteria of AAR-RP-5104, "Locomotive Cab Seats," April 2008.

■ 23. Add appendix H to part 238 to read as follows:

**Appendix H—Rigid Locomotive Design Computer Model Input Data and Geometrical Depiction**

As specified in § 238.705(a)(4), this appendix provides input data and a geometrical depiction necessary to create a computer model of the rigid (conventional) locomotive design for use in evaluating the OVI of a Tier III trainset in a dynamic collision scenario. (This appendix may also be applied to a Tier I alternative passenger trainset to evaluate its OVI, in accordance with appendix G).

The input data, in the form of an input file, contains the geometry for approximately the first 12 feet of the rigid locomotive design. Because this input file is for a half-symmetric model, a locomotive mass corresponding to 130,000 pounds of weight is provided for modeling purposes—half the 260,000 pounds of weight specified for the locomotive in § 238.705(a)(4). Figure 1 to this appendix provides two views of the locomotive's geometric depiction.

\*\*\*\*\*BEGIN INPUT FILE\*\*\*\*\*

\*Heading

\*\* USDOT/VOLPE CENTER FINITE ELEMENT MODEL  
\*\* FULLY RIGID LOCOMOTIVE DESIGNED FOR 1-D MODELING  
\*\* LOCOMOTIVE BASED ON F-40 TYPE  
\*\* HALF-SYMMETRY INPUT FILE  
\*\* WHOLE LOCOMOTIVE WEIGHT: 260,000 POUNDS  
\*\* UNITS: INCHES/POUNDS/SECONDS  
\*\* JULY, 2010  
\*\* Generated by: Abaqus/CAE 6.10-1  
\*\*

\*\* PARTS

\*\*

\*Part, name=PART-1

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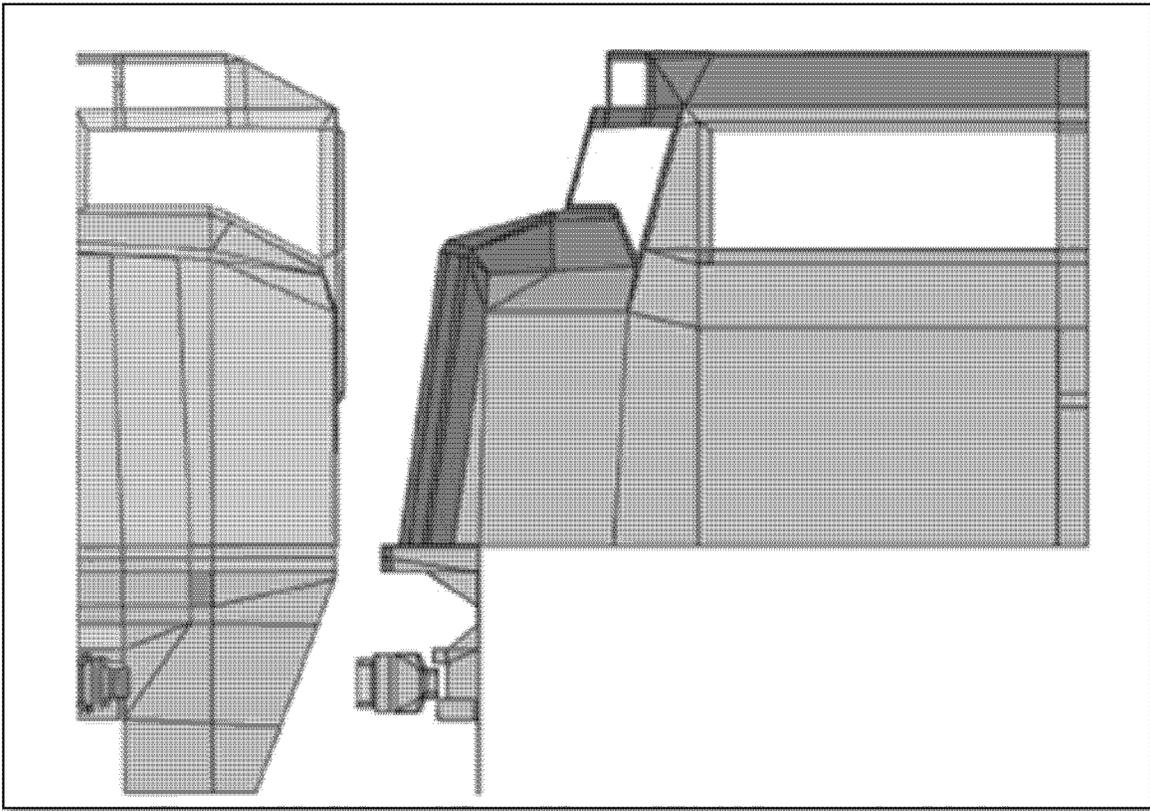
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*Instance, name=PART-1-1, part=PART-1
*End Instance
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*Nset, nset=LOCO_MASS, instance=PART-1-1
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336.439,
*End AssemblyEXTRACT>
*****END INPUT FILE*****
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**Figure 1 to Appendix H—Side and Front Views of Rigid Locomotive Model**



**Sarah Feinberg,**  
*Administrator.*

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