car or a locomotive cab. As proposed in the NPRM, of course, such materials were required to meet the test performance criteria for flammability and smoke emission characteristics contained in Appendix B to part 238, *see* 62 FR 49823–4, or alternative standards after FRA approval. FRA has removed the word ''interior'' from this paragraph in the final rule because its use is inconsistent with the requirements of part 238 as a whole. In the NPRM, proposed Appendix B itself provided test performance criteria for a category of materials entitled, ''Exterior Plastic Components''; specifically, ''End Cap'' and ''Roof Housings'' under the function of material column in the table. Further, proposed Appendix B separately provided test methods and performance criteria for a function of material termed ''Exterior Boxes'' under the category entitled, ''Component Box Covers.'' As expressed in the NPRM, FRA intended that ''exterior'' materials used in constructing passenger cars and locomotive cabs comply with test performance criteria for flammability and smoke emission characteristics.

In the final rule, materials used in constructing passenger cars and locomotive cabs are required to meet the test performance criteria for flammability and smoke emission characteristics as specified in Appendix B, or alternative standards after FRA approval. As a result, with the exception of any alternative standards approved by FRA, the terms of Appendix B govern which testing of materials is, or is not, required as a threshold inquiry. Whether materials are physically located on the exterior or in the interior of a passenger car, for example, such materials are subject to testing for flammability and smoke emission characteristics if so required by the terms of Appendix B. Overall, FRA believes that the final rule more appropriately specifies the flammability and smoke emission testing requirements for materials used in constructing passenger cars and locomotive cabs, without unnecessarily burdening railroads. In particular FRA notes that, unlike the NPRM, Appendix B in the final rule provides express exceptions from the need to test materials used in constructing passenger cars and locomotive cabs under certain conditions. (See the section-by-section analysis discussion of Appendix B to part 238, explaining the changes to Appendix B.)

In its comments on the NPRM, APTA recommended that the requirements of paragraph (a)(1) apply to passenger cars and cabs of locomotives ordered on or after one year following the effective date of the final rule. APTA's suggested rule text did not contain an outside limit on the placement in service of new passenger equipment not meeting the requirements of paragraph (a)(1), although ordered within the permitted time. However, FRA believes that an outside limit on the placement in service of new passenger equipment not meeting the requirements of this section needs to be retained so as not to delay unnecessarily the implementation of the rule.

Under paragraph (a)(2), on or after November 8, 1999 materials introduced into a passenger car or a locomotive cab, during any kind of rebuild, refurbishment, or overhaul of such passenger equipment, shall meet the test performance criteria for flammability and smoke emission characteristics as specified in Appendix B, or alternative standards after FRA approval as specified in this rule. Originally, FRA proposed that the test performance criteria for flammability and smoke emission characteristics apply as of the effective date of the final rule to materials used in refurbishing passenger car and locomotive cab interiors. FRA has removed the express reference to passenger car and locomotive cab interiors for the reasons stated in the above discussion of paragraph (a)(1).

In response to the NPRM, APTA commented that it may support a rule requiring the materials selection criteria to be used when the interiors of existing passenger equipment are refurbished, if the term refurbish were carefully defined in the Working Group meetings. In either case, APTA recommended that this provision should apply as of one year following the effective date of the final rule. FRA has refined paragraph (a)(2) to address APTA's concern: Simply put, if material is introduced into passenger cars and locomotive cabs during any kind of rebuild, refurbishment, or overhaul of the equipment, the material must comply with the test performance criteria for flammability and smoke emission characteristics as specified in Appendix B, or alternative standards after FRA approval. For example, if a seat or a section of a wall is replaced, then the materials used to replace those components (including an individual seat cushion) must comply with the test performance criteria for flammability and smoke emission characteristics as specified in Appendix B, or alternative standards after FRA approval. However, paragraph (a)(2) does not in itself require a railroad to remove existing materials from a vehicle that do not comply with test performance criteria for flammability and smoke emission characteristics, when such materials are found but not intended to be replaced during the railroad's rebuilding, refurbishment, or overhaul of that vehicle. Of course, such non-compliant materials may be required to be removed from the vehicle pursuant to the fire safety analyses required under paragraph (d) of this section; yet, again, the requirements of paragraph (a)(2) do not specifically require such removal. FRA believes that deferring the implementation of this provision for one year, as recommended by APTA, is therefore not necessary for railroads in light of this section's clearly defined application.

As noted above in the discussions of paragraphs (a)(1) and (a)(2), railroads can request FRA approval to utilize alternative standards issued or recognized by an expert consensus organization in lieu of complying with the test performance criteria for flammability and smoke emission characteristics as specified in Appendix B. A railroad must make such a request pursuant to the procedures in § 238.21.

Paragraph (b) requires railroads to obtain certification that a representative sample of combustible materials to be used in constructing passenger cars and locomotive cabs (pursuant to paragraph (a)(1)) or introduced into such equipment as part of any kind of rebuild, refurbishment, or overhaul of the equipment (pursuant to paragraph (a)(2)) have been tested and comply with the fire safety requirements specified in this part. Paragraph (b) is based on § 238.115(b) in the NPRM. FRA has modified the certification requirement following a comment by APTA on the NPRM that the certification be based on a representative sample of the combustible materials used. In response to another APTA comment, FRA has also clarified that the certification be based on the results at the time the materials were tested.

Paragraph (c) requires each railroad to address the fire safety of new equipment during the design stage so as to reduce the risk of harm due to fire to an acceptable level using MIL–STD–882C as a guide or another such formal methodology. (A copy of MIL–STD–882C has been placed in the public docket for this rulemaking.) To this end, the rule requires that each railroad complete a written analysis of the fire safety problem and ensure that good fire protection practice is used during the design of the equipment. This paragraph is based on proposed § 238.105(a) and (b) in the NPRM. *See* 62 FR 49800.

Booz-Allen & Hamilton, Inc. (Booz-Allen) commented that the risk acceptance level be clarified. It stated that MIL–STD–882C does not define a risk acceptance level itself, and it believed each individual railroad should determine that level based on its own operating experience, fleet life, operating conditions, and other factors. FRA recognizes that MIL–STD–882C does not define a specific acceptance level itself. Yet, the Standard leads a railroad through the steps necessary to determine an acceptance level, and the railroad is in the best position to make that determination. FRA notes that Booz-Allen also submitted a number of other comments on the elements on the fire safety analyses required by the rule, and FRA has incorporated several of these comments in whole and in part.

Paragraph (d) requires that existing passenger equipment and operations be subjected to a fire safety analysis similar to that proposed for new equipment in paragraph (c). This paragraph is based on proposed § 238.105(d) in the NPRM. See 62 FR 49801. A preliminary fire safety analysis would be required within the first year. This effort would constitute an overview of the fleet and service environments, together with known elements of risk (e.g., tunnels). For any category of equipment and service identified as possibly presenting unacceptable risk, a full analysis and any necessary remedial action would be required within the following year. A full fire safety analysis, including review of the extent to which materials in all existing cars comply with the test performance criteria for flammability and smoke emission characteristics contained in Appendix B to this part or alternative standards approved by FRA under this part, would be required within 4 years. This overall review would closely parallel and reinforce the passenger train emergency preparedness planning effort mandated under a separate docket (*see* 63 FR 24630; May 4, 1998).

Paragraph (d) responds to NTSB concerns following its investigation of the collision involving a MARC commuter train with Amtrak's Capitol Limited at Silver Spring, Maryland, on February 16, 1996. Among 13 recommendations addressed to FRA was the following:

> Require that a comprehensive inspection of all commuter passenger cars be performed to independently verify that the interior materials in these cars meet the expected performance requirements for flammability and smoke emissions characteristics.

(R–97–20) (NTSB/RAR–97/02, ''Collision and Derailment of Maryland Rail Commuter MARC Train 286 and National Railroad Passenger Corporation AMTRAK Train 29 Near Silver Spring, Maryland on February 16, 1996.'') The NTSB noted that some materials taken from a MARC car not involved in the fire that resulted from the collision ''failed current flammability and smoke emissions testing criteria,'' and that the materials in the actual cab control car involved in the collision ''also most likely would have failed'' to meet the testing criteria. (NTSB/RAR 97/02 at 63.) The NTSB did note, however, that had the materials met current performance criteria, the outcome would not have been any different because of the presence of diesel fuel sprayed into the cab control car. *Id*. Overall, the NTSB found that because other commuter passenger cars may also have interior materials that may not meet specified performance criteria for flammability and smoke emission characteristics, the safety of passengers in those cars could be at risk.

FRA agrees with the NTSB that steps must be taken to minimize fire safety vulnerabilities in the existing rail passenger equipment fleet. Present fire safety guidelines are advisory and were not introduced by FRA until 1984. Even in recent years, passenger railroads have been free to utilize non-compliant materials (particularly during interior refurbishment funded locally without FTA support). It is appropriate for each commuter authority and Amtrak to evaluate the mix of materials, possible sources of ignition, and potential fire environments—including tunnels, cuts and elevated structures where evacuation to the outside of the vehicle may be difficult or ineffectual in reducing the risk of injury—relevant to the risk of injury due to fire or smoke exposure.

FRA is concerned in particular with the risk arising from the operation of cab cars forward and MU locomotives. Due to their position in the lead of a passenger train, these vehicles are more greatly exposed to the risk of fire from collisions with other rail vehicles as well as highway vehicles at grade crossings. In a collision, fire may erupt from the fuel tanks of both the rail and highway vehicles, and also from tanks used by highway vehicles that transport loads of flammable material. The level of risk on each railroad corresponds to the number of highway-rail grade crossings, density of rail traffic, and opportunities for collisions.

FRA requested comments on the costs and benefits associated with the approach contained in paragraph (d). APTA commented that there would be little safety benefit to commuter railroads, and potentially great cost, in requiring the fire safety program for new passenger equipment to be applied to all categories of existing passenger equipment. APTA commented that the need for a program of this type has not been demonstrated, and that neither statistics nor other evidence has been presented to show that non fuel-fed equipment fires are a serious cause of injury or death in the passenger railroad industry. APTA added that, unlike a fire safety analysis of new equipment, where design flexibility exists to correct in an economical manner any deficiencies uncovered by the analysis, costs to modify existing equipment can be an order of magnitude higher. Overall, APTA believed the impact of the proposal to be great due to the expense of retrofitting equipment, although it was unable to quantify the exact impact without performing the fire safety analyses necessary to determine what modifications needed to be done to equipment. Booz-Allen also commented that the rule will not be cost-effective for existing passenger equipment that has less than 5 years of service life.

FRA recognizes the concern that retrofitting existing passenger equipment may impose considerable cost, and FRA neither proposed nor is requiring that materials not complying with the test performance criteria for flammability and smoke emission characteristics be removed in every instance from existing passenger equipment, if such materials are found during a fire safety analysis. Accordingly, each railroad is afforded the flexibility of reducing an unacceptable safety risk uncovered during an analysis of its equipment by the best means it sees fit. However, FRA is reluctant to withhold application of this provision to equipment with less than a specified service life. First, the practical question exists whether the service life of a vehicle can be specified in fact, considering the ability to extend a vehicle's life by rebuilding and the possibility of its sale to other railroads. Second, FRA believes that a preliminary fire safety analysis of all passenger equipment is necessary to determine whether any passenger equipment may present an unacceptable safety risk for passengers and crewmembers, regardless of the age of the vehicle. If an unacceptable risk is in fact found and the railroad had intended on retiring the equipment in the near future, the railroad can evaluate for itself whether it is more economical to retire the equipment or correct the safety deficiency. Further, considering the historical record of fires on passenger equipment, FRA does not expect railroads to find widespread fire safety problems on the equipment it operates, and thus FRA would expect that most of the time a preliminary fire safety analysis would be all that is necessary.

In its comments on the NPRM, Booz-Allen questioned whether the fire safety analysis of existing equipment would include consideration of nonmetallic and noncombustible materials. FRA believes that such consideration is necessary because, for example, floor tiles or other non-metallic materials may have coatings that may emit gas in a fire. Booz-Allen also commented that the fire risk of equipment depends on the ignitability of the materials, and, accordingly, ignitability tests should be included as part of the performance criteria. FRA believes the ignitability of materials is sufficiently addressed by the test performance criteria for flammability and smoke emission characteristics found in Appendix B to this part.

In the end, FRA believes the concern of the commenters as to the expense of paragraph (d) is overestimated. A railroad is not required to replace non-compliant materials in every instance, if such materials are found, and that has been made clear in the rule text. Neither has FRA specified that the railroad perform a fire safety analysis equivalent to that required for new equipment under paragraph (c).

As a final point FRA notes that, following its investigation of the Silver Spring, Maryland, passenger train collision, the NTSB also found that Federal guidelines on the flammability and smoke emission characteristics and the testing of interior materials do not provide for the integrated use of passenger car interior materials and, as a result, are not useful in predicting the safety of the interior environment of a passenger car in a fire. (NTSB/RAR–97/02, at 74) FRA believes that existing fire safety guidelines have continuing value for their specific purpose. Those guidelines are being codified, as revised, in this final rule as the best currently available criteria for analysis of individual materials. As noted above, FRA is conducting research through NIST to address the interaction of materials and other aspects of fire safety from a broader, systems approach. This philosophy is embodied in part in paragraph (c) with respect to new equipment. Based on this ongoing research and industry fire safety efforts, FRA expects to propose new fire safety standards in the second phase of this rulemaking.

Section 238.105 Train Hardware and Software Safety

This section applies to train hardware and software used to control or monitor safety functions in passenger equipment ordered on or after September 8, 2000, and such components implemented or materially modified in new or existing passenger equipment on or after September 9, 2002. Inclusion of these requirements in passenger equipment reflects the growing role of automated systems to control or monitor passenger train safety functions.

This section represents the merger of proposed sections 238.107 (''Software safety program'') and 238.121 ('' Train system software and hardware'') in the NPRM. Although FRA received no particular comments on these sections in response to the NPRM, FRA determined that these sections should be combined to make the requirements of the final rule more concise and clear.

Paragraph (a) requires the railroad to develop and maintain a written hardware and software safety program to guide the design, development, testing, integration, and verification of computer software and hardware that controls or monitors passenger equipment safety functions. In preparing this paragraph of the final rule, FRA essentially combined the requirements proposed in § 238.107(a), and § 238.121(a) of the NPRM. *See* 62 FR 49801, 49803. Paragraph (b) states that the hardware and software safety program shall be based on a formal safety methodology that includes a Failure Modes, Effects, Criticality Analysis (FMECA); full verification and validation testing for all hardware and software that controls or monitors equipment safety functions, including testing for the interfaces of such hardware and software; and comprehensive hardware and software integration testing to ensure that the software functions as intended. A formal safety analysis that includes full verification testing is standard practice for safety systems that contain software components. Hardware and software integration testing ensures that the hardware and the software installed in the hardware function together as intended. This testing is common practice for safety control systems that include both software and hardware components. The requirements found in paragraph (b) arise in particular from § 238.121(a) and (b) of the NPRM. *See* 62 FR 49803.

Paragraph (c) focuses on ensuring the safety and reliability of software that controls or monitors passenger equipment safety functions. Paragraph (c) specifies that, for purposes of complying with this section, such software shall be considered safety-critical unless a completely redundant, failsafe, non-software means to provide the same function is provided. The requirements of this paragraph were principally drawn from § 238.107(a) and (b) of the NPRM. *See* 62 FR 49801. FRA notes that the final rule omits proposed § 238.107(c) in the NPRM as a separate provision in this rule. *See id.* However, in complying with paragraph (c) of the final rule, a railroad must necessarily ensure that software safety requirements are specified in its contracts for the purchase of the software. The railroad must further retain documentation to show that the software was manufactured to the design criteria specified pursuant to this section and that all required testing was performed. However, verification and validation of control systems by an independent entity is not required by this rule, nor is a fully quantitative proof of safety mandated by this rule, as neither was proposed.

Paragraph (d) specifies that hardware and software that controls or monitors safety functions shall include design features that result in a safe condition in the event of a computer hardware or software failure. Such design features are used in aircraft, as well as in weapon control systems, to ensure their safety. In the case of primary braking systems, electronic controls must either fail safely (resulting in a full service brake application) or access to full pneumatic control must be provided. As clarified, this provision was proposed in § 238.121(c) of the NPRM. *See* 62 FR 49803.

Paragraph (e) makes clear that the railroad shall comply with the elements of its hardware and software safety program that affect the safety of the passenger equipment. Failure to carry out a provision unrelated to the safety of the equipment is not implicated by this section, so as not to unnecessarily restrict the flexibility of the railroad. FRA adapted this requirement from that proposed in § 238.107(d) of the NPRM. *See* 62 FR 498901.

Overall, the requirements of this section reflect good practices that have led to reliable, safe computer hardware and software control systems in other industries. Computer hardware and software systems designed to these requirements may require a larger initial investment to develop, but experience in other industries has shown that this investment is quickly recovered by significantly reducing hardware and software integration problems and minimizing trouble-shooting and debugging of equipment.

§ 238.107 Inspection, Testing, and Maintenance Plan

This section contains the general provisions requiring railroads to develop detailed plans for inspecting, testing, and maintaining Tier I equipment. (The inspection, testing, and maintenance plan for Tier II equipment is covered under § 238.503.) FRA's goal is for railroads to develop a set of standards to ensure that equipment remains safe and operates properly as it wears and ages, and to provide enough flexibility to allow individual railroads to adapt the maintenance standards to their own unique operating environment.

Paragraph (b) requires a railroad that operates Tier I passenger equipment subject to this part to develop and provide to FRA, if requested, particulars about its inspection, testing, and maintenance plan for that equipment, including the following:

- Inspection procedures, intervals and criteria;
- Testing procedures and intervals;
- Scheduled preventive maintenance intervals;
- Maintenance procedures; and
- Training of workers who perform the tasks.

Since FRA does not dictate the exact contents of the plan, individual railroads retain much flexibility to tailor the plan to their individual needs and experience. At the same time, FRA believes this requirement is important and will cause railroads to re-examine their inspection, testing, and maintenance procedures to determine that they are adequate to ensure that the safety-related components of their equipment are not deteriorating over time. This approach represents good business practice and in most cases merely formalizes what passenger railroads are already doing. However, FRA believes this section will provide valuable guidance to regional governments or coalitions attempting to establish new commuter rail service.

Paragraph (c) makes clear that the inspection, testing, and maintenance plan required by this section should not include procedures to address employee working conditions that arise in the course of conducting the inspections, tests, and maintenance set forth in the plan. FRA intends for the plan required by this section to detail only those tasks required to be performed in order to conduct the inspections, tests, and maintenance necessary to ensure that the equipment is in safe and proper condition for use. In proposing the creation of these plans, FRA did not intend to enter into the area of addressing employee safety while conducting the inspections, tests, and maintenance covered by the plans. FRA is always concerned with the safety of employees while conducting their duties, but employee safety in maintenance and servicing areas generally falls within the jurisdiction of the United States Department of Labor's Occupational Safety and Health Administration (OSHA). It is not FRA's intent to oust OSHA's jurisdiction with regard to the safety of employees while performing the inspections, tests and maintenance required by this part, except where FRA has already addressed workplace safety issues, such as for blue signal protection. Therefore, in order to prevent any uncertainty as to FRA's intent, FRA has modified this section by eliminating any language or provision which could have been potentially perceived as displacing the jurisdiction of OSHA and has added a specific clarification that FRA does not intend for the plan required by this section to address employee safety issues that arise in the course of conducting the inspections and tests described. Consequently, the specific elements that FRA proposed to be included in the inspection, testing, and maintenance plan have been eliminated for the reasons noted above and because they were merely duplicative of the general requirements contained in paragraph (b) and are unnecessary.

It should also be noted that the general inspection, testing, and maintenance requirements previously proposed in the 1997 NPRM at paragraph (b) of this section (62 FR 49801–802) and the maintenance interval requirements proposed at paragraph (c) have been removed from this section in this final rule. The conditions and components previously proposed in paragraph (b) of this section have been moved to the periodic mechanical inspection contained in § 238.307(c). As the conditions previously proposed in this paragraph were intended to ensure that the railroads had an inspection scheme in place to ensure that all systems and components of the equipment are free of conditions that endanger the safety of the crew, passengers or equipment, FRA believes that a specific inspection interval would be better suited to address the general condition of the equipment and ensure the safety of railroad employees, passengers and equipment. In addition, the maintenance interval requirements have been modified and moved to the periodic mechanical inspection requirements contained in § 238.307(b). Consequently, FRA has moved the general conditions maintenance interval provisions previously addressed in this section to the specific inspection requirements contained in subpart D of this final rule.

Section 238.109 Training, Qualification, and Designation Program

This section contains the training, qualification, and designation requirements for workers (that is, both railroad employees and contractors as defined in the section) who perform inspection, testing, and maintenance tasks. FRA believes that worker training, qualification, and designation are central to a safe operation.

Paragraph (a) requires railroads to adopt and comply with a training, qualification, and designation program for employees and contractors who perform safety-related inspection, testing, or maintenance tasks under this part. ''Contractor,'' in this context, means ''a person under contract with the railroad or an employee of a person under contract with the railroad to perform any of the tasks required by this part.'' FRA intends for the training, qualification, and designation requirements to apply not only to railroad personnel but also to contract personnel that are responsible for performing brake system inspections, maintenance, or tests required by this part. FRA believes that railroads are in the best position to determine the precise method of training that is required for the personnel they elect to use to conduct the required brake system inspections, tests, and maintenance. Although FRA provides railroads with broad discretion to develop training programs specifically tailored to the type of equipment they operate and the personnel they employ, FRA will expect railroads to fully comply with the training and qualification plans they develop. This section has been amended slightly from that proposed in the 1997 NPRM in order to stress that a critical component of this training is ensuring that a railroad's employees are aware of the specific Federal requirements that govern their work. Currently, many railroad training programs fail to distinguish Federal requirements from company policy.

Paragraph (b) contains a series of general requirements or elements which must be part of any training and qualification plan developed and implemented by a railroad. FRA believes that the elements contained in this section are specific enough to ensure high quality training while being sufficiently broad to permit a railroad to develop a training plan that is best suited to its particular operation. This paragraph requires each railroad to identify the specific tasks related to the inspection, testing and maintenance of the brake systems operated by that railroad, develop written procedures for performing those tasks, identify the skills and knowledge necessary to perform those tasks, and specifically identify and educate its employees on the Federal requirements contained in this part related to the performance of those tasks. FRA believes that these requirements will ensure that, at a minimum, the railroad surveys its entire operation and has identified the various activities its employees perform. FRA intends for these written procedures and the identified skills and knowledge to be used as the foundation for any training program developed by the railroad.

This paragraph also makes clear that railroads are permitted to train employees only on those tasks that they will be responsible for performing. FRA tends to agree with several railroad commenters that there is no reason for individuals who solely perform simple air brake or mechanical tests and inspections to be as highly trained as those individuals responsible for conducting comprehensive brake or mechanical inspections or those individuals responsible for trouble-shooting, maintaining, and repairing the equipment. This paragraph also makes clear that a railroad may incorporate an already existing training program, such as an apprenticeship program. Thus, railroads would likely not need to provide much additional training, except training specifically addressing the requirements contained in this part and possibly refresher training, to its mechanical forces that have completed an apprentice program for their craft.

This paragraph also contains requirements that any program developed must include ''hands-on'' training as well as classroom instruction. FRA believes that classroom training by itself is not sufficient to ensure that an individual has retained or grasped the concepts and duties explained in a classroom setting. In order to adequately ensure that an individual actually understands the training provided in the classroom, some sort of ''hands-on'' capability must be demonstrated. FRA believes that the ''hands-on'' portion of the training program would be an ideal place for railroads to fully involve its labor forces in the training process. Appropriately trained and skilled employees would be perfectly suited to provide much of the ''hands-on'' training envisioned by FRA. Consequently, FRA strongly suggests that railroads work in partnership with their employees to develop a training program which utilizes the knowledge, skills, and experience of the employees to the greatest extent possible.

This paragraph specifically requires that employees pass either a written or oral examination covering the equipment, tasks, and Federal regulatory requirements for which they are responsible as well as require that each individual deemed qualified to perform a task required by this final rule demonstrate ''hands-on'' capability to perform that task. This paragraph also contains requirements for conducting periodic refresher training and supervisor oversight of an employee's performance once training is provided. FRA believes both these requirements are essential to ensure that an individual continues to possess the knowledge and skills necessary to continue to perform the tasks for which the individual is assigned responsibility. Furthermore, employees must be periodically retrained in order to keep up with technological advances relating to braking systems that are constantly being made by the industry.

This paragraph also contains the requirements related to maintaining adequate records for establishing that individuals are capable of performing the tasks for which they are assigned responsibility. FRA believes that the record keeping requirements contained in this paragraph are the cornerstone of the training and qualification provisions. As FRA is not proposing specific training curriculums or specific experience thresholds, FRA believes that these record keeping provisions are vital to ensuring that proper training is being provided to railroad personnel. FRA believes these requirements provide the means by which FRA will judge the effectiveness and appropriateness of a railroad's training and qualification program. These provisions also provide FRA with the ability to independently assess whether the training provided to a specific individual adequately addresses the tasks for which the individual is deemed capable of performing, and will most likely prevent potential abuses by railroads to use insufficiently trained individuals to perform the necessary inspections, tests, and maintenance required by this rule. This paragraph makes clear that FRA intends to require that railroads maintain specific personnel qualification records for all personnel (including contract personnel) responsible for the inspection, testing, and maintenance of train brake systems. This paragraph also makes clear that the records maintained by a railroad contain sufficient detail regarding the training provided in order for FRA to ascertain the basis for the railroad's determination.

FRA believes that many benefits can be gained from this increased investment in training. Better inspections will be performed, resulting in the running of less defective equipment, which translates to a better safety record. Equipment conditions requiring maintenance attention are more likely to be found while the equipment is at a maintenance or yard site where repairs can be more easily done. Trouble-shooting of brake and mechanical problems will take less time and more maintenance will be done right the first time, resulting in cost savings due to less rework.

Section 238.111 Pre-Revenue Service Acceptance Testing Plan

This section provides requirements for pre-revenue service testing of passenger equipment and relates to subpart G, which describes requirements for the procurement of Tier II passenger equipment and for a major upgrade or introduction of new technology that could affect safety systems of Tier II passenger equipment. Pre-revenue service acceptance tests are extremely important in that they are the culmination of all the safety analysis and component tests of a railroad's system safety program or other safety planning efforts. The pre-revenue service tests are intended to prove that the equipment can be operated safely in its intended environment and demonstrate the effectiveness of the system safety program or other safety planning undertaken by the railroad.

FRA has revised and clarified this section based on comments received in response to the NPRM. APTA believed that the proposed test program was excessive for equipment that has previous successful operating experience. It believed that an extensive pre-revenue service test program is needed only when a new type of equipment is placed in revenue service for the first time. Otherwise, APTA suggested a simple compatibility check with the infrastructure of a specific railroad is all that is needed when the railroad procures new equipment that has successful operating experience on other railroads. APTA claimed that FRA does not have the in-house expertise to approve plans, and that the need for FRA approval will delay the introduction of new equipment, causing a needless expense. APTA recommended that the rule require a full test program only for the first time equipment is introduced into revenue service, that FRA not approve the test plans, and that FRA instead be invited by railroads to witness the pre-revenue service tests.

Amtrak, in its comments on the NPRM, expressly agreed with APTA. Amtrak believed FRA does not have the resources to support the burden that would be required by the proposal. Further, Amtrak believed there is no technical justification to require the formal testing proposed by FRA when a particular equipment order is nothing more than acquiring additional equipment identical to that purchased on a previous order. Amtrak suggested that formal testing be limited to new and untried types of equipment according to a long-standing AAR practice.

Metra commented that the rule should require railroads to submit their own pre-revenue service testing plans to FRA and invite FRA to witness the testing, instead of having FRA determine when and how railroads should conduct acceptance testing on their systems. Metra explained that railroads know their own systems and are more capable of designing testing plans compatible with their systems. Metra believed waiting for FRA testing and approval would cause needless delay and expense.

In its comments on the NPRM, the BRC believed this section to be wholly necessary because of the types of equipment being brought into service that generally do not comply with the safety appliance laws or the safety glazing regulations, or both. The BRC believed that this equipment must comply with applicable laws and regulations affecting the safety of passengers and railroad workers in order to be brought into service in the United Service. The BRC also recommended that the pre-revenue service testing plan be filed with FRA so that the plan will be available under the Freedom of Information Act (FOIA).

In proposing requirements for pre-revenue service acceptance testing, FRA did distinguish between passenger equipment that has previously been used in revenue service in the United States and that which has not. In lieu of the requirements proposed in § 238.213 (a) through (e) of the NPRM, paragraph (f) provided for an abbreviated testing procedure for passenger equipment that has previously been used in revenue service. *See* 62 FR 49763, 49802–3. Accordingly, FRA agrees that when a particular equipment order is nothing more than acquiring additional equipment identical to that purchased on a previous order, there is no need for detailed testing requirements. This is reflected in § 238.111(a) of the final rule, which governs testing requirements for passenger equipment that has previously been used in revenue service in the United States. Each railroad is required to test such equipment only to ensure the compatibility of the equipment with the railroad's operating system. Although the railroad must keep a record of such testing and make it available to FRA for inspection and copying, no formal submission to FRA is required. (In this regard, FRA does not believe that the plan must be submitted to FRA for the purpose that it may be available to the public under FOIA, as that justification, in itself, would require virtually any railroad safety record to be submitted to FRA, whether or not FRA deems it necessary.) Further, no FRA approval is required prior to testing the equipment or placing it in revenue service. FRA expects the requirements of paragraph (a) to apply in the majority of situations a railroad places passenger equipment in service for the first time, and FRA has consequently placed this provision at the beginning of § 238.111 for ease of use by the regulated community.

As specified in the final rule, § 238.111(a) applies not only to the actual equipment which has previously been used in revenue service in the United States or to equipment which is manufactured identically thereto. Paragraph (a) also applies to equipment which is similarly manufactured to that equipment and has no material differences in safety-critical components or systems.

Paragraph (b) contains the requirements for a railroad placing passenger equipment in service for the first time on its system when the equipment has not previously been used in revenue service in the United States—in other words, when the equipment is not covered by paragraph (a). Each railroad must develop a pre-revenue service acceptance testing plan and submit the plan to FRA at least 30 days prior to beginning testing. Previous testing of the equipment at the Transportation Test Center, on another railroad, or elsewhere should be included in the submission.

The requirements of paragraph (b) distinguish between whether the passenger equipment intended for service is Tier I or Tier II passenger equipment, and FRA has decided to require approval of testing plans only for Tier II equipment. Although FRA disagrees with APTA's claim that FRA does not have the in-house expertise to approve the testing plans, FRA is mindful of APTA's concern that the need for FRA approval of the plans may unnecessarily delay the introduction of new equipment. Further, not having endless resources, FRA has decided to focus its resources here on Tier II passenger equipment in light of the equipment's higher operating speed and greater potential risk. As a result, a railroad intending to place in service Tier I equipment under this paragraph does not need FRA approval of its test plan for the equipment or FRA approval to place the equipment in service. Of course, paragraph (b) does provide that for Tier I equipment the railroad must notify FRA to permit the agency to witness the testing (paragraph (b)(2)); comply with the testing plan (paragraph (b)(3)); document the results of the testing and make it available for FRA inspection (paragraphs (b)(4), (6)); and correct or otherwise compensate for safety deficiencies uncovered during the testing prior to introducing the equipment in revenue service (paragraph (b)(5)). Each railroad is also under an independent duty to comply with the other requirements of Part 238 and the railroad safety laws in general. In this regard, a railroad would have to obtain a waiver of FRA safety regulations through the formal procedures of 49 C.F.R. part 211 before introducing any equipment into service that does not comply with the safety appliance regulations or the safety glazing standards, for example. However, by operation of § 238.111, a railroad is not restricted from seeking a waiver of an FRA safety regulation under 49 C.F.R. part 211, nor is FRA restricted from granting such a waiver. Part 211 contains procedures to ensure that FRA grants a waiver of a safety regulation in the interest of employee and public safety.

For Tier II passenger equipment, paragraph (b) requires the railroad to follow the additional steps of obtaining FRA approval of the testing plan under the procedures specified in § 238.21 (paragraph (b)(1)); reporting the results of the testing to FRA (paragraph (b)(4)); agreeing to comply with any operational limitations imposed by FRA on the use of the equipment (paragraph (b)(5)); and obtaining FRA approval prior to placing the equipment in revenue service (paragraph (b)(7)). Under paragraph (b)(7), a railroad is not required to follow the formal requirements set forth in § 238.21.

Paragraph (c) applies only to Tier II passenger equipment. If a railroad plans a major upgrade or introduction of new technology in Tier II 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 specified in paragraph (b) prior to placing the equipment in revenue service with such a major upgrade or new technology. This requirement is based on proposed §§ 238.603 (b) and (c) in the NPRM. *See* 62 FR 49823. FRA has integrated those proposed requirements into the section for clarity, as alluded to in the NPRM. *See* 62 FR 49785.

Overall, FRA believes the set of steps and the documentation required by § 238.111 are necessary to ensure that all safety risks have been reduced to a level that permits the equipment to be used in revenue service.

Section 238.113 Emergency Window Exits

This section represents the partial merger of NPRM § 238.235, emergency window exit requirements for Tier I passenger equipment, and NPRM § 238.439, as it concerned emergency window exit requirements for Tier II passenger equipment. FRA has combined these sections principally in response to the NTSB's comment on the proposed rule that these requirements should not be differentiated on the basis of train speed.

Paragraph (a)(1) requires that a single-level passenger car, other than a sleeping car or similarly designed car, have a minimum of four emergency window exits, either in a staggered configuration where practical or with one located in each end of each side of the car. A bi-level car shall have a minimum of four emergency window exits on each main level, configured as above, so that the car has a minimum total of eight emergency window exits.

FRA received several comments relating to the quantity of emergency window exits that the rule should require. First, the NTSB commented that specifying a minimum quantity requirement for emergency window exits in passenger cars is not sufficient. The NTSB believed that the requirement should be based on the capacity of the passenger car, the number of door exits, and the scientifically-determined time needed to completely evacuate the fully-loaded passenger car. Next, Talgo commented that passenger cars half the length of conventional cars should be required to have only two emergency window exits on each main level. Further, Bombardier commented that instead of limiting the application of this section to emergency window exits, FRA should apply the requirements of this section broadly to emergency exits—whether or not those exits are windows—to permit flexibility and innovation in future passenger car designs. Bombardier added that any such requirement would be in addition to the requirement for side doors.

The final rule largely carries forward the NPRM's proposal, and the current Federal requirement in § 223.9(c) of this chapter for four emergency window exits in each passenger car. The requirement for a minimum number of window exits is important to ensure an unobstructed avenue of egress in a variety of accident scenarios, regardless of car capacity. Of course, as FRA has explained, the Volpe Center is working on an emergency evacuation performance requirement for passenger cars to determine the number of total exits necessary to evacuate the maximum passenger load in a specified time for various situations. Further, through the APTA PRESS effort, FRA understands that APTA is developing a systems approach to emergency egress similar to that which Bombardier has suggested in its comments. FRA recognizes the merit such approaches have and will consider these alternative approaches in Phase II of the rulemaking.

Paragraph (b) requires, as specified, each emergency window exit in a new passenger car, including a sleeping car, to have a minimum unobstructed opening with dimensions of 26 inches horizontally by 24 inches vertically. In the NPRM, FRA invited comments as to what size requirements for emergency window exits FRA should impose in the final rule. FRA had proposed that Tier I equipment have a minimum, unobstructed emergency window exit opening of 24 inches horizontally by 18 inches vertically, and that Tier II equipment have a minimum, unobstructed emergency window exit opening of 30 inches horizontally by 30 inches vertically. The Tier II Equipment Subgroup, including Amtrak, had recommended the latter requirement for application to Tier II equipment. However, the full Working Group advised against imposing such a requirement on Tier I equipment. FRA had explained in the NPRM that, although it would prefer that all emergency window exits afford the larger opening, the Tier I equipment proposal provided the minimum opening needed for a fully-equipped emergency response worker to gain access to the interior of a train.

The NTSB commented that the horizontal and vertical openings of emergency window exits should be the same for both tiers of equipment, as the speed at which the equipment travels should not matter. The NTSB stated that the emergency window exit dimensions should be determined by the size dimensions needed: (1) To extricate an injured person from the passenger car; and (2) to allow an emergency responder fitted with a self-contained breathing apparatus to enter the passenger car. The NTSB noted that one of the typical adult backboards used by emergency responders to evacuate injured persons is 24 inches wide by 72 inches long, and therefore may not clear a window 24 inches wide. (The NTSB did note that the other typical adult backboards measure 16 inches wide by 72 inches long, and 12 inches wide by 84 inches long. The NTSB also stated that a typical steel basket stretcher used by emergency responders measures about 23 inches horizontally by 8 inches deep by about 81 inches vertically.) The NTSB further noted the concern that if a car derails to the extent that the normal vertical dimension becomes the horizontal dimension, the backboard must be tilted to fit through the opening. (During Working Group discussions, it was noted that for this to happen, the car must come to rest on its end.) Moreover, the NTSB stated that an emergency responder with a self-contained breathing apparatus may have difficulty entering an 18-inch vertical opening.

FRA agrees that the emergency window exit size requirements should be the same for both tiers of equipment. The final rule requires that emergency window exits have a minimum unobstructed opening with dimensions 26 inches horizontally by 24 inches vertically. This requirement only applies to new cars, however, as specified in paragraph (b). FRA recognizes that these dimensions are greater than those proposed for Tier I passenger equipment (and smaller than those proposed for Tier II passenger equipment).

A review of emergency window exit sizes on the nation's rail passenger car shows a wide variation in window size. Differences in size are not necessarily attributable to the age of the passenger cars: On certain railroads, some older passenger cars have smaller emergency window exits than do newer passenger cars; whereas, on other railroads, some newer passenger cars have smaller emergency window exits than do older passenger cars. Staff from the Boston, Massachusetts, and Los Angeles, California, fire departments recommended, upon DOT's inquiry, that emergency window exits provide at least a 26-inch horizontal opening to maneuver a 24-inch wide stretcher into and out of the window. They also expressed concern whether an 18-inch vertical opening would be large enough to allow an emergency responder wearing a self-contained breathing apparatus to fit through the window. United States Department of Defense MIL–STD–1472E (October 31, 1996), which contains design criteria for human engineering, provides dimensions for rectangular access openings for male body passage as differentiated by the amount of clothing worn. For side access, MIL–STD–1472E, section 5.7.8.3 provides that openings shall be not less than 26 inches in depth (vertical) and 30 inches in width (horizontal) for a male wearing light clothing. Further, the standard provides that openings shall be not less than 29 inches in depth and 34 inches in width for a male wearing bulky clothing. (This section of the military standard has been placed in the public docket for this rulemaking.)

On the basis of the comments and information received following publication of the NPRM, FRA believes that an emergency window exit vertical opening of 18 inches is not sufficient for new rail cars. The emergency window exit size requirements contained in this final rule provide a more reasonable dimension for passage of large, fully-clothed persons, including emergency response personnel with fire gear. The dimensions are practicable in light of the design of many passenger cars in the United States.

FRA explained in the NPRM that safety may be advanced by staggering the configuration of emergency window exits so that the exits are located diagonally across from each other on opposite sides of a car, instead of placing them directly across from each other. FRA invited comment on this issue, as well as on the concern that the seat arrangement of passenger cars may block access to and the removal of emergency window exits. The NTSB commented that emergency window exits should be staggered rather than opposite each other, and they must also be distributed as uniformly as practical to allow for passenger distribution. The rule will require staggering where practical, but other considerations must be taken into account, including the need to provide an unobstructed exit without diminishing normal seating capacity. Railroads should be mindful that if the ends of a car are crushed in a collision, then the window exits located at the car's ends may be rendered inoperable. In this regard, FRA's use of the term ''in each end'' in paragraph (a)(1) refers to the forward and rear ends of a car as divided in its center—and does not literally refer to the extreme forward and rear ends of a car nor require that emergency window exits be placed at the extreme ends of a car.

FRA is requiring that each sleeping car, and any similarly designed car having a number of separate compartments intended to be occupied by passengers or train crewmembers, have at least one emergency window exit in each compartment. An example of a similarly designed car subject to this requirement is a crew dormitory car. If an emergency window exit is not provided in individual sleeping compartments, occupants of those compartments may have difficulty reaching the car's doors quickly in an emergency, especially if the car's interior passageways become blocked or obscured by smoke. An emergency window exit is necessary in each compartment to enable occupants to quickly exit the car in a life-threatening situation, as when the car is submerged. FRA notes that, for purposes of this section, a restroom is not a compartment specifically required to have an emergency window exit.

Paragraph (a)(3) requires that each emergency window exit be designed to permit rapid and easy removal during an emergency situation without requiring the use of a tool or other implement. In the NPRM, FRA had specified that the emergency window exit must be easily operable by a 5th-percentile female without requiring the use of a tool or other implement. In response to the proposal, Bombardier commented that the feasibility and practicability of making the emergency exit operable by a 5th-percentile female is not known at this time. Bombardier recommended FRA more fully examine the feasibility of designing and maintaining passenger cars to meet this requirement before it is made a rule. In the final rule, FRA believes it appropriate not to specify a requirement at this time for the ease of operability of an emergency window exit by a 5th-percentile female. In Phase II of the rulemaking, FRA will evaluate with the Working Group whether such a concept should be reintroduced. Instead, FRA has decided to incorporate into the final rule language from the definitions of ''emergency window'' found in 49 CFR parts 223 and 239—that is, each emergency window must be designed to permit its rapid and easy removal during an emergency situation—and specifically require that such rapid and easy removal of the window be able to be accomplished without requiring the use of a tool or other implement.

Paragraph (c) is reserved for emergency window exit marking and operating instruction requirements. These requirements are currently provided in the rule on passenger train emergency preparedness. *See* 63 FR 24630. In Phase II of the rulemaking, FRA will consider integrating into this part (part 238) the emergency window exit marking and operating instruction found in parts 223 and 239 of this chapter. Additionally, FRA will consider revising those requirements as necessary.

Section 238.115 Emergency Lighting

Experience gained during emergency response to several passenger train accidents indicates that emergency lighting systems either did not work or failed after a short time, greatly hindering rescue operations. This section requires that passengers cars ordered on or after September 8, 2000, or placed in service for the first time on or after September 9, 2002, be equipped with emergency lighting providing at least an average illumination level of 1 foot-candle at floor level adjacent to each exterior door and each interior door providing access to an exterior door (such as a door opening into a vestibule). In addition, the emergency lighting on such cars must provide an illumination level of at least an average of 1 foot-candle at floor level along the center of each aisle and passageway, and a minimum of 0.1 foot-candle at floor level at any point along the center of each aisle and passageway. The cars must also be equipped with a back-up power feature capable of operating the lighting for a minimum of 90 minutes after loss of normal power with no more than a 40% loss of the prescribed illumination levels.

In the NPRM, FRA proposed requiring for both passenger cars and locomotives a minimum emergency lighting illumination level of 5 foot-candles at floor level for all potential passenger and crew evacuation routes from the equipment. *See* 62 FR 49803. FRA explained that its proposal was not a recommendation of the Working Group, as FRA believed an illumination level higher than that suggested by members of the Working Group was necessary for passengers to locate emergency exits, read instructions for operation of the exits, and operate the exits. *See* 62 FR 49764. FRA did request comments whether the lighting intensity requirement need be 5 foot-candles at floor level for all potential evacuation routes if the rail vehicle has a combination of lower intensity floor proximity lighting, similar to that used on aircraft to mark the exit path, and higher intensity lighting at the vehicle's exits. FRA also proposed applying the emergency lighting requirements to rebuilt passenger equipment, and noted that it was considering applying these requirements to existing passenger equipment sooner than when the equipment is rebuilt.

In response to FRA's proposal, APTA commented that requiring a minimum emergency lighting illumination level of 5 foot-candles is excessive. APTA believed that roughly a five-fold increase in battery capacity would be necessary to comply with the proposed illumination standard when combined with the two-hour minimum duration requirement proposed in the rule. APTA stated that a minimum emergency lighting illumination level of 1 foot-candle is adequate for new equipment, based on recent light level measurements taken on passenger coaches by Volpe Center personnel. APTA noted that a survey in support of its APTA PRESS efforts shows emergency lighting illumination levels to be between approximately 0.2 foot-candles and 1 foot-candle on existing passenger equipment. APTA observed that even an illumination level of less than 1 foot-candle measured at the floor can allow for an orderly evacuation of a passenger coach with well-marked exits.

In regard to applying the requirements of this section to existing passenger equipment, APTA suggested imposing an emergency lighting illumination level of less than 1 foot-candle on such equipment to avoid an expensive retrofit. APTA further recommended that the rule allow the emergency lighting illumination level to decay over the proposed two-hour duration it would be required to operate, and APTA suggested allowing the illumination level to degrade to no less than 50% of the original illumination level after two hours. In addition, APTA noted that emergency lighting systems in conventional locomotive cabs are radically different from those in passenger cars, and APTA asked FRA to reconsider how it would apply emergency lighting requirements inside locomotive cabs.

In commenting on this proposal, the BRC stated that the requirements for emergency lighting must be phased into existing passenger equipment sooner than when it is rebuilt. The BRC explained that for passengers it would be far better to have cars equipped with emergency and exit lighting to eliminate many of the hazards in getting out of the cars, and that there is no justification or analysis in the record for delaying the implementation of the requirements in existing passenger cars.

Metra, in its comments on this proposal, stated that a requirement for an emergency lighting illumination level of 5 foot-candles would be unnecessarily bright and costly. Metra recommended that the illumination level be set at 0.5 foot-candle. Further, Metra suggested that for new passenger equipment the requirement be modified to apply only to new orders placed after January 1, 1998, so as to avoid costs associated with change orders and dual standards on ongoing orders that will be delivered both before and after January 1, 1998. Finally, the Omniglow Corporation (Omniglow) commented in response to the NPRM that to effectively address an emergency situation where lives are at stake, each train exit should be equipped with emergency lighting.

In light of these comments and after further analysis, FRA has revised the requirements of this section in several ways from those originally proposed in the NPRM. First, under the final rule, the requirements of this section apply only to passenger cars—and not to passenger locomotives as proposed in the NPRM. As MU locomotives and cab cars that transport passengers are considered passenger cars under this rule, however, the practical effect of this revision is not to apply the specific emergency lighting requirements in this rule to conventional passenger locomotives. Moreover, the issue of specifying emergency lighting requirements for conventional locomotives as a whole, taking into account their unique characteristics, has been placed before the RSAC Locomotive Crashworthiness Working Group for its consideration.

Second, the requirements of the final rule do not apply to rebuilt passenger equipment. FRA is seeking a broader approach to implementing emergency lighting requirements in existing passenger cars, whether or not the cars are rebuilt. To accomplish this, FRA does not necessarily expect that existing passenger cars will be required to meet the area lighting standard specified for new equipment. However, FRA desires that achievable emergency lighting enhancements to existing passenger cars will be implemented over a reasonable period of time. In the second phase of the rulemaking, FRA will evaluate the anticipated APTA PRESS standard for implementing emergency lighting requirements in existing passenger cars with a view to incorporating the APTA standard into this Federal standard.

Third, as provided in paragraphs (b)(1)–(3) of the final rule and modified from the NPRM, this section prescribes the minimum emergency illumination level for new passenger cars as a 1 foot-candle average at floor level adjacent to each exterior door and each interior door providing access to an exterior door (such as a door opening into a vestibule), a 1 foot-candle average measured 25 inches above the floor level along the center of each aisle and passageway, and a minimum of 0.1 foot-candle measured 25 inches above the floor level at any point along the center of each aisle and passageway. These illumination levels are based on the emergency lighting illumination levels specified in Section 5–9.2.1 of the National Fire Protection Association's (NFPA) ''Life Safety Code Handbook,'' Seventh Ed. (a copy of this section has been placed in the public docket for this rulemaking) and the Illuminating Engineering Society Lighting Handbook. Specifying the measurement of the emergency lighting illumination level at the floor for doors is intended to permit passengers and crewmembers to see and negotiate thresholds and steps typically located near doors. Specifying the measurement of the emergency lighting illumination level at 25 inches above the floor for aisles and passageways is intended to permit passenger and crewmembers to see and make their way past obstacles as they exit a train in an emergency, as demonstrated by tests conducted by the Volpe Center. At the same time, specifying that the illumination level be measured above the floor for aisles and passageways recognizes that light emitted from lighting fixtures placed on the sides of passenger cars may be obstructed, as by car seats, before the light reaches the floor, and, in this regard, the rule provides greater flexibility to railroads in the placement of lighting fixtures. FRA notes that the permanency of this area lighting standard will be dependent on successful resolution of issues related to emergency signage, exit path marking, and egress capacity that are being progressed toward resolution through the APTA PRESS Task Force and the Volpe Center, as noted below, as a predicate for completion of the standards in the second phase of this rulemaking.

FRA believes that the emergency lighting illumination levels specified in this section will enable the occupants of rail cars to discern their immediate surroundings and thereby minimize or avoid panic in an emergency. In this regard, a lighting demonstration was conducted in a SEPTA rail car in March 1998, and in the judgement of the FRA participants it showed that these illumination levels appear sufficient. These emergency lighting illumination levels are achievable for rail cars. In fact, the NFPA 101 specifications for emergency lighting illumination levels, noted above, are recommended for use in rail transit cars through NFPA 130, Section 5–5.3.

In the second phase of the rulemaking, FRA will focus on augmenting the emergency illumination level specified in this section by including requirements for lighted signage and exit path marking, as touched on above. Through a research study conducted by the Volpe Center, FRA has been investigating emergency lighting requirements as part of a systems approach to effective passenger train evacuation. This approach takes into consideration the interrelationship between features such as the number of door and window exits in a passenger car, lighted signs that indicate and facilitate the use of the door and window exits, and floor exit path marking, in addition to the general emergency lighting level in a car. FRA will also examine the APTA PRESS standard on emergency lighting, when final, to determine whether the standard satisfactorily addresses matters related to emergency signage, exit path marking, and egress capacity so that FRA does not have to revisit the issue of area lighting with a view toward increased illumination levels. In the interim, FRA will entertain proposals to utilize alternative methods of providing at least an equivalent level of emergency illumination to that prescribed in this rule.

FRA has further revised the requirements of this section from those proposed in the NPRM by shortening the required operation time period of the emergency lighting, and by permitting the emergency lighting illumination level to degrade over time, as well. Specifically, the final rule requires a passenger car to be equipped with a back-up power feature capable of operating the lighting for a minimum of 90 minutes after loss of normal power with no more than a 40% loss of the prescribed illumination levels. As a result, illumination levels shall be permitted to decline, as appropriate, from 1 ft-candle to 0.6 foot-candle, and from 0.1 foot-candle to 0.06 foot-candle. The lighting decay permitted here is also based on that specified in Section 5–9.2.1 of the NFPA's ''Life Safety Code Handbook,'' cited above. Operation of emergency lighting for an extended time is particularly necessary in the event of passenger train rescue operations in remote locations. Fully-equipped emergency response forces can take an hour or more to arrive at a remote accident site, and additional time would be required to deploy and reach people trapped or injured in a train. Even passenger train accidents in urban areas can pose significant rescue problems, especially in the case of tunnels, nighttime operations, and operations in inclement weather.

This section also requires the emergency lighting back-up power system to be able to operate in all orientations within 45 degrees of vertical and after experiencing a shock due to a longitudinal acceleration of 8g and vertical and lateral accelerations of 4g. The shock requirement will ensure that the back-up power system has a reasonable chance of operating after the initial shock caused by a collision or derailment. FRA originally considered that the back-up power system be capable of operation within a vehicle in any orientation. However, members of the Working Group advised that some battery technologies utilize a liquid electrolyte which can leak when the battery is tilted.

FRA invited commenters to address whether the back-up power system should be made capable of operation within a vehicle in any orientation, *see* 62 FR 49764; and, in response, the BRC commented that the back-up power system must be capable of operating in any orientation since railcars do not always remain upright when they derail. The BRC believed that the fact batteries may have a liquid electrolyte which can leak when the battery is tilted does not excuse railroads from obtaining proper batteries that will function in any orientation.

In the final rule, FRA is not requiring that the back-up power system be capable of operating in any orientation, and instead FRA is retaining the proposal in the NPRM that the system be capable of operating in all equipment orientations within 45 degrees of vertical. FRA will further examine this issue in the second phase of the rulemaking, and FRA is aware of a more costly battery technology utilizing a gel that should not leak when turned in any orientation. However, even if the back-up power system could operate when turned in any direction, FRA recognizes that a derailment of the magnitude that would cause such a situation would potentially destroy the battery box as a whole or sever the cables connecting the battery to the emergency lighting fixtures, or both. In this regard, FRA believes it more important to focus in the second phase of the rulemaking on addressing the NTSB's recommendation to require reliable emergency lighting fixtures in passenger cars, each fitted with a self-contained independent power source (R–97–17). (See NTSB/RAR–97/02) Section 238.115 does permit continued use of battery power common to all emergency lighting circuits in a particular car.

FRA notes, however, that the concept of a power source at each fixture, as a regulatory requirement, is novel. FRA findings in recent accidents support the NTSB's implied concern that placement of electrical conduits and battery packs below the floor of passenger coaches can result in damage that leads to the unavailability of emergency lights precisely at the time they are most needed. However, from initial investigation it is not certain whether current ''ballast'' technology provides illumination of sufficient light level quality with reliable maintainability. FRA presented the issue of placing an independent power source at each emergency lighting fixture to the Passenger Equipment Safety Standards Working Group at a meeting in December, 1997. FRA will aggressively pursue this option for more reliable emergency illumination in the second phase of the rulemaking, and FRA will also work with APTA PRESS on this issue.

Section 238.117 Protection Against Personal Injury

This section contains a general requirement to protect passengers and crewmembers from moving parts, electrical shock and hot pipes. This section extends to passenger equipment not classified as locomotives the protection against personal injury which applies to locomotives under 49 CFR 229.41. The requirements represent common-sense safety practice; reflect current industry practice; and should result in no additional cost burden to the industry. Although FRA received no specific comments on this section, FRA has modified this section to make clear that its requirements do not apply to the interior of a private car, consistent with FRA's overall approach to private cars in this rule. The protections of this section would apply, of course, to rail employees and others who may inspect or perform work on the exterior of a private car.

Section 238.119 Rim-Stamped Straight-Plate Wheels

This section addresses the NTSB's safety recommendation concerning the use of rim-stamped straight-plate wheels on tread-braked rail passenger equipment. Following its investigation of a January 13, 1994 Ringling Bros. and Barnum & Bailey Circus train derailment which killed two circus employees, the NTSB determined that the probable cause of the derailment was the fatigue failure of a thermally damaged straight-plate wheel due to fatigue cracking that initiated at a stress raiser associated with a stamped character on the wheel rim. *See* 62 FR 49743; NTSB/RAR–95/01. Noting that tread braking is a significant source of wheel overheating and thermal damage; straight-plate wheels are vulnerable to thermal damage; and rim-stamping provides a stress concentration for crack initiation, the NTSB recommended that FRA ''[p]rohibit the replacement of wheels on any tread-braked passenger railroad car with rim-stamped straight plate wheels.'' (Class II, Priority Action) (R–95–1).

In the NPRM, FRA stated that because a wheel having a rim-stamped straight-plate character is a sufficient safety concern in itself, FRA proposed extending the NTSB's safety recommendation to apply to all such wheels used on passenger equipment regardless whether the equipment were tread-braked or not. *See* 62 FR 49743, 49803. Further, FRA proposed addressing separately the use of such wheels on passenger equipment other than private passenger cars—for which there would be an immediate prohibition on the use of the wheels—in distinction to the use of such wheels on private cars—for which there would be a prohibition on the wheels' use as replacement wheels. *See* 62 FR 49743–4, 49803.

Based on comments received in response to the proposed rule, and after further analysis, FRA has modified the requirements of this section from those proposed in the NPRM. In the final rule, the restrictions on the use of rim-stamped straight-plate wheels apply only to such wheels use on tread-braked passenger equipment. AAPRCO, in its comments on the NPRM, stated that the proposed section was overly broad in prohibiting rim-stamped straight-plate wheels from being used as replacement wheels on private cars operated in a passenger train. Citing the above-noted NTSB report, AAPRCO explained that the only detected problem involving the use of rim-stamped straight-plate wheels occurred when such wheels were subjected to tread braking. AAPRCO believed that there is no known problem involving the use of such wheels on passenger equipment that is disc-braked and, therefore, not subject to heating. Accordingly, AAPRCO recommended limiting the prohibition against using rim-stamped straight-plate wheels as replacement wheels on private cars to those wheels that are tread-braked.

FRA notes that the stamping of manufacturers' marks on railroad wheel rims introduces stress concentrations in the wheel rims. Such stress risers can help originate cracks as the wheel is subjected to the low-cycle thermal fatigue of repeated tread-brake applications. As freight equipment operates with tread brakes, the AAR has discontinued rim stamping in order to preclude wheel failures due to cracking initiated at the stamp marks.

Disc brakes use a caliper and pad arrangement (like a bicycle brake) which operates on (squeeze) a disc which is affixed to the axle of a rail car, or to the back face of the wheel in a ''cheek'' mounted scheme, to provide retarding force. Disc brakes introduce no heat into the rim, since the heat is generated by the friction between the caliper pads and the disc. This condition is true only if the strategy to stop a vehicle relies solely on discs without tread-brake assistance.

Disc-braked rail cars sometimes have tread brakes which are used as parking brakes. These tread brakes may be applied periodically while the train is running, using low cylinder forces, in order to clean the wheel tread surface of oxides and debris which can interfere with the ability of the wheel to make an electrical connection with the rail for the purposes of shunting the track circuits to activate signals. This action is typically of short duration and is controlled by automatic circuitry (snow brakes) and should not pose a threat to the integrity of the wheels.

Braking strategies sometimes involve a combination of disc and tread braking to achieve desired deceleration rates. For example, Amtrak's AMFLEET I and II cars use such a combination—approximately 40% tread and 60% disc. In such a case, the wheels are tread-braked every time the vehicle comes to a stop, as opposed to the lower energy snow braking described above.

Straight plate wheels are well-known to be much more susceptible to thermal damage than curved or S-plate wheels. Plate curvature permits radial breathing of the rim as it is heated, resulting in lower rim stresses. The straight-plate wheel is much stiffer radially and stresses in these wheels are therefore greater for the same thermal input. If straight-plate wheels experience tread braking, or if tread brakes are used in the event of disc brake failure, the possibility exists for wheel thermal damage. However, the use of straight-plate, rim-stamped wheels should not pose a safety threat if the wheels are never tread-braked.

Because the use of straight-plate, rim-stamped wheels should pose no safety threat if the wheels are never tread-braked, the requirements of this section do not apply to such wheels used in such circumstances. Moreover, as provided in paragraph (c), if the wheels are in fact tread-braked but only in a limited manner to clean the wheel surface, the requirements of this section likewise do not apply. However, FRA hereby makes clear that the requirements of this section apply to the use of straight-plate, rim-stamped wheels when the wheels are subjected to tread braking in any combination with disc brakes for the purpose of slowing the passenger equipment.

The second principal change in the final rule from the NPRM provides particular consideration for the use of Class A rim-stamped, straight-plate wheels mounted on inboard-bearing axles on commuter passenger equipment. In commenting on the NPRM, APTA noted that a number of commuter railroads are currently operating—or are in the process of implementing service with—Bombardier-manufactured bi-level coaches that are equipped with Class A rim-stamped, reverse-plate wheels. APTA specified that the affected commuter railroads operate 182 passenger coaches equipped with these wheels and consist of the Southern California Regional Rail Authority (Metrolink), San Diego Northern Railway, Tri-County Commuter Rail Authority, Dallas Area Rapid Transit, and the San Joaquin Railroad Commission. APTA explained that reverse-plate wheels are considered a hybrid of the straight-plate design and therefore subject to the prohibition of this section. APTA added that these wheels have an average service life of five years. According to APTA, imposing this prohibition on the affected commuter rail operations will dramatically reduce or terminate commuter rail operations while replacement wheels are procured and installed. APTA stated that Class A reverse-plate wheels have a safe history of usage with no indication of wheel cracks caused by rim stamping, and that failures of Class B and C wheels of a true straight-plate design led to the NTSB's recommendation here. Based on these differences, APTA recommended that FRA allow Class A, rim-stamped reverse-plate wheels to continue in service.

FRA has considered APTA's comments and notes that the rim-stamped ''reverse''-plate wheels in issue are indeed straight-plate wheels. The ''reverse'' connotation refers to the orientation (angle) of the wheel plate with respect to the axle. Passenger wheelsets have inboard bearings—that is, the bearings are located between the wheels on the axle. Freight wheelsets are outboard-bearing in that the wheels are mounted between the bearings. The wheel plate is pitched one way or the other in either circumstance so that the wheel flanges end up being the same distance apart. In this way, either wheelset can transverse the same standard gage track.

From discussions with APTA, FRA understands that these Class A, rim-stamped straight-plate wheels are installed on rail cars weighing approximately 115,000 pounds, utilizing blended dynamic and friction braking. The friction-based portion of the braking system in turn is composed of approximately 67% tread braking, and 33% disc braking. FRA further understands that, when properly used, the extended-range dynamic brake can slow the vehicle from 90 mph—its top operating speed—to less than 10 mph with no friction (pneumatic) braking applied, and that this is the recommended method of operating these rail cars. The service brake rate is 2.0 mph/sec and the emergency rate is 2.5 mph/sec. In combination with the wheel slip/slide protection system provided for these cars, FRA believes that the wheels on these rail cars should be subjected to limited thermal input.

Further, FRA notes that wheels are generally classified as L, A, B, or C depending on the carbon content of the wheel material. The amount of carbon determines the hardness and strength of the steel. A Class A wheel has a lower carbon content, and correspondingly lower hardness and strength than a Class B or C wheel. Lower hardness means that the wheel has increased ductility or improved ability to resist cracking (fracture toughness). This is why Class L and A wheels are recommended for severe braking conditions. However, since these wheels are ''softer,'' heavy wheel loads will result in poor wear performance, which is why they are recommended only for light to moderate wheel loads. Class B and C wheels (with more carbon and increased hardness) exhibit good wear behavior, but are more prone to cracking. Railroads choose the wheel type for a particular class of service based on its operating characteristics.

As reflected in paragraph (a)(2), FRA believes that the commuter railroads operating vehicles with Class A, rim-stamped straight-plate wheels mounted on inboard-bearing axles—i.e., reverse-plate wheels—may continue to do so provided the railroads do not modify the operation of the vehicles in any way that would result in increased thermal input to the wheels during braking. As a result, vehicles equipped with these wheels may not operate at speeds exceeding their current maximum operating speeds. Further, these wheels may not be placed on different (especially heavier) rail vehicles. Provided the conditions for continued use of the wheels are met, however, a railroad may continue to use the wheels until it exhausts its stock of replacement wheels held as of May 12, 1999, which is the date of this final rule's publication. FRA understands that the manufacturer of these wheels has already started to stamp the wheels on their hubs, instead of on their rims, and FRA believes that the railroads' inventory of such rim-stamped wheels will be exhausted within the next 18 months. Once a commuter railroad's inventory of Class A, rim-stamped straight-plate wheels is exhausted, each such wheel must be replaced at the end of the wheel's service life with a wheel that is not rim-stamped.

In commenting on the NPRM, Talgo suggested clarifying the requirements of this section to state that the stamping of characters on the rim of a wheel is prohibited due to dangers associated with stress concentration. According to Talgo, if indeed the purpose of this section is to address rim-stamping itself, then the rule should be revised to address all types of wheels and not just straight-plate wheels. FRA does recognize that the stamping of manufacturers' marks on railroad wheel rims introduces stress concentrations in the rims, and, all things being equal, manufacturers should stamp wheels on their hubs instead of on their rims. Yet, FRA is concerned in particular with rim-stamped straight-plate wheels because, as noted above, a straight-plate wheel design is more susceptible to thermal damage than a curved wheel design. The plate curvature permits radial breathing of the rim as it is heated, resulting in lower rim stresses.

Similar to the proposal in the NPRM, the final rule allows rim-stamped, straight-plate wheels on tread-braked private cars to continue in service throughout the life of each wheel. However, as provided in paragraph (b), such wheels may not be used as replacement wheels on these cars. As explained in the NPRM, FRA recognizes that private cars are generally not highly utilized in comparison to intercity or commuter passenger equipment, and Amtrak imposes its own safety requirements on the use of such cars in its trains. *See* 62 FR 49743–4.

In commenting on the NPRM, a member of the public stated that many private car owners have a substantial investment in rim-stamped straight-plate wheels, and precluding their installation would consequently place a financial burden on many private car owners. This commenter requested that a provision be added to the rule to allow private car owners to install such wheels on their cars after January 1, 1998,—which FRA proposed as the effective date for this section—provided the wheels were owned by that date. In this regard, FRA notes that Amtrak has issued a letter to private car owners dated September 19, 1995, stating that after June 30, 2000, Amtrak will decline to move any tread-braked passenger cars with rim-stamped straight-plate wheels. In addition, Amtrak stated in the same letter that it would not accept any new applications for wheel change out with rim-stamped straight-plate wheels, regardless of the brake type. Amtrak's letter referenced the NTSB's safety recommendation noted in this section.

Since Amtrak is the chief carrier of private rail cars, the ability of a private rail car owner to use rim-stamped, straight-plate wheels will be significantly affected independent of the requirements of this rule. Further, allowing such wheels to continue in use until a car owner's inventory of the wheels is depleted would prolong the use of such wheels for potentially decades. FRA believes that the rule allows due consideration for private rail car owners in allowing them to continue using tread-braked private rail cars equipped with rim-stamped, straight-plate wheels throughout the life of each wheel, while recognizing that, as a whole, the wheels are subject to greater thermal input when in use and are more susceptible to cracking than the commuter railroad wheels discussed above. Moreover, FRA notes that under the definition of ''passenger equipment'' in this rule, a private rail car not operated in a train with a passenger car, such as in a freight train, or in a consist of private rail cars, is not subject to the requirements of this rule. (See above discussion of passenger equipment in § 238.5.). In addition, the final rule does not apply to tourist railroads, and a private rail car may therefore operate on such railroad without complying with the requirements of this rule. See § 238.3.

Subpart C—Specific Requirements for Tier I Passenger Equipment

Section 238.201 Scope.

This subpart contains specific requirements for railroad passenger equipment operating at speeds not exceeding 125 mph. This subpart contains various structural standards (§ 238.203Bstatic end strength; § 238.205—anti-climbing mechanism; § 238.207—link between coupling mechanism and car body; § 238.209—forward-facing end structure of locomotives; § 238.211—collision posts; § 238.213—corner posts; § 238.215—rollover strength; § 238.217—side structure; § 238.219—truck-to-car-body attachment; and § 238.223—fuel tanks). These structural standards do not apply to passenger equipment if used exclusively on a rail line (A) with no public highway-rail grade crossings, (B) on which no freight operations occur at any time, (C) on which only passenger equipment of compatible design is utilized, and (D) on which trains operate at speeds no higher than 79 mph.

In general, except for the static end strength standards (' 238.203) and as otherwise provided in this subpart, the requirements of this subpart apply only to passenger equipment ordered on or after September 8, 2000 or placed in service for the first time on or after September 9, 2002. That is, where no specific date or dates are provided in the regulatory text for a particular section, such as § 238.225 (Electrical system), these dates apply to that section's requirements. Of course, certain existing Federal requirements, such as the window safety glazing standards in part 223 of this chapter that are referenced in § 238.221 (Glazing), continue to apply by their own force.

The rule does provide that passenger equipment placed in service for the first time on or after September 8, 2000, unless otherwise provided in the cited sections, must meet the minimum structural requirements specified in: § 238.205(a) (anti-climbing mechanism); § 238.207 (link between coupling mechanism and car body); and § 238.211(a) (collision posts). Further, as specified in detail below, any such equipment in use on or after November 8, 1999 must also meet the static end strength standards specified in § 238.203. These four particular requirements are virtually identical to existing Federal requirements, found in 49 CFR § 229.141(a)(1)–(4), that apply to MU locomotives built new after April 1, 1956, and operated in trains having a total empty weight of 600,000 pounds or more. These requirements reflect the common construction practices for passenger equipment currently in service in the United States, and FRA believes they are minimum safety requirements. FRA notes that the 600,000-pound consist weight threshold for purposes of 49 CFR § 229.141 is not an appropriate distinction to apply to passenger equipment operated on the general system, intermingled with equipment of more substantial strength; and, as a result, part 238 contains no such consist weight distinction. In this regard, FRA notes that through this final rule it is amending the application of 49 CFR § 229.141 so that its requirements will not apply to passenger equipment subject to part 238.

In addition to these four structural requirements, the rule also requires that passenger equipment comply with other structural requirements specified in: §§ 238.205(b) (anti-climbing mechanism for locomotives); 238.209 (forward-facing end structure of locomotives); 238.211(b) (collision posts for locomotives); 238.213 (corner posts); 238.215 (rollover strength); 238.217 (side structure); 238.219 (truck-to-car-body attachment); and 238.223 (fuel tanks). These requirements apply to passenger equipment ordered on or after September 8, 2000, or placed in service for the first time on or after September 9, 2002, unless otherwise provided in the cited sections. FRA notes that, under special circumstances, it will allow the placement in service of passenger equipment not meeting these structural requirements if the equipment was in fact ordered within September 8, 2000 but not placed in service until after September 9, 2002. In such case, the railroad must provide documentation to the satisfaction of the Associate Administrator for Safety that demonstrates the special circumstances accounting for the delay in placing the equipment in service.

Structural Standards for Existing Equipment

The final rule requires that all passenger equipment (other than locomotives that comply with an alternative standard as specified, private cars, unoccupied vehicles operating at the rear of a passenger train, or equipment used in non-commingled service, as discussed below) in use on or after November 8, 1999 have a minimum static end strength of 800,000 pounds as specified in § 238.203. Static end strength is critical in protecting passenger equipment from crushing in a head-on or rear-end collision, especially in the North American railroad operating environment that includes frequent highway-rail grade crossings and the mixed operation of freight and passenger trains. FRA is confident that all but a limited number of existing passenger cars in the United States have been built to this basic compressive strength requirement. Beginning in 1939, the AAR recommended that new passenger cars operated in trains of over 600,000 pounds empty weight have a minimum static end strength of 800,000 pounds, and since 1956, Federal Regulations (49 CFR. 229.141) have required that new MU locomotives operated in such trains must meet this standard. Railroads with existing passenger cars that do not meet the minimum static end strength requirement may petition FRA for grandfathering approval to continue to use the equipment; see discussion under § 238.203.

FRA does, however, recognize that low-speed rail operations that are structured to totally preclude both operations over highway rail grade crossings and the sharing of trackage between light rail equipment and conventional equipment do not require the structural standards required for commingled operations. Accordingly, the final rule (in § 238.201) provides that passenger equipment is not subject to the structural requirements of the rule if it used exclusively on a rail line (A) with no public highway-rail grade crossings, (B) on which no freight operations occur at any time, (C) on which only passenger equipment of compatible design is utilized, and (D) on which trains operate at speeds no higher than 79 mph. FRA will discuss with the Working Group in Phase II of the rulemaking what structural standards are appropriate for such operations.

In the NPRM, FRA considered requiring that one or more of the other structural requirements for new passenger equipment, discussed above, be made applicable to existing equipment as soon as one of the following events occurs: the equipment is sold to another railroad; the equipment is rebuilt; the equipment reaches 40 years of age; or 10 years elapses after the effective date of the rule. FRA invited comments on: (1) What equipment would be affected by each of these structural requirements; (2) the feasibility and costs of retrofitting such equipment, with costs broken out for each of the different structural requirements, in the event such triggering events were adopted in the final rule; (3) whether these triggering events are reasonable, or whether some other fixed deadline should be established for making one or more of these structural requirements applicable to existing passenger equipment; and (4) the safety benefits that could accrue by making these requirements applicable to existing equipment. FRA did specifically note in the NPRM that older passenger equipment may not meet the collision post requirements in § 238.211(a) because of a change in collision post design following a collision between two Illinois Central Gulf Railroad commuter trains in Chicago, Illinois, on October 30, 1972.

In response, APTA commented that it opposed application of the rule's structural standards to existing passenger equipment in light of the potential adverse economic impact on passenger railroads. AAPRCO, in its comments on the NPRM, believed the costs associated with rebuilding private cars to meet the new passenger equipment requirements would be extremely high with no significant benefit to the public. AAPRCO stated that Amtrak requires all cars, including private cars, that operate on their system be maintained to strict standards of inspection, including full 40-year truck teardowns with specified periodic scheduled truck roll-outs, annual inspections, and full COT&S. AAPRCO noted that nearly all private cars currently in operation are over 40 years old.

In the final rule, FRA has made the compressive strength requirement the only structural requirement applicable to existing passenger equipment. However, in general, if the need arises to apply one of the other structural requirements specified in the rule to existing passenger equipment, FRA will reconsider whether such requirements should be made applicable to existing equipment. In particular, FRA will ask its Working Group in Phase II of the rulemaking to consider applying the other structural requirements specified in the rule to existing passenger equipment when the equipment is ''rebuilt'' or otherwise improved such that the useful life of the equipment is materially extended. Further, FRA will not specifically limit the consideration of the Working Group in this regard to the rule's structural requirements, but will include in its consideration any of the other requirements for Tier I passenger equipment in this final rule.

Equipment of Special Construction

Comments from Talgo, discussed in general above and in more specific terms below, question the relevance or appropriateness of some of the proposed structural standards to a trainset built with articulated connections using a monocoque or space frame design. In consultations associated with the Working Group review, FRA sought information from the commenter regarding its trainset and has sought to identify requirements that might be appropriate for this configuration. However, in general, the analytical basis for alternative engineering values suggested by the commenter either was not evident or was determined not to be appropriate. Talgo did submit additional engineering information in October of 1998 but FRA could not appropriately analyze this data for purposes of the final rule without substantially delaying the rule's issuance. FRA does recognize that special attention is needed to the specifics of this design, which is unique in current service in the United States, both to avoid inappropriate requirements and to ensure sound functioning of features that may warrant exceptions from other requirements.

In the final rule, § 238.201 has been amended to permit approval of equipment of special construction. (This alternative compliance approval process does not apply to the minimum static end strength requirements set forth in § 238.203.) The basis for decision would be similar to that discussed in the NPRM with respect to waivers (62 FR 49728, 49755), but the special approval mechanism would be employed as a more appropriate means of recognizing whether the equipment provides an equivalent level of safety with the standard of safety benchmarked in the particular provisions of the subpart.

No New Safety Appliance Requirements

FRA is not imposing new safety appliance requirements for passenger equipment subject to this subpart. The safety appliance requirements referenced in § 238.229 continue to apply to such passenger equipment and are noted in this rule for clarity. Similarly, the window glazing requirements in 49 CFR part 223 continue to apply by their own force.

Section 238.203 Static End Strength

This section contains the requirements for the overall compressive strength of all Tier I rail passenger equipment, except for equipment meeting the requirements of § 238.201. This section is based on the long-standing practice of constructing passenger cars to possess a minimum static end strength of 800,000 pounds on the line of draft without permanent deformation of the body structure. This practice has proven effective in the North American railroad operating environment that includes frequent highway-rail grade crossings, mixed operation of freight and passenger trains, and less than fully-capable signal and train control systems. This section should be read with the discussion relating to static end strength earlier in the preamble.

In general, paragraph (a) requires that on or after November 8, 1999 all passenger equipment (except as otherwise provided in § 238.201) shall resist a minimum static end load of 800,000 pounds applied on the line of draft without permanent deformation of the body structure. As specified in paragraph (a)(2), unoccupied volumes of a passenger car or a locomotive may have a lesser static end strength to allow a crash energy management design approach to be employed, if the car or locomotive resists a minimum static end load of 800,000 pounds applied on the line of draft at the ends of its occupied volume without permanent deformation of the body structure. FRA makes clear that, for purposes of paragraph (a)(2), the ability of a car or locomotive to resist a minimum static end load of 800,000 pounds applied on the line of draft at the ends of its occupied volume without permanent deformation of the body structure shall be determined on the basis of the individual car or locomotive's own strength and crash energy management design. Two or more units of passenger equipment may not be included in demonstrating the ability of the occupied volume of an individual passenger car or locomotive to resist a minimum static end load of 800,000 pounds as specified in paragraph (a)(2).

Paragraph (a)(2) is based on proposed § 238.203(b) in the NPRM, *see* 62 FR 49804. In the final rule, FRA has revised and incorporated that paragraph into paragraph (a). FRA has done so in part to make clear that a passenger car or a locomotive must first resist a minimum static end load of 800,000 pounds applied at the ends of the car or locomotive, unless the car or locomotive employs a crash energy management design in which case the load may then be resisted at the ends of the volume of the car or locomotive occupied by passengers or crewmembers.

FRA has included paragraph (a)(3) in the final rule in response to the comments on the NPRM that existing AEM–7 locomotives would not comply with the static end strength requirement proposed by FRA. As FRA understands, applying the 800,000-pound load at the buff stops of an AEM–7 locomotive apparently creates too large a moment on either the draft gear housing or on the buffer beam to side sill connection. Having analyzed the AEM–7 locomotive, FRA believes that the structure can support a 1,000,000-pound load applied at the center of the buffer beam, and provide an equivalent or greater level of safety than that proposed in the NPRM.

The requirements of paragraph (a)(3) are based on former AAR Standard 034–69, Section 6—Buffing, paragraph (f). In the final rule, FRA has doubled the load provided in the AAR Standard from 500,000 pounds to 1,000,000 pounds, to ensure safety. Further, FRA has tailored paragraph (a)(3) so that the alternative specified therein does not apply to any locomotive placed in service on or after July 12, 1999, as FRA wishes to limit application of this alternative to existing locomotives. In addition, the alternative specified in paragraph (a)(3) may not be applied to a cab car or an MU locomotive. Use of the alternative for such a locomotive will not provide as high a level of safety as for a conventional locomotive.

As specified in paragraph (a)(4), the requirements of paragraph (a) do not apply to unoccupied passenger equipment operating at the rear of a passenger train. In the NPRM, FRA had proposed excepting from the requirements of paragraph (a) vehicles such as auto-carriers and RoadRailers operated at the rear of a passenger train and used solely to transport freight. To the extent such equipment could be excepted from the requirements of this paragraph, FRA determined that other unoccupied passenger equipment operating at the rear of a passenger train could also be excepted. In general, however, FRA would prefer that every vehicle in a passenger train have a minimum static end strength as specified in this section so that in the event of a train collision the cars in the train will crush or resist crushing with a certain degree of predictability and, thereby, further the ability of the train to remain upright and in line. As most collisions involving a passenger train occur at the train's forward end, the requirement for unoccupied passenger equipment to possess a minimum compressive strength is more significant for such equipment operated at the train's forward end and in front of the passenger car consist, than for such equipment operated at the rear. As proposed in the NPRM, private cars are also excepted from the requirements of paragraph (a). Nevertheless, FRA believes that, at a minimum, most private cars do comply with the compressive strength requirements that are specified in this paragraph for other passenger equipment.

In the final rule, FRA has included paragraph (b) to address the concern of railroads commenting on the NPRM that their existing passenger equipment may need to undergo potentially costly testing to determine whether the equipment complies with the static end strength requirements specified in this rule. Although FRA believes that only a limited number of existing passenger equipment on the nation's railroads does not comply with the static end strength requirement specified in paragraph (a)(1), FRA has included a presumption in the final rule to alleviate the burden on railroads to show that their existing equipment complies with the requirements of this paragraph. Paragraph (b) provides that any passenger equipment placed in service before November 8, 1999 is presumed to comply with paragraph (a)(1) (and thus presumed to resist a minimum static end load of 800,000 pounds applied on the line of draft without permanent deformation of the body structure), unless the railroad operating the equipment has knowledge, or FRA makes a showing, that such passenger equipment was not built to the requirements specified in paragraph (a)(1). FRA makes clear that passenger equipment built in accordance with AAR specifications for the construction of passenger equipment operating in trains of more than 600,000 pounds total empty weight is deemed to be built to the requirements specified in paragraph (a)(1) and, thereby, compliant in this regard. Originally adopted in 1939, Section 6, paragraph (a), of AAR Standard S–034–69, ''Specification for the Construction of New Passenger Equipment Cars,'' provides in part, ''The car structure shall resist a minimum static end load of 800,000 lbs. at the rear draft stops ahead of the bolster on the center line of draft, without developing any permanent deformation in any member of the car structure.'' FRA also makes clear that, in a case where the railroad does not know whether its passenger equipment was built to the requirements specified in paragraph (a)(1) (or, in essence, this AAR specification), the presumption that the equipment was built to the requirements specified in paragraph (a)(1) still applies. The presumption is not applicable only in those cases where the railroad knows, or FRA can make a showing, that the equipment was not built to the requirements specified in paragraph (a)(1).

In response to the NYDOT's comment as to the effect of applying the static end strength requirement to existing passenger equipment, and thereby to the turboliner equipment planned for use in New York State, FRA believes that the RTL trainsets undergoing rebuild comply with the end strength requirement specified in paragraph (a)(1). However, these RTL trainsets need to be contrasted with the RTG trainsets which the NYDOT has also expressed an interest in rebuilding for like use. FRA believes that these RTG trainsets do not meet the end strength requirement specified in paragraph (a)(1), as FRA understands they were built in accordance with UIC (International Union of Railways) structural standards (which provide for lesser structural strength). FRA does note that no RTG trainsets are currently in service in the United States and that to rebuild the equipment would involve substantial cost while failing to meet the crashworthiness objectives of this rule. Information available to FRA indicates that the only useable remaining components of these trainsets are their shells. Further, FRA is not aware that any funding has been allocated to initiate the remanufacture of these trainsets, and any planned use of these trainsets should be considered speculative.

To prevent sudden, brittle-type failure of the passenger equipment body structure, paragraph (c) requires that the body structure be designed, to the maximum extent possible, to fail by buckling or crushing, or both, of structural members rather than by fracture of structural members or failure of structural connections.

In the final rule, FRA has added a paragraph (d) to provide a process for grandfathering approval of passenger equipment in use on a rail line or lines on November 8, 1999 that does not meet the minimum static end strength requirements. If the operator of the equipment files a petition with FRA seeking grandfathering approval to continue to use the equipment within this 180-day period after the rule is published, the equipment could continue in such usage while the petition is being processed, but such usage must stop May 8, 2000 unless the petition is approved. The section sets forth the requirements for petitions and service of the petition, and the process FRA will follow in soliciting comments on the petition and disposing of petitions.

FRA plans to ''grandfather'' equipment only for use in particular operating environments providing a sufficient showing is made that any incremental safety risk incurred in those environments is not of significant concern or that specific measures mitigating the risk to the traveling public and to railroad employees are utilized. Petitioners will need to demonstrate—through a quantitative risk assessment that incorporates design information, engineering analysis of the equipment's static end strength and of the likely performance of the equipment in derailment and collision scenarios, and risk mitigation measures to avoid the possibility of collisions or to limit the speed at which a collision might occur, or both, that will be employed in connection with the usage of the equipment on a specified rail line or lines—that use of the equipment, as utilized in the service environment for which recognition is sought, is in the public interest and is consistent with railroad safety. In this regard, FRA notes that passenger equipment not possessing the minimum static end strength specified in this rule does not have the same capacity to absorb safely within its body structure the compressive forces that develop in a collision as equipment meeting the standard. The engineering analysis submitted by the petitioner should address how these forces will be dissipated in a manner that does not jeopardize occupant safety in collision scenarios.

Grandfathering approval of non-compliant equipment is limited to usage of the equipment on a particular rail line or lines. Before grandfathered equipment can be used on another rail line, a railroad must file and secure approval of a grandfathering petition for such usage.

Section 238.205 Anti-Climbing Mechanism

This section contains the vertical strength requirements for anti-climbing mechanisms on rail passenger equipment. The purpose of the anti-climbing mechanism is to prevent the override or telescoping of one passenger train unit into another in a derailment or collision. FRA is requiring that all passenger equipment placed in service for the first time on or after November 8, 1999 shall have an anti-climbing mechanism at each end capable of resisting an upward or downward vertical force of 100,000 pounds without permanent deformation. When coupled together in any combination to join two vehicles, AAR Type H and Type F tight-lock couplers satisfy this requirement. This requirement incorporates a long-standing industry practice into the final rule.

The rule further requires that the forward end of a locomotive ordered on or after September 8, 2000, or placed in service for the first time on or after September 9, 2002, be equipped with an anti-climbing mechanism capable of resisting an upward or downward vertical force of 200,000 pounds without failure. This requirement applies to locomotives or power cars of permanently coupled trains, and includes cab cars and MU locomotives. Specifying a vertical load requirement for lead vehicles (locomotives) that is greater than that for coupled vehicles is needed to address the greater tendency for override in a collision between uncoupled vehicles. AAR Standard S–580, which addresses the crashworthiness of locomotives, has included this requirement for all freight locomotives built since August 1990. FRA believes this industry practice is sound, and this requirement received endorsement by passenger railroad representatives. FRA recognizes that incorporating a separate anti-climbing arrangement in the leading structure of cab cars and MU locomotives presents a significant challenge. FRA will continue to work with the APTA PRESS Task Force to derive a suitable solution.

In its comments on the proposed rule, Talgo remarked that § 238.205(a), as drafted, seemed to consider that only couplers may properly function as anti-climbing mechanisms. Talgo recommended modifying this section to avoid this implication and ensure that anti-climbing mechanisms of varying design can be evaluated fairly. Talgo asserted that such a modification would ensure that articulated trainsets are not unfairly subject to a requirement that focuses only on conventionally coupled units. WDOT, in its comments on the NPRM, raised similar points, noting that articulated joints of semi-permanently coupled trainsets provide anti-climbing ability. As a result, FRA makes clear that the term anti-climbing mechanism is intended to be read broadly to encompass more than a conventional coupler, and that an articulated connection may serve as an anti-climbing mechanism for the purposes of this section provided it can withstand the vertical forces specified in this section.

In its comments on the NPRM, Talgo also believed that the rule should be restated to accommodate trains of different masses. Specifically, in determining the strength of the anti-climbing feature, Talgo recommended stating the operative variable as vertical acceleration, expressed in gs (units of acceleration of gravity), rather than load, expressed in pounds. Accordingly, Talgo recommended modifying this section so that the anti-climbing mechanism be capable of resisting a certain value of acceleration, instead of a vertical force of 100,000 pounds. Talgo supplemented its comments on this section following FRA's announcement that the minutes of the rulemaking's Working Group meetings had been added to the rulemaking's docket, *See* 63 FR 28496; May 26, 1998. As FRA had permitted comments for inclusion in the record as to whether the minutes accurately reflected statements made at the Working Group meetings, Talgo stated that the minutes do not mention that a representative of the Volpe Center acknowledged that this section should be modified to address lighter rail equipment. Talgo stated that, aside from the ends of its articulated trainsets which it noted are compliant with the 100,000 pound vertical force requirement, intermediate joints in the trainsets need only be equipped with anti-climbing mechanisms of 47,000 pounds strength to provide the same level of safety as required by the rule. Talgo explained that, for purposes of calculating a vertical force requirement, one should focus on the static force needed to lift a car of specified weight from one end while supported by the truck on the other end. Talgo further explained that this value should be multiplied by a safety factor—equal to 2.2., as it derived from values in the proposed rule—in order to take into account the possibilities of misalignment and similar dynamics in the event of a collision. As a result, Talgo believed specifying a 47,000-pound strength requirement for anti-climbing mechanisms on its equipment would provide the same level of safety as specifying a 100,000-pound strength requirement for anti-climbing mechanisms on conventional cars.

FRA notes that during a train collision the relatively strong underframe of a rail vehicle may ride up above the underframe of an adjacent rail vehicle, and extensively crush the weaker superstructure of the overridden vehicle. The potential for override to occur is influenced by the dynamic motions of the cars, the relative heights of the vehicles' underframes, and the changing geometry of the vehicles' structures as they crush during the collision. These factors allow the development of a vertical component of the very high longitudinal forces occurring in a train during a collision. This vertical force component, in effect, squeezes one underframe up and over the underframe of another vehicle in the train. While all three factors play a role in the occurrence of override, results of actual collisions indicate that the changing geometry of the car structures as they crush—which, in effect, creates a ramp during the collision—can overwhelm the influence of the difference in sill heights. There are numerous examples of cars with relatively low underframe heights that have overridden cars with relatively high underframe heights.

FRA has not modified the final rule in response to Talgo's comment that the rule should require the anti-climbing mechanism to be capable of resisting a certain value of acceleration instead of a specified vertical force. First, Talgo has not indicated in its comments what that value of acceleration should be, and FRA believes that formulating a performance standard in pounds of force, instead, is appropriate. Second, Talgo's subsequent comments have focused on specifying a 47,000-pound vertical force as an alternative to the

100,000-pound vertical force that an anti-climbing mechanism must resist under this section. In response to this latter suggestion by Talgo, FRA notes that the longitudinal force acting on a vehicle in a train during a collision is, in large part, a function of the vehicle's own deceleration plus the force required to decelerate all the vehicles behind it. (The longitudinal force is also dependent on the force required to crush the vehicles in the train.) When a sufficient vertical component of this total force develops, override occurs. Because the longitudinal force required to decelerate the trailing vehicles can exceed the force required to decelerate the subject vehicle, it is not possible to relate the deceleration of a single vehicle to the tendency to override in the way that Talgo has explained in arriving at its proposed 47,000-pound strength value. The Volpe Center representative cited by Talgo sought to make this point clear at the December 15, 1997 Working Group meeting. This representative also tried to make clear that he did not agree that consideration should be given to lighter rail equipment in the way that Talgo proposed at the Working Group meeting and in its comments on the rule.

Even though it may be theoretically possible to develop a formula which relates the decelerations of all the cars in a train to the tendency to override, such a formula would have to take into account the specific cars in the train and the time-phasing of the decelerations of the cars during a collision, as well as the forces required to crush each of the cars. Development of such a formula is beyond FRA's resources in issuing initial passenger equipment safety standards as mandated by Congress. However, FRA will further examine this issue in evaluating equipment of special construction.

Section 238.207 Link Between Coupling Mechanism and Car Body

This section contains the vertical strength requirements for the structure that links the coupling mechanism to the car body on passenger equipment. The purpose of this requirement is to avoid a premature failure of the draft system so that the anti-climbing mechanism will have an opportunity to engage.

FRA is requiring that all passenger equipment placed in service for the first time on or after November 8, 1999 be provided with a coupler carrier or other coupler-to-car-body linking structure that is designed to resist a vertical downward thrust from the coupler shank of 100,000 pounds, without permanent deformation for any normal horizontal position of the coupler or coupling mechanism.

In its comments on the NPRM, Talgo stated that this section should be modified to apply only in the case where the coupler between cars itself acts as the anti-climbing mechanism—not in cases where other anti-climbing designs such as articulated unions are utilized. As a result, Talgo recommended that the requirements of this section should apply only to the couplers at the far ends of an articulated trainset, and not to the interior articulated unions which do not employ couplers. Talgo believed that this approach has been proposed in the rule with respect to Tier II passenger equipment. Talgo further commented that the load requirement should be the same as provided in § 238.205.

FRA recognizes that in an articulated trainset, the articulated joint connecting the cars in the train serves as both the coupler carrier and as the anti-climbing mechanism. Such cars do not have a coupler shank, *per se*. For practical reasons, including administration of the rule, FRA proposed separate requirements for the strength of the anti-climbing mechanism in § 238.205 and for the strength of the link between the coupling mechanism and car body in § 238.207 because the vast majority of Tier I passenger equipment possesses a conventional draft system. However, FRA intended that for passenger equipment utilizing articulated connections that comply with the requirements of § 238.205(a), such articulated connections would also comply with the requirements of this section. In the final rule, FRA has made this explicit by adding a sentence to the rule text, and FRA has therefore adopted Talgo's comment in this regard. Talgo's comment with respect to specifying an appropriate load requirement for this section is consequently addressed in the discussion of § 238.205, above.

Section 238.209 Forward-Facing End Structure of Locomotives

This section contains the requirements for the covering or skin of the forward-facing end structure of each passenger locomotive ordered on or after September 8, 2000, or placed in service for the first time on or after September 9, 2002. The purpose of these requirements is to protect the occupied volume of the locomotive cab. This area is especially vulnerable in a highway-rail grade crossing collision if a fuel tank that is part of or being transported by the highway vehicle ruptures, or bulk hazardous materials are released.

FRA is requiring that the skin covering the forward-facing end of each passenger locomotive, including a cab car and an MU locomotive, be at a minimum equivalent to a ½-inch steel plate with a 25,000 pounds-per-square-inch yield strength. Material of a higher yield strength material may be used to decrease the required thickness of the material provided at least an equivalent level of strength is maintained. The skin shall also be designed to inhibit the entry of fluids into the occupied area of the equipment, and be affixed to the collision posts or other main vertical structural members of the forward-facing end structure to add to the strength of the end structure.

AAR Standard S–580 has included these requirements for all locomotives built since August 1990. From observations of the improved performance of locomotives during collisions, FRA believes that this industry standard should be part of these safety standards. Passenger railroad representatives in the Working Group endorsed this improved safety requirement.

In its comments on the NPRM, APTA recommended that paragraph (c) be clarified so that the skin be designed to permit a train line door with a window in the forward-facing end structure of cab cars and MU locomotives. In fact, as proposed in the NPRM, the rule defined "skin" to mean the "outer covering on a fuel tank or the front of a locomotive, including a cab car and an MU locomotive, excluding the windows and forward-facing doors." *See* § 238.5; 62 FR 49795 (The skin may also be covered with another coating of a material such as fiberglass). APTA's recommendation is therefore consistent with FRA's proposal. For clarity, however, FRA has revised the final rule by removing the exclusion concerning windows and forward-facing doors from the definition of "skin" in § 238.5, and placing the exclusion instead directly in paragraph (d) of this section.

Section 238.211 Collision Posts

This section contains the structural strength requirements for collision posts. Collision posts provide protection against the crushing of occupied volumes of passenger equipment, including the telescoping of one vehicle into another, in the event of a collision or derailment.

Paragraph (a) requires that all passenger equipment placed in service for the first time on or after November 8, 1999 shall have either two full-height collision posts, each collision post having an ultimate longitudinal strength of not less than 300,000 pounds, or an equivalent end structure. The 300,000-pound strength requirement makes mandatory the long-standing construction practice for collision posts in passenger equipment operating in the United States and has proven effective in the Nation's railroad operating environment. This requirement is similar to that contained in 49 CFR 229.141(a)(4), which applies to MU locomotives operated in trains having a total empty weight of 600,000 pounds or more, but also requires the collision posts to be full-height. As noted, FRA does not believe the 600,000-pound consist weight threshold is an appropriate distinction to retain for passenger equipment operating on the general system intermingled with equipment of more substantial strength, and, as a result, no such consist weight distinction is made in the final rule.

Full-height collision posts provide additional protection because they extend higher than posts attached only at the underframe. Little, if any, additional cost is imposed on builders by requiring full-height posts. Spacing the collision posts at approximately the one-third points laterally across the ends of the equipment will allow both posts to be engaged in many collision scenarios. An equivalent single end structure may be used in place of the two collision posts provided the structure can withstand the sum of the forces that each collision post is required to withstand. This allows for the design of monocoque, unitized or like structures. FRA notes, of course, that such a single end structure must also resist the loading requirements for corner posts as specified in § 238.213, as well as any other applicable end structure requirements as specified in this rule for Tier I passenger equipment.

Amtrak, in its comments on the NPRM, noted that its rail passenger operation is unique in the United States because it includes the use of unoccupied express and mail cars. Amtrak stated that collision posts applied to unoccupied head end cars (express cars) are unwarranted because the posts unnecessarily increase the tare weight of this equipment without any associated improvement in safety. FRA had originally proposed requiring that all passenger equipment comply with the requirements of paragraph (a), except for a vehicle of special design that operates at the rear of a passenger train and is used solely to transport freight, such as an auto-carrier or a RoadRailer. *See* 62 FR 49804. FRA sought this broader application of the collision post requirements in part because collision posts serve to repel adjacent passenger equipment in a train collision or derailment and, thereby, help prevent the uncontrolled crushing of equipment which could tend to misalign the train consist. For occupant safety, it is optimal that a train remain in line and upright in the event of a collision or derailment, and gradually come to a stop after ''plowing the ballast'' along the railroad track.

Nonetheless, FRA has revised the final rule to except unoccupied passenger equipment from the requirements of this section—whether operated at the rear or forward end of a passenger train. However, as noted above in the discussion of § 238.203, unoccupied passenger equipment operated at the forward end of a passenger train must comply with the static end strength requirement to maintain the integrity of the train.

Paragraph (b) requires that each locomotive, including a cab car or MU locomotive, ordered on or after September 8, 2000, or placed in service for the first time on or after September 9, 2002, have two forward collision posts, located at approximately the one-third points laterally across the end of the locomotive, each post capable of withstanding a 500,000-pound longitudinal force without exceeding the ultimate strength of the joint. In addition, each post must be capable of withstanding a 200,000-pound longitudinal force exerted 30 inches above the joint of the post to the underframe, without exceeding its ultimate strength. AAR Standard S–580 has included this requirement for all locomotives built since August 1990. From observation of the improved performance of these locomotives during collisions, including collisions with motor vehicles at highway-rail grade crossings, FRA believes this industry practice should become part of this rule's safety standards.

As an alternative, an equivalent end structure may be used in place of the two forward collision posts described in paragraph (b), to allow for the design of monocoque, unitized or like structures. The single end structure shall withstand the sum of the forces that each collision post is required to withstand, in addition to the loading requirements for corner posts as specified in § 238.213 and any other applicable end structure requirements as specified in this rule for Tier I passenger equipment.

Paragraph (c) provides that for a consist of semi-permanently coupled, articulated units, the end structure requirements in paragraphs (a) and (b) of this section apply only to the ends of the semi-permanently coupled consist of articulated units, provided that the railroad submits to the FRA Associate Administrator for Safety under the procedures specified in § 238.21—and FRA accepts as persuasive—a documented engineering analysis establishing that the articulated connection is capable of preventing disengagement and telescoping to the same extent as equipment satisfying the anti-climbing and collision post requirements contained in this subpart. In such case, the interior ends of the individual units in the consist need not be equipped with an end structure meeting the requirements of paragraphs (a) and (b). FRA notes that, in commenting on proposed § 238.211(c), both Talgo and WDOT had requested that FRA substitute the phrase ''semi-permanently coupled'' for ''permanently joined'' in describing the consist of units subject to the exception provided in paragraph (c). This recommendation has been adopted.

FRA has modified paragraph (c) from that proposed in the NPRM, *see* 62 FR 49804, by not providing an automatic exception from the collision post requirements for the interior ends of individual units in a consist of semi-permanently coupled, articulated units. Instead, a railroad must submit a documented engineering analysis supporting the capabilities of the articulated connection, as described above, and FRA must find that analysis persuasive. Articulated assemblies have a history of remaining in line during derailments and collisions and, if not designed to be uncoupled, only the outside ends of the entire assembly should be exposed to the risks of override. However, none of the relevant recent experience is on the North American continent, and the ability of articulated connections to remain intact during a collision with North American passenger equipment, freight rolling stock, or a fixed obstruction has not been demonstrated analytically. FRA noted the weakness in the proposed exception (§ 238.211(c) of the NPRM) while preparing the final rule. An approved, documented engineering analysis supporting the capabilities of the articulated connection is necessary to ensure the safety of passengers and crewmembers.

Section 238.213 Corner Posts

This section contains the requirements for corner posts on passenger cars, such as passenger coaches, cab cars and MU locomotives, ordered on or after September 8, 2000, or placed in service for the first time on or after September 9, 2002. FRA has clarified the requirements of this section, as explained below.

A corner post is the vertical structural member normally located at the intersection of the end of a rail vehicle with a side of that vehicle. Paragraphs (a) and (b) specify the loads and orientation of the loads that a corner post in a passenger car must resist. The values specified in paragraphs (a) and (b) are the same as those proposed in the NPRM, *see* 62 FR 49804, though they have been stated in a different manner for clarity in the final rule.

This section allows flexibility so that corner posts may be located at positions other than at the extreme outside corners of a passenger car, as long as the corner posts are placed ahead of the occupied volume of the car. In this manner, corner posts may be positioned adjacent to the occupied volume of a passenger car to provide structural protection to the occupied volume. For instance, for passenger coaches equipped with end vestibules, the corner posts may be located in the side structure inboard of the vestibules' side door openings, provided that such posts are not placed inside the occupied volume, which includes any space for crew or passenger seating. FRA has fully defined ''occupied volume'' in § 238.5 to mean the volume of a rail vehicle or passenger train where passengers or crewmembers are normally located during service operation, such as the operating cab, and passenger seating and sleeping areas. The entire width of a vehicle's end compartment that contains a control stand is an occupied volume. Further, a vestibule is typically not considered occupied, except when it contains a control stand for use as a control cab.

FRA did not intend that the flexibility to place corner posts at locations other than at the extreme outside corners of passenger cars would permit such corner posts to be placed inside the occupied volume of the cars, and FRA recognizes that it should have made this point more explicit in the NPRM. *See* 62 FR 49766. (Of course, as a railroad is free to take safety measures beyond those required in this rule, a railroad may, therefore, operate a passenger car with corner posts inside the occupied volume of the car if another set of corner posts that do comply with the requirements of this section are placed ahead of the occupied volume.) In light of the vulnerabilities of cab cars and MU locomotives operating as the leading units in a passenger train, such passenger cars must be equipped with corner posts meeting the requirements of this section that are placed ahead of the occupied volume. Cab cars and MU locomotives will normally be occupied by a train crewmember in an end compartment, and thus must have corner posts placed near the extreme ends of the vehicles. As stated in its comments on the NPRM, the BLE does not wish the cab control compartment to be the designated section of a passenger car to crush in a collision, and FRA agrees with the BLE that the cab must be protected.

Bombardier, in its comments on the 1997 NPRM, suggested that proposed section 238.213(a) be modified so that the corner posts must resist the loads specified in this section at the point of attachment to the underframe and at the point of attachment to the roof structure, as those loads are applied individually. FRA had proposed that the corner post be able to resist these loads as applied simultaneously, not as applied individually. FRA has carried forward its proposal into the final rule, and has not adopted Bombardier's comment. Requiring the corner post to resist the specified loads as applied simultaneously at the points of attachment to the underframe and at the roof structure is a stricter requirement. In addition, the requirement is likely more representative of the conditions present in an actual collision where the corner post may be impacted at both points simultaneously, as in the case of a sideswipe with a passing rail car.

In their comments on the NPRM, Talgo and WDOT stated that the rule should provide an exception for articulated trainsets similar to that proposed for collision posts in § 238.211(c) of the NPRM. Accordingly, these commenters believed that corner posts should be required only at the far ends of an assembly of semi-permanently coupled, articulated passenger equipment—not at each end of each intermediate, semi-permanently coupled vehicle. FRA has not adopted these comments in the final rule. First, as discussed above, FRA has modified § 238.211 on collision posts so that there is no automatic exception from the collision post requirements for intermediate vehicles in an assembly of semi-permanently coupled, articulated passenger equipment. Further, corner posts, by their very definition and location, protect against hazards in a way that collision posts (positioned closer to the center of the end of a vehicle) cannot. There are many different scenarios in which a passenger car may be struck at its corner, such as in a corner-to-corner collision with another rail vehicle, or a raking collision with an object fouling the right-of-way. As noted in the NPRM, eight passengers were killed following incursion of a freight car into the side of two Amtrak coaches beginning at the corner of each car, near Lugoff, South Carolina, on July 31, 1991. Although there may be less chance of striking the corner of a semi-permanently coupled, articulated passenger car under certain circumstances, the possibility of doing so does exist. FRA, therefore, cannot grant an exclusion from the corner post requirements to such equipment operated as an intermediate unit in an assembly of semi-permanently coupled, articulated passenger cars.

In additional comments on this section, the BLE stated that the proposed corner post strength requirements for Tier I passenger equipment do not adequately address its safety concerns. The BLE noted that past cornering collisions may have resulted in fewer deaths and injuries had improved corner post structures been in place, and that Tier I passenger equipment may operate up to 125 mph in corridors with a significant number of highway-rail intersections. The BLE recommended that FRA apply the corner post requirements proposed for Tier II power cars in § 238.409 to all new and upgraded Tier I passenger equipment.

As FRA explained in the NPRM, the structural parameters for corner post strength represent the common practice for passenger cars built for North American service. They are being adopted as an interim measure to prevent the introduction of equipment not meeting such minimum requirements. FRA recognizes that current design practice has proven inadequate to protect the occupied volume in several recent side-swipe collisions involving passenger trains with cab cars leading. Crash modeling suggests that it is not feasible to modify current equipment designs to protect against collisions of the magnitude that occurred at Secaucus, New Jersey, and Silver Spring, Maryland, in February of 1996. Nevertheless, stronger corner posts are necessary to address collisions involving lower closing speeds. FRA is assisting the APTA PRESS Task Force in preparing a standard for corner post arrangements on cab cars and MU locomotives. Adoption of a suitable standard will be an immediate priority upon publication of the final rule.

Section 238.215 Rollover Strength

This section contains the structural requirements intended to prevent significant deformation of the normally occupied spaces of a passenger car in the event it rolls onto its side or roof. This section essentially requires the vehicle structure to be able to support twice the dead weight of the vehicle while the vehicle is resting on its side or roof. Analysis has shown that current passenger car design practice meets this requirement. This requirement has proven effective in preventing massive structural deformation of cars that have rolled during collisions or derailments. For this reason, FRA believes this requirement should be incorporated into these safety standards.

In the NPRM, FRA invited comment whether this requirement should also apply to locomotives. Representatives from RPI had advised that locomotives do not roll over frequently enough to justify such requirements for conventional locomotives.

The BRC commented that this requirement should apply to locomotives to protect the locomotive's crew from the crush and deformation of the locomotive's occupied volume. While recognizing that locomotives may not roll over frequently, the BRC observed that the additional strength will protect the locomotive's crew if other equipment does land on top of the locomotive. The BRC believed that the occupied volume of the locomotive must be protected to increase the chances of survivability for crewmembers. FRA notes that a rollover strength requirement for all locomotives—freight and passenger—is being examined in the RSAC Locomotive Crashworthiness Working Group. FRA believes that the Locomotive Crashworthiness Working Group is the most appropriate forum in which to address a rollover strength requirement for locomotives overall.

In its comments on the NPRM, Talgo stated that paragraph (a) should include the clarification that local deformations are acceptable when the car rests on its side, just as paragraph (b) specifies that some deformation is permitted to the roof when the car is resting thereon. In paragraph (b), FRA has specified that deformation to the roof sheathing and framing is allowed to the extent necessary for the vehicle to be supported directly on the top chords of the side frames and end frames. This type of deformation does not impinge on the volume normally occupied by passengers. However, side wall deformations pose a safety risk to passengers since seats and other interior fittings are typically attached to the side wall, and passenger limbs are at risk of entrapment or crushing. Therefore, FRA has modified this section in response to Talgo's comment only to permit local yielding of the outer skin of a passenger car provided the resulting deformations in no way intrude upon the occupied volume of the car.

As Bombardier suggested in its comments on the NPRM, FRA has also made a minor clarification to this section by substituting the words ''in the structural members of the'' in place of the word ''for'' in the phrase which originally read in the NPRM, ''the allowable stress for occupied volumes. . . .'' *See* 62 FR 49804–49805.

Section 238.217 Side Structure

This section contains car body side structure requirements. These requirements are intended to prevent the side panels of a passenger car from flexing excessively while in operation, and help to resist penetration of the passenger car's side structure by an outside object. These provisions essentially codify, with minor modifications, sections 16 and 17 of AAR Standard S–034–69, Specification for the Construction of New Passenger Equipment Cars.

This section was originally entitled ''Side impact strength'' in the NPRM. FRA has changed the section title because the requirements in this section principally refer to the stiffness of a car's side panel, rather than the panel's strength. That is, these provisions principally focus on preventing the side panel from flexing excessively under service loads. The greatest service loads acting on the sidewalls of a passenger car probably result from the aerodynamic loads of a train entering or exiting a tunnel, and from two trains passing each other at speed. Residually, these requirements will provide some protection in the event the passenger car's side panel is struck by an outside object.

FRA believes that a side structural strength requirement is necessary because approximately 13% of the grade crossing accidents involving a passenger train result from a highway vehicle striking the side of the passenger train. Further, passenger trains may be struck in the side by other trains, individual rail cars that roll out of sidings, or freight being transported on trains sharing common rights-of-way. In addition, during a derailment or train-to-train collision, trains frequently buckle, exposing the sides of cars to potential impacts during the collision.

In its comments on this section in the NPRM, Bombardier noted that the proposed requirement was based on AAR Standard 034, Section 20, and it believed that to be consistent with the AAR Standard and to take advantage of the higher strength steels currently used in carbody construction, the rule should specify in paragraph (a) that, ''Where minimum section moduli or thickness are specified, they shall be adjusted in proportion to the ratio of the yield strength of the material used, to that of mild open-hearth steel.'' FRA agrees that this comment is applicable to cars whose structural members are made of steel of higher strength than mild open-hearth steel. Accordingly, FRA has expressly provided that the minimum section moduli or thickness specified in paragraph (a) may be adjusted in proportion to the ratio of the yield strength of the material used to that of mild open-hearth steel only for a car whose structural members are made of a higher strength steel.

Talgo, in its comments on this section in the NPRM, believed that the requirement should be rewritten to specify the units used for each of the concepts discussed. For clarity, FRA states that the dimensional units in this paragraph are in inches, and the units for the section moduli are ''in inches^3'' (inches cubed) in paragraphs (a)(1) and (2).

In its comments on the NPRM, WDOT stated that it appeared FRA has continued to refuse to provide it with detailed information on the risks and true need for side impact standards. WDOT stated that it had previously asked FRA for documentation to support FRA's assertion that, as originally stated in the ANPRM, ''[d]esigns of some passenger equipment have floor levels low to the rail, creating the tendency for a heavy highway vehicle striking the side of the train to climb into the occupied passenger volume rather than being driven under the underframe of the passenger rail car'' (61 FR 30692). Without such detailed evidence, WDOT recommended that proposed § 238.217 be deferred until the second phase of the rulemaking.

The Volpe Center has analyzed a highway vehicle side impact into a single-level Amfleet car. The results of that analysis indicate that the Amfleet car will derail and push sideways before significant crushing of the car can occur. It is expected that rail cars having similar structures—side sill, body bolster, and center sill—at a similar height would behave in the same way in such a collision. This includes most passenger cars operating in the United States. However, other cars, such as Amtrak's bi-level cars and WDOT's single-level rail cars, have floor structures that are structurally different and positioned closer to the rail. Preliminary analysis indicates that significant crushing may occur if a highway vehicle collides into the side of one of these cars.

As a general principle in specifying a side impact strength requirement for a passenger car, the objective is to ensure that the side of the passenger car is strong enough so that the car derails and is pushed sideways—rather than collapses—when struck in the side by another rail vehicle or a highway vehicle. FRA believes that current practice may not be adequate to meet this goal, and that cars with low floors are particularly vulnerable to penetration when struck in the side. A more meaningful side structure requirement than contained in this section is necessary to address this concern. Such a requirement will include specifying minimum shear values at the car's floor as well as at some point above the floor to protect the car's occupants. This will be a priority in the second phase of the rulemaking. The requirement in this final rule is, therefore, an interim measure. As FRA believes that this section does not address in particular the vulnerability of low-floor passenger cars to a side impact by a heavy highway vehicle, FRA has, in effect, deferred consideration of a requirement to do so.

FRA notes that WDOT also commented as to the likelihood that a highway vehicle will strike the side of a passenger train. WDOT disagreed with FRA's analysis and conclusions on this issue as stated in the NPRM. *See* 62 FR 49730–1. WDOT stated that FRA had omitted mentioning that two-thirds of all the highway vehicle side impact collisions into a passenger train involved the highway vehicle striking the side of the locomotive. From this, WDOT estimated that one-half of one percent (0.5%) of all grade crossing accidents over the 10-year period shown in the NPRM may have involved a ''heavy'' highway vehicle striking the side of a passenger car.

FRA has gathered more recent data since publication of the NPRM on highway vehicle side impact collisions into passenger trains. Between January 1, 1990, and December 31, 1997, 1,572 collisions occurring at public highway-rail public grade crossings between passenger trains and highway vehicles were reported to FRA. In 202 of these instances (12.8%) highway vehicles struck the side of a passenger train. In other words, a highway vehicle struck the side of a passenger train an average of approximately 25 times each year in this period. Further, in this period 137 collisions involved the highway vehicle striking the first unit of the passenger train, and 65 collisions involved the highway vehicle striking a unit behind the first unit in the train. As a result, WDOT is correct insofar as approximately two-thirds of such collisions involved the highway vehicle striking the first unit in the passenger train, which ostensibly was a locomotive but could also have been a passenger car (cab control car or MU locomotive).

Over the same 8-year period, 31 of the 202 occurrences in which a highway vehicle struck a passenger train involved a ''heavy'' highway vehicle. For purposes of this analysis, FRA considered heavy highway vehicles to consist of all those vehicles identified as a ''Truck-Trailer'' (3) and one-half of those vehicles identified as ''Truck'' (55), as specified according to Form FRA F6180–57—Rail-Highway Grade Crossing Accident/Incident Report. In this period, then, a heavy highway vehicle struck the side of a passenger train an average of 4 times each year—and of these occurrences a heavy highway vehicle struck other than the lead unit in the train an average of 1 to 2 times each year.

In its comments on the NPRM, the WDOT noted that FRA had not provided a record of any injuries or deaths occurring from highway vehicle collisions into passenger trains. FRA states here that in the 8-year period from 1990 through 1997, highway vehicle collisions into passenger trains resulted in 7 total injuries reported to FRA—3 injuries to railroad employees, and 4 injuries to passengers—and no reported fatalities. FRA notes that reliance on this passenger injury data in the abstract is not appropriate when considering the risks associated with operating a particular rail passenger vehicle. For example, it is possible that a highway vehicle collision into the side of an Amfleet rail car that does not injure any passengers would instead cause injuries under the same circumstances in a collision involving a rail car with a different floor structure positioned closer to the rail. As noted above, most of the passenger cars in the United States possess floor structures similar to the Amfleet rail car, positioned at a similar height above the rail. FRA maintains that the potential for a highway vehicle to strike the side of a passenger train is real, as shown by the record of the frequency of highway vehicles striking the sides of passenger trains. FRA therefore advises railroads to consider the risks and consequences of such a collision, with particular attention to the different units of passenger equipment in their operations.

As noted above, the side strength of a passenger car is also highly pertinent to its crashworthiness in a side or raking collision with other railroad rolling stock. Examples could include a freight car rolling out of a siding or industrial spur into the side of a passenger train, or a locomotive moving in a terminal area passing through a switch and into the side of a passenger train. Recognizing these concerns, the Tier II provision on side strength does attempt to address the identified need. This provision was derived from discussions with Amtrak concerning development of specifications for its high-speed trainsets for the Northeast Corridor.

Section 238.219 Truck-to-car-body attachment

This section contains the truck-to-car-body attachment strength requirement for passenger equipment. The attachment is required to resist without failure a 2g vertical force on the mass of the truck and a force of 250,000 pounds in any horizontal direction on the truck.

The intent of the requirement for the attachment to resist without failure a minimum vertical force equivalent to 2g acting on the mass of the truck is to prevent the truck from separating from the car body if it is raised or rolls over. In effect, the attachment must resist, without failure, a force equal to twice the weight of the truck and all the components attached to the truck. Many types of keepers are used to keep trucks attached to car bodies. FRA believes that the majority of them are capable of meeting this requirement. The intent of the requirement for the attachment to resist without failure a minimum force of 250,000 pounds acting in any horizontal direction on the truck is to address the forces that act upon the truck during a derailment that would tend to shear the truck from the car body. The parameter selected represents the current design practice that has proven effective in preventing horizontal shear of trucks from car bodies.

If the truck separates from the car body in a collision or derailment it may become a hazardous projectile that will intrude upon the occupied volumes of the equipment involved in the collision or derailment. Further, if the truck separates from the car body it will not be able to serve, in effect, as an anti-climbing device in a collision or derailment. With the truck attached to the car body, the truck of an overriding rail vehicle is likely to be caught by the underframe of the overridden rail vehicle, thus arresting the override.

In its comments on the NPRM, Talgo recommended that the regulation be modified so that the strength of the attachment against horizontal force is also measured in gs. Specifically, Talgo suggested that the vertical force resistance limit of 2g could be employed rather than a fixed load measure that, according to Talgo, did not take into account individual truck mass. Talgo believed that this modification would not undermine the intent of the rule, which it noted as allowing the truck to act as an anti-climbing device during a collision, citing the NPRM at 62 FR 49767.

In addressing Talgo's comments, FRA would like to make clear that the fundamental reason for requiring the truck-to-car-body attachment to resist without failure a minimum force of 250,000 pounds acting in any horizontal direction on the truck is to prevent the truck from shearing off (separating from) the car body. (FRA believed this implicit in the preamble discussion of the NPRM, and is making it clear here to remove any doubt.) Whether the truck separates from the car body if the car rolls over, or whether the truck separates from the car body from being sheared off, the truck may become a hazardous projectile in either case. FRA did state in the NPRM, ''If the truck remains attached to the car body, the truck is less likely to be struck by [or strike] other units of the train.'' 62 FR 49767. Having the truck remain attached to the car body also allows the truck to serve, in effect, as an anti-climbing device to prevent one vehicle from overriding another in a collision. In this regard, FRA stated in the NPRM, ''*With the truck attached to the car body,* the truck of an overriding vehicle is likely to be caught by the underframe of the overridden vehicle, thus arresting the override.'' Id. (Emphasis added.) However, insofar as FRA's statement in the NPRM that the ''Arequirement for the [truck-to-car-body] attachment to resist a horizontal force is intended to allow the truck to act as an anti-climbing device during a collision'' has been understood to represent the only intent of the horizontal loading resistance requirement, FRA makes clear here that such an understanding of the requirement's intent is too narrow.

FRA believes it appropriate to specify that a passenger rail vehicle's truck-to-car-body attachment must resist without failure a minimum force of 250,000 pounds acting in any horizontal direction on the truck. This force may be possessed by one rail vehicle (Vehicle A) as it collides with the truck of another rail vehicle (Vehicle B) in a collision. Vehicle A is able to possess this force independent of the mass of Vehicle B's truck—or, for that matter, the mass of Vehicle B itself. Nonetheless, Vehicle B's truck-to-car-body-attachment must resist this force so that its truck does not separate from its body. In this regard, FRA believes it inappropriate to restate the horizontal force requirement in this section so that it is dependent on the mass of an individual rail vehicle's truck. FRA does note that it has related the mass of the truck to the vertical force that the truck-to-car-body attachment must resist: In this case, the mass of the truck necessarily determines how strong the truck-to-car-body attachment must be to prevent the truck from separating from the vehicle, as the weight of the truck essentially acts to ''pull'' the truck away from the rail vehicle.

Talgo, in further commenting on the requirements of this section, recommended that the rule should except articulated equipment utilizing a single-axle truck positioned between two car bodies. Talgo stated that in the event a compressive force is generated by a collision, the truck attached to articulated equipment would become embedded between the two car bodies. In this case, it believed the truck is not intended to serve as an anti-climbing device, and that the train's articulated joints would instead provide protection against climbing. WDOT also raised this point in its comments on the NPRM, and recommended that FRA work with Talgo to develop an appropriate alternative to the proposed rule for non-conventional equipment.

As noted, having the truck remain attached to the car body in a collision or derailment helps to prevent one vehicle from overriding another vehicle as the truck of the vehicle attempting the override is caught on the underframe of the other vehicle. Further, the opportunity of having the truck of one vehicle caught on the underframe of another vehicle in such a scenario should be less likely to occur in a collision involving single-axle articulated passenger rail cars than in the case of non-articulated, conventional rail equipment. Yet, as FRA has made clear, the requirements of this section are principally intended to prevent a truck from separating from a rail passenger vehicle. Trucks can and have separated from articulated rail equipment in a collision; and truck separation poses a direct threat to the safety of a passenger train's occupants, especially when the cars in which those passengers ride are structurally vulnerable to penetration. As a result, the requirements of this section must apply to all passenger rail equipment-whether articulated or not.

Section 238.221 Glazing

This section contains additional requirements concerning the safety glazing of passenger equipment subject to the requirements of 49 CFR part 223. Existing safety glazing requirements for windows have largely proven effective in passenger service at speeds up to 125 mph. However, part 223 does not address the performance of the frame which attaches the window glazing to the car body. Paragraph (b)(1) requires each exterior window on a locomotive cab or a passenger car to remain in place when subjected to the forces the glazing itself is required to resist in part 223 of this chapter. In this way, the window glazing must be secured in place so that it can both resist spalling when struck by a projectile, for example, and also resist being knocked out of the window frame. Paragraph (b)(2) requires each exterior window on a locomotive cab or a passenger car to remain in place when subjected to 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. This requirement is also intended to prevent the window from being forced from the window frame, potentially injuring passengers and crewmembers. FRA believes that most existing passenger equipment subject to part 223 meets these requirements.

FRA did not receive any specific comments on this section. However, for clarity, FRA has restated the requirements proposed in § 238.221(b) and (c) in the NPRM, *see* 62 FR 49085, as § 238.221(b) in this final rule. The focus in paragraph (b) in the final rule is clearly on the ability of each exterior window to remain in place, however the window may be secured, and not have the window become a potential projectile itself.

Section 238.223 Fuel tanks

This section contains the structural requirements for external and internal fuel tanks on passenger locomotives ordered on or after September 8, 2000, or placed in service for the first time on or after September 9, 2002.External fuel tanks must comply with the performance requirements for locomotive fuel tanks contained in Appendix D to this part, or an industry standard providing at least an equivalent level of safety if approved by FRA's Associate Administrator for Safety under § 238.21. The requirements in Appendix D are based on AAR Recommended Practice-506, Performance Requirements for Diesel Electric Locomotive Fuel tanks, as adopted on July 1, 1995. In the NPRM, FRA proposed incorporating the requirements of AAR RP–506 directly into the rule. *See* 62 FR 49805. In preparing the final rule, however, FRA determined that restating the requirements of RP–506 in Appendix D would facilitate FRA's administration of the external fuel tank performance requirement. RP–506 itself is not specifically written as a regulatory document, and one of its provisions on fueling does not appear to be a safety requirement. However, FRA does not intend to make any substantive change from the requirements of RP–506, except as noted in detail in the discussion of Appendix D.

FRA has included a definition of external fuel tank in the final rule to mean a fuel containment volume that extends outside the car body structure of the locomotive. An external fuel tank is distinguished from an internal fuel tank, which is defined in the rule as a fuel containment volume that does not extend outside the car body structure of the locomotive. As a result, a fuel tank that is built into the car body structure but is exposed in any way to the outside is considered an external fuel tank under the rule.

FRA has changed the title of paragraph (b) in the NPRM from *Integral fuel tanks* to *Internal fuel tanks,* reflecting the clarification in the definitions. This change is consistent with FRA's intent that, for purposes of the rule, locomotive fuel tanks must comply with one of two standards, depending upon the exposure of the fuel tank outside the car body structure. FRA has dispensed with the term ''integral'' fuel tank—i.e., a fuel tank that is essentially integrated with a structural member of the locomotive not designed as a fuel container—because, depending on its placement, an integral fuel tank either may or may not be exposed outside the locomotive car body structure.

In commenting on the NPRM, Bombardier noted that the requirements proposed in this section have not been applied by the industry to diesel multiple-unit locomotives (DMUs). Bombardier believed that the need and feasibility of applying these standards to DMUs must be evaluated specially because DMUs have much smaller enclosed and protected fuel tanks than those found on conventional North American locomotives. Accordingly, Bombardier recommended that FRA defer applying the requirements of this section to DMUs, until specific requirements for DMUs are developed.

Having considered Bombardier's comment, FRA does not recommend separately addressing requirements for DMU locomotives at this time. FRA has not been provided the operational or performance information necessary for an in-depth evaluation of DMU fuel tanks, and only a limited number of DMUs presently operate within the U.S. FRA will further consider formulating separate requirements for DMU fuel tanks in Phase II of the rulemaking, as operational and performance information is gained.

Section 238.225 Electrical System

FRA did not receive any specific comments on this section, and it is adopted as proposed. This section contains the requirements for the design of electrical systems on passenger equipment. In developing the proposed rule, the Working Group advised that no single, well-recognized electrical code or set of standards applied directly to the design of railroad passenger equipment. As a result, the Working Group recommended broad performance requirements which reflect common electrical safety practice and are widely recognized as good electrical design practice. FRA had offered for comment more detailed electrical system design requirements in the ANPRM, but as advocated by the Working Group the NPRM's approach was more performance-oriented and provided wide latitude in equipment design. FRA believes that this approach helps to ensure good electrical design practice without imposing unnecessary costs on the industry.

The electrical system requirements include provisions for:

- Electrical conductor sizes and properties to provide a margin of safety for the intended application;
- Battery system design to prevent the risk of overcharging or accumulation of dangerous gases that can cause an explosion;
- Design of resistor grids that dissipate energy produced by dynamic braking with sufficient electrical isolation and ventilation to minimize the risk of fires; and
- Electromagnetic compatibility within the intended operating environment to prevent electromagnetic interference with safety-critical equipment systems and to prevent interference of the rolling stock with other systems along the rail right-of-way.

Electrical standards currently under development by an APTA PRESS Task Force will help give effect to these requirements and supplement them as appropriate.

Section 238.227 Suspension System

This section contains the requirements for suspension system performance of all Tier I passenger equipment. In the ANPRM, FRA presented for comment a large set of detailed suspension system performance requirements. The Working Group advised that such an extensive set of requirements was not needed for Tier I passenger equipment, and the NPRM reflected this advice.

Overall, FRA is requiring that all passenger equipment shall exhibit freedom from hunting oscillations at all speeds. Further, FRA is requiring particular suspension system safety requirements for passenger equipment operating at speeds above 110 mph but not exceeding 125 mph, near the transition speed range from Tier I to Tier II requirements. Although FRA believes that for speeds not exceeding 110 mph existing equipment has not demonstrated serious suspension system stability problems, most of this same equipment is only operated at speeds that do not exceed 110 mph. Accordingly, when new or existing passenger equipment is intended for operation above 110 mph, this equipment must demonstrate stable operation during pre-revenue service qualification tests at all speeds up to 5 mph in excess of its maximum intended operating speed under worst-case conditions—including component wear—as determined by the operating railroad. The Working Group advised FRA that a single definition of worst-case conditions could not be applied generally to all railroads; and, as a result, the definition of worst-case conditions shall be determined by each railroad based upon its particular operating environment.

FRA has revised paragraph (a) based on a comment from Talgo by defining hunting oscillations in the rule text directly, and removing the definition of *hunting oscillations* from § 238.5. Further, FRA has clarified the intent of paragraph (a) that passenger equipment shall exhibit freedom from hunting oscillations at all ''operating'' speeds, by inserting the word ''operating'' as recommended by Bombardier in its comments on the rule. FRA has made a similar clarification in paragraph (b).

AAPRCO, in its comments on the NPRM, stated that ''hunting'' is a dynamic resonance phenomenon in which factors as diverse as car body characteristics, truck characteristics, suspension conditions, wheel tread contours and multiple rail alignment, profile, and lubrication conditions all interact to produce a condition in which the truck oscillates back and forth rapidly as the train moves down the track. AAPRCO recognizes that hunting may be dangerous because high forces can be generated between the wheels and the rails. However, according to AAPRCO, because complex interactions of many factors lead to hunting, there is no straightforward way for a car owner or railroad carrier to determine ahead of time whether hunting will occur without extensive, dynamic testing at operating speed and often on the particular track in question. AAPRCO believed that all cars which exhibit hunting when in service should be fixed at the first opportunity. Yet, AAPRCO recommended deleting from the rule the requirement that passenger equipment exhibit freedom from hunting oscillations at all speeds for lack of a practical, predictive method to determine whether an individual car meets this requirement.

FRA agrees with AAPRCO's comments to the extent that the onset of truck hunting cannot always be predicted. However, railroads should not use equipment that they know has a hunting problem; and FRA is retaining the proposed requirement in the final rule. FRA has added AAPRCO's suggestion that if hunting oscillations do occur, a railroad shall take immediate action (such as a reduction in speed and subsequent attention to wheel contours) to prevent derailment. FRA does note that private rail cars are typically heavy rail cars and, therefore, less likely to hunt than lighter rail cars.

FRA has added paragraph (c) to this section to make clear that the requirements of 49 C.F.R. part 213 concerning vehicle/track interaction apply by their own force to passenger equipment, notwithstanding any provision of this section. The requirements of 49 C.F.R. § 213.345 are more detailed than those that are contained in this section, and apply as specified in that section to the qualification of the vehicle/track system for track Classes 6 through 9 for passenger equipment operating above 90 mph (and freight equipment operating above 80 mph).

Section 239.229 Safety appliances

This section references current safety appliance requirements contained in 49 U.S.C. chapter 203 and 49 CFR part 231. These existing requirements continue to apply independently to all Tier I passenger equipment, and FRA is referencing them here for clarity.

Section 238.231 Brake system

This section contains general brake system performance requirements that apply on or after September 9, 1999 to Tier I passenger equipment except as otherwise provided. Paragraph (a) contains a requirement that the primary braking system be capable of stopping the train with a service application of the brakes from its maximum authorized operating speed within the signal spacing existing on the track. FRA believes that this requirement is the most fundamental performance standard for any train brake system. This section merely codifies a requirement which is current industry practice and is the basis for safe train operation in the United States.

Paragraph (b) requires that passenger equipment ordered on or after September 8, 2000, or placed in service for the first time on or after September 9, 2002 be designed not to require an inspector to place himself or herself on, under, or between components of the equipment to observe brake actuation or release. The requirement allows railroads the flexibility of using a reliable indicator in place of requiring direct observation of the brake application or piston travel, because the current designs of many passenger car brake systems make direct observation extremely difficult without the inspector placing himself or herself underneath the equipment. Brake system piston travel or piston cylinder pressure indicators have been used with satisfactory results for many years. FRA recognizes the concerns raised by certain labor representatives regarding the use of piston travel indicators, and although such indicators do not provide 100 percent certainty that the brakes are effective, FRA believes that they have proven themselves effective enough to be preferable to requiring an inspector to assume a dangerous position.

Paragraph (c) requires that an emergency brake application feature be available at any time and that it produce an irretrievable stop. This section merely codifies current industry practice and ensures that passenger equipment will continue to be designed with an emergency brake application feature. This provision recognizes the reality that most passenger brake equipment currently provides a deceleration rate with a full service application that is close to the emergency brake rate. The current design requirement contained in 49 CFR Part 232, Appendix B, requiring the emergency application feature increase a train's deceleration rate by 15 percent, would require the lowering of full service brake rates on passenger equipment, thereby compromising safety and lowering train speeds. Consequently, FRA will not require a specific deceleration rate that must be obtained through an emergency brake application.

Paragraph (d) requires that the train brake system respond as intended to brake control signals and that the brake control system be designed so that a loss of control signal causes a redundant control to take over or cause the brakes to apply. These provisions are fundamental requirements necessary for effective brake system performance, and a codification of current industry practice. FRA intends the requirement to apply to all types of brake control signals, including pneumatic, electric, and radio signals.

Paragraph (e) prohibits the introduction of alcohol or other chemicals into the brake line. During periods of extreme cold weather, railroad employees at times resort to adding alcohol or other freezing point depressants to the brake line in an attempt to prevent accumulated moisture in the line from freezing. Virtually every railroad has a policy against this practice because alcohol and other chemicals attack the o-rings and gaskets that seal the brake system, causing them to age or fail prematurely. This practice can lead to dangerous air leaks and it increases maintenance costs.

Paragraph (f) requires that the brake system be designed and operated to prevent dangerous cracks in wheels. Passenger equipment wheels are normally heat treated so that the wheel rim is in compression. This condition forces small cracks that form in the rim to be closed. Heavy tread braking can heat wheels to the point that a stress reversal occurs and the wheel rim is in tension to a certain depth. Rim tension is a dangerous condition because it promotes surface crack growth. In the 1994 NPRM on power brakes, FRA proposed a wheel surface temperature limit to prevent this condition. *See* 59 FR 47729. Several brake manufacturers and railroads objected to this approach, claiming that the temperature limit was too conservative and did not allow for the development of new materials that can withstand higher temperatures. Based on these comments and concerns, FRA proposed in the 1997 NPRM and is retaining a more flexible performance requirement rather than a wheel tread surface temperature limit. This is an extremely important safety requirement because a cracked wheel that fails at high speed can have catastrophic consequences. In addition to the safety concerns, FRA believes that this requirement will lead to longer wheel life, and thus should provide maintenance savings to the railroads.

Paragraph (g) requires that brake discs be designed and operated so that the disc surface temperature does not exceed manufacturer recommendations. In the 1994 NPRM, FRA proposed a disc surface temperature limit. *See* 59 FR 47729. As noted above, several brake manufacturers and railroads objected to this approach, claiming that the temperature limit was too conservative and did not allow for the development of new materials that can withstand higher temperatures. Based on these comments and concerns, FRA proposed in the 1997 NPRM and is retaining a more flexible requirement rather than a single disc surface temperature limit. FRA believes this requirement will lead to longer disc life, and thus will produce maintenance savings to railroads.

Paragraph (h) contains the requirements related to hand brakes and parking brakes on passenger equipment. A hand or parking brake is an important safety feature that prevents the rolling or runaway of parked equipment. In the 1997 NPRM, FRA proposed an all encompassing requirement that all locomotives, except those ordered and placed in service before certain dates, and all other passenger equipment be provided with a hand or parking brake that could be set and released manually and could hold the equipment on the maximum grade anticipated by the operating railroad. Based on the concerns of labor representatives, FRA recognizes that this proposed provision is somewhat at odds with the hand brake provisions currently contained in 49 CFR part 231, particularly the requirements that the hand brake be able to be operated while the equipment is in motion and that the hand brake operate in harmony with the brake system. As it is FRA's intent to remain consistent with the existing safety appliance requirements for Tier I passenger equipment, FRA has slightly modified the provisions requiring hand or parking brakes on passenger equipment.

FRA is retaining the requirement for equipping locomotives, except for MU locomotives, with either a hand brake or a parking brake that can be set and released manually and can hold the equipment on the maximum grade anticipated by the operating railroad. As there are currently no requirements for equipping locomotives with hand brakes, FRA will permit the use of a parking brake or hand brake which meets the above specifications on these vehicles. However, for all other passenger equipment and for MU locomotives, FRA is requiring that they be equipped with a hand brake or parking brake which meets the requirements contained in 49 CFR part 231 regarding hand brakes on passenger cars. Although part 231 does not currently require hand brakes on MU locomotives, FRA is requiring that the hand brake required to be installed on these locomotives under this paragraph comply with the requirements contained in part 231 for other passenger equipment. As these locomotives generally transport members of the general public, similar to passenger coaches, the necessity to apply the hand brake while the car is in motion becomes critical for passenger safety. Therefore, FRA believes that MU locomotives should be equipped with a hand brake which meets the design requirements contained in part 231 regarding passenger cars.

This paragraph contains the requirement that the hand brake or parking brake hold the loaded unit on the maximum grade anticipated by the operating railroad. FRA makes clear that the term ''loaded unit'' refers to the maximum weight and capacity that the unit will carry during its operation. Thus, such things as maximum fuel capacity, maximum passenger capacity, maximum train crew capacity, and the maximum weight of any lading that the locomotive or other unit will carry should be considered in determining the holding ability of any hand or parking brake utilized.

Paragraph (i) contains the requirement that passenger cars be equipped with a means for the emergency brake to be applied that is clearly identified and accessible to passengers. This is a longstanding industry practice and an important safety feature because crucial time may be lost requiring passengers sensing danger to find a member of the train crew to stop the train.

Paragraph (j) contains provisions to ensure that the dynamic brake does not become a safety-critical device. Railroads have consistently held that dynamic brakes are not safety devices because the friction brake alone is capable of safely stopping a train if the dynamic brake is not available. The provisions in this paragraph include requiring that the blending of the friction and dynamic brakes be automatic, that the friction brakes alone be able to stop the train in the allowable stopping distance, and that a failure of the dynamic brake does not cause thermal damage to wheels or discs due to the greater friction braking load. FRA believes that without these requirements the dynamic brake would most likely become a safety-critical item and railroads would not be permitted to dispatch trains unless the dynamic brake were fully operational.

Although FRA recognizes the concerns of labor representatives that dynamic brakes are safety critical and should be required to work at all times, FRA believes that in the context of blended braking labor's concerns are somewhat misplaced and are adequately addressed by various provisions contained in this final rule. In the blended brake context, unlike freight operation, there is not an independent dynamic brake: The dynamic brake and the pneumatic brake systems are automatically blended without separate action being taken by the locomotive engineer. Thus, the undue reliance on the dynamic brake is not a major concern when blended braking systems are utilized. In addition, the provisions contained in this paragraph ensure that blended brake systems are designed so that failure of the dynamic portion of the blended braking system does not impact the safe operation and stopping of the train. Furthermore, as part of the exterior calendar day mechanical inspection railroads are required to verify that all secondary braking systems are in operating mode and do not have any known defects. *See* § 238.303(e)(15). Consequently, the railroad must verify that the dynamic brakes are in operating mode and do not contain any known defects and take prescribed action whenever the dynamic brakes are found to be inoperative prior to releasing a locomotive from an exterior calendar day mechanical inspection.

Paragraph (k) requires that either computer modeling or dynamometer tests be performed to confirm that new brake designs not result in thermal damage to wheels or discs. Further, if the operating parameters of the new braking system change significantly, a new simulation must be performed. This requirement provides a means to ensure that the requirements in paragraphs (f) and (g) are being complied with by new brake designs.

Paragraph (l) requires that all locomotives ordered on or after September 8, 2000, or placed in service for the first time on or after September 9, 2002, be equipped with effective air coolers or air dryers if equipped with air compressors. The coolers or dryers must be capable of providing air to the main reservoir with a dew point suppression at least 10 degrees F. below ambient temperature. FRA and most members in the industry agree that moisture is a major cause of brake line contamination. Consequently, reducing moisture leads to longer component life and better brake system performance. Currently, virtually all passenger railroads purchase only locomotives equipped with air dryers or coolers. Therefore, FRA is merely requiring the continuation of what it believes is good industry practice. Although labor representatives contend that a dew point suppression of 10 degrees below ambient temperature is insufficient to prevent condensation in the train line, these commenters provided no support for that contention other than the assertion that prior specifications called for a 35 degree dew point suppression. Based on available information, FRA believes that a 10 degree dew point suppression is adequate. Without further study into the issue, FRA is reluctant to impose a more burdensome standard than that which was proposed. This issue may be further considered in the second phase of this passenger equipment rulemaking process.

Paragraph (m) requires that when a train is operated in either direct or graduated release, the railroad shall ensure that all cars in the train consist are set-up in the same operating mode. This provision was added based upon the concerns of several labor commenters regarding trains operated by Amtrak which contain a mixture of traditional passenger equipment and freight-like equipment. Most passenger trains are operated in what is known as a graduated release mode, whereby brake cylinder pressure may be reduced in steps proportional to increments of brake pipe pressure build-up; however, when passenger trains operated by Amtrak contain certain freight-like equipment the train is operated in a direct release mode, whereby brake cylinder pressure is completely exhausted as a result of an increase in brake pipe pressure. As these two different types of operating modes are now being utilized on passenger trains, FRA agrees it is necessary to require a railroad to ensure that all the cars in the train are set-up in the same operating mode in order to prevent potential train handling problems.

Section 238.233 Interior Fittings and Surfaces

This section contains the requirements concerning interior fittings and surfaces that apply, as specified in this section, to passenger cars and locomotives ordered on or after September 8, 2000, or placed in service for the first time on or after September 9, 2002.

FRA and NTSB investigations of passenger train accidents have revealed that luggage, seats, and other interior objects breaking or coming loose is a frequent cause of injury to passengers and crewmembers. During a collision, the greatest decelerations and thus the greatest forces to cause potential failure of interior fitting attachment points are experienced in the longitudinal direction, *i.e.*, in the direction parallel to the normal direction of train travel. Current practice is to design seats and other interior fittings to withstand the forces due to accelerations of 6g in the longitudinal direction, 3g in the vertical direction, and 3g in the lateral direction. Due to the injuries caused by broken seats and other loose fixtures, FRA believes that the current design practice is inadequate.

Paragraph (a)(1) requires that each seat in a passenger car remain firmly attached to the car body when subjected to individually applied accelerations of 4g in the lateral direction and 4g in the upward vertical direction acting on the deadweight of the seat or seats, if held in tandem. Based on a comment from Simula in response to the NPRM, FRA has clarified this requirement from that proposed in the NPRM by specifying that the vertical loading is in the ''upward'' direction. Paragraph (a)(2) specifies that a seat attachment shall have an ultimate strength capable of resisting the longitudinal inertial force of 8g acting on the mass of the seat plus the load associated with the impact into the seat back of an unrestrained 95th-percentile adult male initially seated behind the seat back, when the floor decelerates with a triangular crash pulse having a peak of 8g and a duration of 250 milliseconds (msec). By resisting the force of an occupant striking the seat from behind, a potential domino effect of seats breaking away from their attachments is avoided. As used in this section, a 95th-percentile adult male has been defined in § 238.5 of the final rule based on the same characteristics for such a vehicle occupant specified by the National Highway Traffic Safety Administration (NHTSA) in its motor vehicle safety standards at 49 CFR § 571.208, S7.1.4. At the January 1998 Working Group meeting, the NTSB had recommended use of the NHTSA specifications for purposes of the rule's occupant protection requirements.

The requirement contained in paragraph (a)(2) represents a modification from FRA's original proposal that the seat attachment resist a longitudinal inertial force of 8g acting on the mass of the seat plus the impact force of the mass of a 95th-percentile male occupant(s) being decelerated from a relative speed of 25 mph and striking the seat from behind. *See* 62 FR 49806. The impact speed at which the occupant strikes the seatback ahead of him during a collision depends on the distance from the occupant to the seatback and the deceleration of the car (the crash pulse) during the collision. In drafting the rule, FRA has assumed a seat pitch, or distance from the occupant to the seatback ahead of him, consistent with the longest seat pitch currently used in intercity passenger train service. As a result, the final rule specifies the crash pulse and its duration, and need not specify the secondary impact velocity. This change is intended to clarify the rule by relating it more directly to how the rule is applied and allow for different seat pitches. Seat pitches are expected to reflect actual use of the seats and be less than that assumed by FRA. Consequently, secondary impact speeds of occupants striking the seatbacks ahead of them are expected to be 25 mph or less—a marginally less severe test condition than that provided for in the NPRM.

The revision to this paragraph is based in part on comments from Simula that the rule require the seat to resist a dynamic crash pulse, which it believed to be triangular with a 250 millisecond duration and an 8g peak, plus the impact of representative unrestrained occupants seated in a second row directly behind the test article. Simula noted that including a dynamic crash pulse in the longitudinal direction (parallel to the normal direction of train travel) provides a simulation of a typical train-to-train collision in which the seat would be involved. According to Simula, a dynamic crash pulse is more representative of the crash environment than the shock pulse defined by a peak acceleration only. Simula explained that the crash pulse is typically specified for seat testing in the aircraft and automotive industries. Specifying a crash pulse in essence specifies the operation of the test equipment. FRA notes that the seat testing proposed in the NPRM (and required in the final rule) is similar to such testing performed in the aircraft and automotive industries, and FRA expects that the actual testing of rail equipment will utilize the same test equipment as used in these other industries. FRA has, therefore, specified a crash pulse in this paragraph.

FRA notes that at the Working Group meeting in December 1997, APTA explained that it could not agree then to change any of the proposed seat testing requirements, and that it was conducting research in these matters. However, FRA does not believe the inclusion of a crash pulse in this paragraph and elimination of the 25 mph impact speed to significantly alter the required strength of the seats from that proposed in the NPRM. In fact, the original proposal was potentially more rigorous than that required under this final rule.

Simula additionally commented that each crash test dummy used to impact the seat back in testing the strength of the seat must be instrumented, and that the injury data gathered from each dummy then meet specified injury criteria. Simula explained that, like automotive and transport aircraft testing, rail seat design requirements should include the use of crash test dummies to measure specified loads and accelerations for meeting specified injury criteria. FRA believes that Simula's comment is significant and wholly appropriate for consideration in the second phase of rulemaking on passenger equipment safety standards. In this regard, FRA notes that Simula references in its comments on proposed § 238.435 (the Tier II counterpart to this section) the use of a future APTA standard to specify occupant injury criteria and other parameters. Accordingly, resolution of this issue in the second phase of the rulemaking should benefit from APTA's efforts in this area.

In its comments on the NPRM, Simula also suggested modifying the rule so that the requirements of paragraph (a) apply to each seat assembly and specify that each seat assembly not separate from its mountings or have any of its parts detach. FRA believes that Simula's suggested modification restates the requirements of this section, in effect, and FRA does not find it necessary to change the explicit wording of the rule text. Simula further recommended specifying in the rule that in sled testing the strength of the seat attachment to the car, the attachment that is tested must be representative of the actual structure and attachment. FRA agrees with Simula that testing a seat and its attachment of a design or structure not representative of that actually used in a passenger car would necessarily fail to demonstrate that the actual seat and its attachment comply with the requirements of the rule. FRA has made this explicit in paragraph (g). Of course, any tests of passenger equipment or components of a design or structure not representative of an actual rail vehicle or actual components subject to the requirements of this part would necessarily fail to demonstrate that such actual vehicle or components comply with the requirements of this part—whether or not FRA has made this explicit in the rule text.

Paragraph (b) requires that overhead storage racks provide longitudinal and lateral restraint for stowed articles to minimize the potential for these objects to come loose and injure train occupants. Further, to prevent overhead storage racks from breaking away from their attachment points to the car body, these racks shall have an ultimate strength capable of resisting individually applied accelerations of 8g longitudinally, 4g vertically, and 4g laterally acting on the mass of the luggage stowed. This mass shall be specified by each railroad. In commenting on the NPRM, the BRC did not believe that a railroad should be allowed to specify the mass of the luggage stowed for purposes of this requirement. However, each railroad is in the best position to determine the mass of the luggage that can be stowed in the stowage area.

Paragraph (c) requires that all other interior fittings in a passenger car be attached to the car body with sufficient strength to withstand individually applied accelerations of 8g longitudinally, 4g vertically, and 4g laterally acting on the mass of the fitting. FRA believes the attachment strength requirements for seats, overhead storage racks, and other interior fittings will help reduce the number of injuries to occupants in passenger cars.

Passenger car occupants may also be injured by protruding objects, especially if the occupants fall or are thrown against such objects during a train collision or derailment. As a result, FRA is requiring in paragraph (d) that, to the extent possible, all interior fittings in a passenger car, except seats, shall be recessed or flush-mounted. Fittings that are recessed or flush-mounted do not protrude above interior surfaces and thereby would help to minimize occupant injuries.

Paragraph (e) is a general, common sense prohibition against sharp edges and corners in a locomotive cab and a passenger car. Just as FRA is concerned about protruding objects, these surfaces could also injure passenger train occupants. If sharp edges and corners cannot be avoided in the equipment design, they should be padded to mitigate the consequences of occupant impacts.

The requirements of paragraph (f) apply to each floor-mounted seat in a locomotive cab as well as to any seat provided for an employee regularly assigned to occupy the cab. FRA is requiring the seat attachment to have an ultimate strength capable of resisting the loads due to individually applied accelerations of 8g longitudinally, 4g vertically, and 4g laterally acting on the combined mass of the seat and its occupant. When turned backwards during a collision, seats with head rests that are designed to this requirement can effectively restrain crewmembers and minimize or prevent injuries.

In the NPRM, FRA had proposed that the requirements of this section apply to each floor-mounted seat provided exclusively for a crewmember assigned to occupy the cab of a locomotive. *See* 62 FR 49806. Simula, in its comments on the NPRM, recommended that the requirements of this section not be limited to floor-mounted seats and instead suggested substituting the words ''car-mounted seat.'' Simula expressed concern that railroads may use wall-mounted seats for crewmembers that do not comply with these requirements. Yet, as noted below in the discussion of § 238.445(g) (this provision's Tier II counterpart), Bombardier observed that an additional seat—commonly a flip-up or a shelf-type seat—is in many cases provided in the cab for a train crewmember who is not normally in the cab. Bombardier believed these seats should not be subjected to the same requirements as for the train operators' seats.

FRA has revised paragraph (f) so that the requirements of this provision apply to floor-mounted seats and each seat provided for a crewmember regularly assigned to the locomotive cab. FRA recognizes that flip-down and other auxiliary seats are provided in locomotive cabs for the temporary use of employees not regularly assigned to the cab, such as a supervisor of locomotive engineers conducting an operational monitoring test of the engineer. These seats do not need to meet the requirements of this section.

In further commenting on this paragraph, Simula recommended specifying that the seat resist a triangular crash pulse of a 250 msec duration having an 8g peak. However, FRA believes that the static 8g load requirement proposed in the NPRM is a rational option, and has retained it in the final rule. As train operators' seats are not likely to be hit from behind, they are not likely to experience the impact forces that passenger seats experience. Adopting Simula's comment would result in a more expensive test without a corresponding increase in safety.

Simula additionally commented that, in conducting a test of the seat, the attachment of the seat to the sled fixture must be representative of the actual structure and attachment. FRA has adopted this comment, as noted above, in paragraph (g). Testing a seat and its attachment of a design or structure not representative of that actually used in a locomotive cab would necessarily fail to demonstrate that the actual seat and its attachment comply with the requirements of the rule.

Section 238.235 Doors

This section contains the requirements for exterior doors on passenger cars. These doors are the primary means of egress from a passenger train.

Paragraph (a) requires that by December 31, 1999, each powered, exterior side door in a vestibule that is partitioned from the passenger compartment of a passenger car shall have a manual override device that is: capable of releasing the door to permit it to be opened without power from inside the car; located adjacent to the door which it controls; and designed and maintained so that a person may readily access and operate the override device from inside the car without requiring the use of a tool or other implement. Passenger cars subject to this requirement that are not already equipped with such manual override devices must be retrofitted accordingly. FRA notes that a vestibule is not partitioned from the passenger compartment of a passenger car solely by the presence of any windscreen which extends no more than one-quarter of the width across the car from the wall to which it is attached.

The requirements in paragraph (a) originally arose from the NTSB's emergency safety recommendations (R–96–7) as part of its investigation of the passenger train collision in Silver Spring, Maryland, on February 16, 1996. In the NPRM, FRA fully set out these emergency safety recommendations and FRA's response. *See* 62 FR 49734–5. As announced following its full investigation of the Silver Spring, Maryland passenger train collision, and stated here in particular among its final recommendations, the NTSB recommended that FRA:

> Require all passenger cars to have easily accessible interior emergency quick-release mechanisms adjacent to exterior passageway doors and take appropriate emergency action to ensure corrective action until these measures are incorporated into minimum passenger car safety standards.

(R–97–14) (See NTSB/RAR–97/02)

FRA received a number of comments as to the date by which passenger cars must be equipped with manual overrides to open exterior, side doors as specified in this section. In its comments on the NPRM, Septa asked that the date be set three years after the effective date of the final rule, citing funding reasons. Metra commented that the date be set four to six years from the effective date of the final rule. FRA notes that this comment may have been based on the assumption that the rule requires manual override devices to be installed on the exterior of existing passenger cars, which this section does not. The UTU commented that the proposal in the NPRM afforded railroads more than enough time to comply with the requirement, considering their advance notice of this issue. Finally, in its comments on the NPRM, the NTSB stated that a two-year period to accomplish the equipping of passenger cars with the manual override feature is too long.

Having considered the comments submitted, FRA has decided to require that compliance with this section be effected by December 31, 1999. FRA understands that a majority of the passenger cars are already in compliance with the rule as proposed. FRA recognizes that some entities may not be able to accomplish the total retrofit within the required time, to the extent their budget and acquisition process can only commence once the rule becomes final. However, these are self-imposed constraints that should not arrest progress in the industry as a whole. Any entity faced with such constraints should seek a waiver.

Paragraph (b) also provides that each powered, exterior side door have a manual override feature the same as that required in paragraph (a) for existing equipment, except that the manual override must also be capable of opening the door from outside the car. This requirement is intended to provide quick access to a passenger car by emergency response personnel, and represents the consensus recommendation of the Working Group. Paragraph (b) applies to each such door on a passenger car ordered on or after September 8, 2000, or placed in service for the first time on or after September 9, 2002. Paragraph (b)'s requirements for a minimum number and dimension of side doors on a passenger car is discussed earlier in the preamble.

Paragraph (c) permits a railroad to protect a manul override device with a cover or screen to safeguard such devices from casual or inadvertent use. The rule requires that such cover and screens be capable of being removed by passengers, however.

Paragraph (d) is reserved for door marking and operating instruction requirements. These requirements are addressed in the final rule on passenger train emergency preparedness (49 CFR part 239), specifically § 239.107. *See* 63 FR 24630; May 4, 1998.

Section 238.237 Automated Monitoring

This section requires on or after November 8, 1999 an operational alerter or a deadman control in the controlling locomotive of each passenger train operating in other than cab signal, automatic train control, or automatic train stop territory. This section further requires that such locomotives ordered on or after September 8, 2000, or placed in service for the first time on or after September 9, 2002, must be equipped with a working alerter. As a result, the use of a deadman control alone on these new locomotives would be prohibited.

An alerter will initiate a penalty brake application if it does not receive the proper response from the engineer. Likewise, a deadman control will initiate a penalty brake application if the engineer fails to maintain proper contact with the device. The Working Group discussed establishing specific setting requirements for alerters or deadman controls based on maximum train speed and the capabilities of the signal system. This discussion led to the conclusion that settings should be left to the discretion of individual railroads as long as they document the basis for the settings that they select. If the device fails en route, the rule requires a second person qualified on the signal system and brake application procedures to be stationed in the cab or the engineer must be in constant radio communication with a second crewmember until the train reaches the next terminal. This is intended to allow the train to complete its trip with the device's function of keeping the operator alert taken over by another member of the crew.

Alerters are safety devices intended to verify that the engineer remains capable and vigilant to accomplish the tasks that he or she must perform. Equipping passenger locomotives with an alerter is current industry practice. These devices have proven themselves in service, and the requirement will not impose an additional cost on the industry.

In the final rule, FRA has clarified the procedures a railroad must follow if the alerter or deadman control fails en route. In addition to the requirements of paragraph (d)(1), under paragraph (d)(2)(i) a tag shall be prominently displayed in the locomotive cab to indicate that the alerter or deadman control is defective, until such device is repaired. Further, under paragraph (d)(2)(ii), when the train reaches its next terminal or the locomotive undergoes its next calender day inspection, whichever occurs first, the alerter or deadman control shall be repaired or the locomotive shall be removed as the controlling locomotive in the train.

Subpart D—Inspection, Testing, and Maintenance Requirements of Tier I Passenger Equipment

Section 238.301 Scope

This subpart contains the requirements regarding the inspection, testing, and maintenance of all types of passenger equipment operating at speeds of 125 mph or less. This subpart is intended to address both MU locomotives and push-pull equipment.

This subpart includes the requirements for the inspection, testing, and maintenance of Tier I passenger equipment brake systems as well as the other mechanical and electrical safety components of Tier I passenger equipment.

Section 238.303 Exterior Calendar Day Mechanical Inspection of Passenger Equipment

This section contains the requirements for performing exterior calendar day mechanical inspections on passenger equipment and is patterned after a combination of the current calendar day inspection required for locomotives under the Railroad Locomotive Safety Standards and the pre-departure inspection for freight cars under the Railroad Freight Car Safety Standards. *See* 49 CFR 229.21 and 215.13, respectively. FRA intends for the exterior calendar day mechanical inspection to generally apply to all passenger cars and all unpowered vehicles used in passenger trains (which includes, e.g., not only coaches, MU locomotives, and cab cars but also any other rail rolling equipment used in a passenger train). However, paragraph (a) has been slightly modified to clarify that an inspection of secondary braking systems must be conducted on all passenger equipment, which includes all locomotives. A mechanical safety inspection of freight cars has been a longstanding Federal safety requirement, and FRA believes that the lack of a similar requirement for passenger equipment creates a serious void in the current Federal railroad safety standards.

As noted in the general preamble discussion, FRA has made minor changes and clarifications to the exterior calendar day mechanical inspection that was proposed in the 1997 NPRM. In paragraph (d) of this final rule, FRA is explicitly stating that the exterior mechanical inspection is to be performed to the extent possible without uncoupling the trainset and without placing the equipment over a pit or on an elevated track. This explicit statement has been added in response to APTA's concerns regarding what would constitute proper performance of these inspections. It was never FRA's intent to require this inspection to be conducted in such a manner. FRA intended the inspection to be very similar to the freight car safety inspection currently required pursuant to part 215.

FRA also recognizes that certain items contained in the proposed exterior mechanical inspection could not have been easily inspected without proper shop facilities. Therefore, FRA has moved some of the exterior mechanical inspection requirements related to couplers and trucks to the periodic mechanical inspection requirements as these periodic inspections will likely be performed at locations with facilities available that are more conducive to inspecting the specific components. The specific items which have been moved to the periodic mechanical inspection requirements include: all trucks are equipped with a device or securing arrangement to prevent the truck and car body from separating in case of derailment; all center castings on trucks are not cracked or broken; the distance between the guard arm and the knuckle nose is not more than 5⅛ inches on standard type couplers (MCB contour 1904) or more than 5 5⁄16 inches on D&E couplers; the free slack in the coupler or drawbar not absorbed by friction devices or draft gears is not more than ½ inch; and the draft gear is not broken. The changes made in this final rule were discussed with the Working Group at the December 15–16, 1997 meeting.

Paragraph (a) requires that each passenger car and each unpowered vehicle used in a passenger train receive an exterior mechanical safety inspection at least once each calendar day that the equipment is placed in service except under the circumstances described in paragraph (f). As noted above, this paragraph also recognizes that the requirement contained in paragraph (e)(15) that all secondary braking systems on all passenger equipment are in operating mode and do not have any known defects. FRA has amended this requirement from that proposed in the 1997 NPRM, which proposed to require that all secondary braking systems be working (62 FR 49808), in order to acknowledge that it is impossible to ascertain whether some secondary braking systems, such as dynamic brakes, are working unless the equipment is in use. Thus, FRA has modified the language of the requirement to ensure that all secondary braking systems are capable of working when released from the exterior mechanical inspection. Paragraph (a) and paragraph (e)(15) have also been modified to accurately reflect FRA's intent to ensure that all secondary braking systems are inspected. The requirements for an exterior calendar day mechanical inspection are generally applicable only to passenger cars and other unpowered vehicles used in a passenger trains. Thus, except for MU locomotives and cab cars, other locomotives would not fall within the requirements of this section. However, many locomotives contain secondary braking systems such as dynamic brakes. Thus, in order to effectuate FRA's intent that these secondary braking systems be inspected, paragraph (e)(15) has been modified to clarify that it is applicable to all passenger equipment, which includes all locomotives. Consequently, FRA intends for the secondary braking systems on all locomotives to be inspected and that it be known that those systems are in operating mode and do not contain any known defects.

Paragraph (b) is also a new provision being added to this final rule in order to address the inspections of vehicles that are added to a passenger train while en route. FRA is modifying the Class I brake test and exterior calendar day mechanical inspection requirements to ensure the proper operation of all cars added to a train while en route. In paragraph (b) FRA is requiring the performance of an exterior mechanical inspection on each car added to a passenger train at the time it is added to the train unless documentation is provided to the train crew that an exterior mechanical inspection was performed on the car within the previous calendar day. FRA is adding this requirement in order to address the concerns raised by various labor representatives that no provisions were provided in the 1997 NPRM to address circumstances when cars are added to an en route train. FRA believes that the added provision will ensure the integrity of the mechanical components on every car added to an existing train and should not be a burden for railroads since cars are generally added to passenger trains at major terminals with the facilities and personnel available for conducting such inspections. Furthermore, the inspection requirements contained in this paragraph are very similar to what is currently required when a freight car is added to a train while en route. *See* 49 CFR § 215.13.

Paragraph (c) requires that exterior calendar day mechanical inspections be performed by a qualified maintenance person. FRA believes the combination of a daily Class I brake test and a mechanical safety inspection performed by highly qualified personnel is a key to safer passenger railroad operations. Such a practice will most likely detect and correct equipment problems before they become the source of an accident or incident resulting in personal injuries or damage to property. As noted in previous discussions, FRA does not intend to provide any special provisions for weekend operations with regard to conducting calendar day mechanical inspections by QMPs as suggested in the comments submitted by some APTA representatives. The rationale for requiring daily mechanical attention by highly qualified inspectors, a proposition generally accepted by Working Group members, appears to apply equally to weekend periods. In fact, based on FRA's experience, equipment used on weekends is generally used more rigorously than equipment used during weekday operations.

At present, only one commuter operation (Metra) has raised significant concerns regarding weekend operations. Although there is no specific data suggesting that existing weekend operations on Metra have created a safety hazard, FRA has found it virtually impossible to draft and justify provisions providing limited flexibility for Metra that do not create potential loopholes that could be abused by other passenger train operations that have not had the apparent safety success of Metra. Moreover, based on FRA's independent investigation of Metra's operation, it is believed that the impact of this final rule on Metra's weekend operations will be significantly less than that indicated in APTA's written comments and originally perceived by Metra. FRA believes that most of the personnel needed by Metra to conduct its weekend operations in accordance with this final rule are available to Metra or its contractors and that minor adjustments could be made to its weekend operations that might avoid significant new expense. As the concerns regarding weekend operations appear to involve just one commuter operation and because the precise impact on that operation is not known or available at this time, FRA believes that the waiver process would be the best method for handling the concerns raised by that operator. This would afford FRA an opportunity to provide any relief that may be warranted based on the specific needs and the safety history of the individual railroad without opening the door to potential abuses by other railroads that are not similarly situated.

Paragraph (e) identifies the components that are required to be inspected as part of the exterior daily mechanical safety inspection and provides measurable inspection criteria for the components. The railroad is required to ascertain that each passenger car, and each unpowered vehicle used in a passenger train conforms with the conditions enumerated in paragraph (e) and that all passenger equipment conforms with the requirement contained in paragraph (e)(15). Deviation from any listed condition makes the passenger car or unpowered vehicle defective if it is in service. The Working Group members generally agreed that the components contained in this section represent valid safety-related components that should be frequently inspected by railroads. However, members of the Working Group had widely differing opinions regarding the criteria to be used to inspect these components. FRA selected and has retained inspection criteria based on the locomotive calendar day inspection and the freight car safety pre-departure inspection required by 49 CFR parts 229 and 215, respectively. FRA believes that, at a minimum, passenger cars should receive an inspection which is at least equivalent to that received by locomotives and freight cars.

As discussed in the 1997 NPRM, FRA intends for the daily mechanical inspection to serve as the time when the railroad repairs defects that occur en route. Thus, this section generally requires that safety components not in compliance with this part be repaired before the equipment is permitted to remain in or return to passenger service. (*See* § 238.9 for a discussion of the prohibitions against using passenger equipment containing defects; and §§ 238.15 and 238.17 for a discussion of movement of defective equipment for purposes of repair or sale). The purpose of the defect reporting and tracking system required in § 238.19 is to have the mechanical forces make all necessary safety repairs to the equipment before it is cleared for another day of operation. In other words, FRA generally intends for the flexibility to operate defective equipment in passenger service to end at the calendar day mechanical inspection.

In paragraph (e)(15), FRA has modified the requirements regarding secondary braking systems to clarify that secondary braking systems must be in operating mode and contain no known defective conditions. FRA has also included provisions to address the handling of defective dynamic brakes in order to specifically establish restrictions on the movement of equipment containing this type of defective secondary brake and to recognize the concerns raised by several commenters regarding the importance that these secondary brakes have in the operation of passenger equipment. FRA agrees that in many circumstances it is desirable to have operative dynamic brakes in order to prevent thermal stress to the wheels, which has the potential of occurring if certain passenger trains are operated for extended periods without dynamic brakes and compensating train control practices are not used. In developing the requirements for handling defective dynamic brakes, FRA has generally incorporated the current best practices of the industry.

This paragraph draws a distinction between dynamic brakes on MU locomotives and dynamic brakes on conventional locomotives, treating each slightly differently due to the safety implications involved in each type of operation. FRA intends to require that MU locomotives equipped with dynamic brakes found not to be in operating mode or containing a defective condition which prevents the proper operation of the dynamic brakes be handled in the same manner as a running gear defect pursuant to § 238.17. Thus, MU locomotives found with defective dynamic brakes at the exterior calendar day mechanical inspection must have the dynamic brakes repaired prior to continuing in passenger service. FRA further intends that MU locomotives which experience a dynamic brake defect while en route be handled the same as a running gear defect pursuant to § 238.17. Thus, the locomotive would have to be inspected by a QMP and be properly tagged at the location it is found to be defective.

The requirements related to conventional locomotives found with dynamic brakes not to be in operating mode or containing a defective condition which prevents the proper operation of the dynamic brakes are somewhat less stringent than the movement requirements placed on MU locomotives. In these cases, the locomotive may remain in passenger service provided that the unit is properly tagged, each locomotive engineer taking charge of the train is informed as to the status of the locomotive, and the locomotive's dynamic brakes are repaired within three calendar days of being found defective.

FRA has treated MU and conventional locomotives slightly differently for several reasons. Past history has shown that failure to have operative dynamic brakes in MU operations increases the potential of causing thermal stress to the wheels of the vehicles to a much greater extent than inoperative dynamic brakes in conventional locomotive operations. MU locomotive operations generally tend to have a greater number of station stops, requiring the use of the brakes, than operations where conventional locomotives are utilized and, thus, the potential for thermal stress to the wheels is increased. Furthermore, operations utilizing conventional locomotives tend to operate for extended distances across the country and, thus, are further from locations where repairs to the dynamic brakes can be properly repaired. Therefore, these operations may need extra time to get a defective locomotive to a particular location for repair. Furthermore, FRA believes that the tagging and notification requirements imposed on conventional locomotives reduce the potential of an engineer's undue reliance on a secondary brake system which is not available. Finally, the handling requirements contained in this paragraph are consistent with the current practices within the industry and should have a minimal impact on passenger operations.

Paragraph (f) contains a narrow exception which allows long-distance intercity passenger trains that miss a scheduled exterior calendar day mechanical inspection due to a delay en route to continue in passenger service to the location where the inspection was scheduled to be performed. At that point, a calendar day mechanical inspection must be performed prior to returning the equipment to service of any kind. This flexibility applies only to the mechanical safety inspections of coaches. FRA does not intend to relieve the railroad of the responsibility to perform a locomotive calendar day inspection as required by 49 CFR part 229.

Paragraph (g) contains certain minimal recordkeeping requirements related to the performance of the exterior calendar day mechanical inspection provisions. FRA believes that proper and accurate recordkeeping is the cornerstone of any inspection process and is essential to ensuring the performance and quality of the required inspections. Without such records the inspection requirements would be difficult to enforce. Although recordkeeping was discussed in the Working Group and FRA believes it to be an integral part of any inspection requirement, FRA inadvertently omitted any such requirements in the NPRM specifically related to mechanical inspections. This omission was brought to FRA's attention through verbal and written comments provided by various interested parties and has now been corrected. This paragraph specifically permits a railroad to maintain the required records either in writing or electronically, and the record may be part of a single master report covering an entire group of cars. Whatever format the railroad elects to use to record the information, it must contain the specific information listed in this paragraph.

Paragraph (h) specifies an additional contingent component of the calendar day exterior mechanical inspection. If a car requiring a single car test is moved in a train carrying passengers or available to carry such passengers to a place where the test can be performed, then the single car test must be performed before or during the exterior calendar day mechanical inspection. This provision has been retained from the 1997 NPRM. The comments submitted by APTA suggested that the word ''next'' be inserted prior to ''calendar day mechanical inspection.'' FRA did not make this change as it would provide greater latitude than FRA intended. Paragraph (h) applies to equipment that is already in transit from the location where repairs were conducted that required the performance of a single car test. Thus, in order to remain consistent with the provisions contained in § 238.311(f) such cars must receive the single car test prior to, or as part of, the car's exterior calendar day mechanical inspection. Although FRA recognizes the concerns of labor representatives with regard to this provision, FRA believes that it is necessary to provide the railroads the flexibility to make the necessary repairs to a piece of equipment and then move it to a location which is most conducive to performing the required single car test. FRA currently permits such flexibility and is not aware of any significant safety problems that have arisen as a result of such a practice. However, in order to ensure the safe movement of such equipment, FRA has added various inspection and tagging requirements in § 238.311(f) that must be performed prior to hauling such equipment to another location for the performance of a single car test. (See section-by-section discussion of § 238.311.)

Section 238.305 Interior Calendar Day Mechanical Inspection of Passenger Cars

This section contains the requirements for the performance of interior mechanical inspections on passenger cars (which includes, e.g., passenger coaches, MU locomotives, and cab cars) each calendar day that the equipment is used in service except under the circumstances described in paragraph (d). Unlike the exterior calendar day mechanical inspection, FRA in paragraph (b) of this section permits the interior inspections of passenger cars to be performed by ''qualified persons,'' individuals qualified by the railroad to do so. Thus, these individuals need not meet the definition of a ''qualified maintenance person.''

As noted in the 1997 NPRM, FRA's original position was to require the interior inspections to be performed by qualified maintenance persons. However, after several discussions with members of the Working Group and several other representatives of passenger railroads, FRA determined that the training and experience typical of qualified maintenance persons is not necessary and often does not apply to inspecting interior safety components of passenger equipment. In addition, the flexibility created by permitting someone less qualified than a qualified maintenance person can reduce the cost of performing the mechanical safety inspection since the most economical way to accomplish the mechanical inspection is to combine the exterior inspection with the Class I brake test and then have a crewmember inspect on arrival at the final terminal or have a train coach cleaner combine the interior coach inspection with coach cleaning.

Paragraph (c) lists various components that are required to be inspected as part of the interior calendar day mechanical safety inspection. As a minimum, FRA requires that the following components be inspected: trap doors; end and side doors; manual door releases; safety covers, doors and plates; vestibule step lighting; and safety-related signs and instructions. Consistent with the discussions regarding the movement of defective equipment with non-running gear defects, all en route defects and all noncomplying conditions under this section must be repaired at the time of the daily interior inspection or the equipment would be required to be locked-out and empty in order to be placed or remain in passenger service with the exception of a defect under § 238.305(c)(5). (*See* § 238.9 for a discussion of the prohibitions against using passenger equipment containing defects, and § 238.17 for a discussion of the movement of defective equipment for purposes of repair.)

It should be noted that two of the items contained in paragraph (c) have been slightly modified in order to clarify FRA's intent and to ensure the safety of the traveling public. Paragraph (c)(5), regarding the continuing use of a car with a defective door, has been modified by the addition of subparagraph (c)(5)(iii), which requires that at least one operative and accessible door be available on each side of the vehicle in order for the car to continue to be used in passenger service. FRA believes the addition of this requirement is necessary to ensure that passengers have adequate egress from the equipment should an emergency occur.

Paragraph (c)(8) has also been modified to clarify that the inspection of the manual door releases, as proposed in the 1997 NPRM, need only be made to the extent necessary to verify that all D rings, pull handles, or other means to access manual door releases are in place based on a visual inspection. FRA recognizes that inspection of the actual manual door release would be overly burdensome, costly, and unnecessary due to the relative reliability of such devices. It should also be noted that the final rule contains a new paragraph (c)(9) which requires that the interior mechanical inspection ensure that all required emergency equipment, including fire extinguishers, pry bars, auxiliary portable lighting, and first aid kits be in place. These items are required pursuant to the regulations on passenger train emergency preparedness contained at 49 CFR part 239, and FRA believes that the inspection to ensure the presence of such equipment is appropriate under this section.

Paragraphs (d) and (e) contain provisions which are identical to certain requirements pertaining to exterior calendar day mechanical inspections. Paragraph (d) allows long-distance intercity passenger trains that miss a scheduled calendar day mechanical inspection due to a delay en route to continue in passenger service to the location where the inspection was scheduled. Paragraph (e) contains the recordkeeping requirements related to the performance of interior calendar day mechanical inspections. FRA believes that proper and accurate recordkeeping is the cornerstone of any inspection process and is essential to ensuring the performance and quality of the required inspections. Without such records the inspection requirements would be difficult to enforce. Although recordkeeping was discussed in the Working Group and FRA believes it to be an integral part of any inspection requirement, FRA inadvertently omitted any such requirements in the 1997 NPRM specifically related to mechanical inspections. This omission was brought to FRA's attention through verbal and written comments provided by various interested parties and has been corrected. This paragraph specifically permits a railroad to maintain the required records either in writing or electronically, and the record may be part of a single master report covering an entire group of cars. Whatever format the railroad elects to use to record the information, it must contain the specific information listed in this paragraph.

Section 238.307 Periodic Mechanical Inspection of Passenger Cars and Unpowered Vehicles Used in Passenger Trains

This section contains the requirements for performing periodic mechanical inspections on all passenger cars and all unpowered vehicles used in passenger trains. Paragraph (b) makes clear that the periodic mechanical inspections required under this section are to be performed by a qualified maintenance person as defined in § 238.5. In the 1997 NPRM, FRA proposed that the following components be inspected for proper operation and repaired, if necessary, as part of the periodic maintenance of the equipment: emergency lights; emergency exit windows; seats and seat attachments; overhead luggage racks and attachments; floor and stair surfaces; and hand-operated electrical switches. *See* 62 FR 49808–09. FRA further proposed that such periodic inspections be performed every 180 days. As noted above, FRA, with the intent of requiring their inspection on a periodic basis, removed certain items previously proposed in the exterior calendar day mechanical inspection as they could not be easily inspected without proper shop facilities.

After a review of the industry's practices regarding the performance of periodic mechanical-type inspections, FRA believes that some of the items removed from the exterior calendar day mechanical inspection as well as some of the items previously proposed in the 180 day periodic mechanical inspection should be and are currently inspected on a more frequent basis by the railroads. As it is FRA's intent in this proceeding to attempt to codify the current best practices of the industry, FRA believes that the current intervals for inspecting certain components should be maintained. Consequently, FRA is modifying the time interval for conducting periodic mechanical inspections to include a 92-day and a 368-day periodic inspection.

In paragraph (c), FRA requires the periodic inspection on a 92-day basis of certain mechanical components previously proposed as part of the exterior calendar day mechanical inspection, as well as an inspection of floors, passageways, and switches. The mechanical components to be inspected that were previously included as part of the calendar day mechanical inspection include verification that all trucks are equipped with a device or securing arrangement to prevent the truck and car body from separating in case of derailment and that all center castings on trucks are not cracked or broken. FRA will also require a 92-day inspection of emergency lighting systems as they are critical to the safety of passengers in the event of an accident or derailment. FRA is adding an inspection of the roller bearings to the 92-day inspection. Although this component was inadvertently left out of the NPRM, FRA believes that roller bearings are an integral part of the mechanical components and must be part of any mechanical inspection scheme. Furthermore, several labor commenters recommended inspections criteria similar to that contained in 49 CFR Part 215, which specifically addresses the condition of roller bearings. *See* 49 CFR § 215.115. As roller bearings are best viewed in a shop facility context, FRA is adding the inspection of this component to the 92-day periodic mechanical inspection which is consistent with the current practices of the industry. FRA is also adding the general conditions and components previously proposed in § 238.109(b) (62 FR 49801–802) to the 92-day periodic mechanical inspection contained in this paragraph. As the conditions previously proposed in § 238.109(b) were intended to ensure that the railroads had an inspection scheme in place to ensure that all systems and components of the equipment are free of conditions that endanger the safety of the crew, FRA believes that a specific inspection interval is better suited to address the general condition of the equipment and ensure the safety of the riding public and railroad employees. This paragraph also requires that all of the components inspected as part of the exterior and interior calendar day inspection be inspected at the 92-day periodic inspection.

Paragraph (d) of this section retains a semi-annual periodic inspection for certain components as proposed in the 1997 NPRM. In the NPRM, FRA proposed a 180-day periodic inspection, but in order to remain consistent with the 92-day inspection scheme this paragraph requires a 184-day periodic inspection of certain mechanical components. These include: seats; luggage racks; beds; and emergency windows. This paragraph also contains an added requirement related to the inspection of the couplers; couplers were removed from the calendar day inspection and have been inserted in the 184-day inspection scheme. FRA is placing the coupler inspection at this interval rather than at the 92-day interval in order to reduce the amount of coupling and uncoupling of equipment that will be required. In paragraph (e) FRA has extended the inspection interval related to manual door releases over that which was proposed in the 1997 NPRM. Due to the general reliability of these devices and because they are partially inspected on a daily basis, FRA believes that an annual inspection of the releases will ensure their proper operation. Thus, the final rule requires an inspection of the manual door releases every 368 days.

In paragraph (b) FRA has attempted to make clear that, although FRA has established certain periodic inspection intervals in order to establish a default interval, FRA will allow railroads to develop alternative intervals for performing such inspections for specific components or equipment based on a more quantitative reliability assessment completed as part of their system safety programs. FRA expects that railroads will utilize reliability-based maintenance programs as appropriate, given this opportunity to do so. As successful reliability based maintenance programs are dynamic, it is expected that, in the process of defining and documenting the reliable use of equipment or specific components, over time, continued assessments may indicate a need to increase or decrease inspection intervals. FRA will only permit lengthened inspection intervals beyond the default intervals when such changes are justified by a quantitative reliability assessment. The previously described inspection intervals are based on sound but limited information provided to FRA that FRA believes represents a combination of operating experience, analytical analyses, knowledge and intuition. FRA expects that railroads will collect and respond to additional data throughout the operating life of the equipment.

FRA believes that the approach taken to identify the stated default inspection intervals contained in this section combined both qualitative, or subjective, judgement with available quantitative information. FRA believes this approach is appropriate for the conservative default strategy defined. However, FRA recognizes that this mixed approach does not yield a quantified level of equipment reliability. The reliability of a system or component is defined as the probability that, when operating under stated environmental conditions, the system or component will perform its intended function adequately for a specified interval of time, number of cycles of operation, or number of miles. Reliability is a quantitative measure. FRA believes that quantified, high levels of reliability are desired for the continued safe operation of passenger equipment. Therefore, FRA encourages equipment owners to perform additional sensitivity analyses to determine which components or equipment has the greatest potential for introducing risk, thus requiring the most careful monitoring to increase reliability while reducing the consequences of failure. FRA believes that, in addition to component design reliability, quality assurance, as well as maintenance and inspection proficiency may be considered and evaluated by the equipment owners as a part of this process. When considering the reliable use of passenger equipment, elements such as couplers as well as suspension systems; trucks; side bearings; wheels; jumpers; cable connections; buffer plates; diaphragms; and secondary brake systems, and human factors as it relates to inspecting and maintaining these elements may be considered. Component level structural fatigue, corrosion, and wear are variables that may be considered to bound or introduce uncertainty in passenger equipment performance, effectively reducing reliability as well.

Given the limited quantitative information that is presently available regarding factors that influence the reliability of passenger equipment, the primary sources of information available for initial reliability assessments include: judgement; simulations; field, laboratory, and office experiments; operating environment and maintenance process reviews; and accident and near-miss investigations. FRA believes that in the operation of passenger equipment, where failure costs are high and casualties infrequent, accident data for informed decision making may be scarce or not fully applicable. Further, legal and punitive threats may provide significant impediments to identifying the contributing, initiating, and compounding causes of failures. Data from near-miss, or near-catastrophic incidents may be found to be instructive, but often not all of the parameters entering a quantitative analysis are recorded or communicated in these cases.

FRA believes that for the initial reliability assessments of passenger equipment and components qualified judgment will be an important source of quantitative information. Qualified judgment is based upon both the accumulation of experience and a mental synthesis of factors allowing the evaluator to assess the situation and produce results. Such judgment has a rightful place in making initial quantitative reliability assessments because current available data is often deficient for the evaluation of a particular situation. However, as adequately structured databases are developed and implemented for reliability center maintenance programs, FRA believes more reliance can be placed on objective data and reliability assessments will be based on a combination of data and judgment. FRA believes that, in the very near term, sole reliance cannot be placed on objective data sources to provide quantitative reliability assessments; instead, adequately qualified and unbiased judgment will continue to be required in conjunction with verifiable operating data for analysis purposes.

When planning the maintenance of a component or system to protect the safety and operating capability of the equipment, FRA expects that a number of items will be considered in the reliability assessment process, which include:

1. The consequences of each type of functional failure;
2. The visibility of a functional failure to the operating crew (evidence that a failure has occurred);
3. The visibility of reduced resistance to failure (evidence that a failure is imminent);
4. The life or age-reliability characteristics of each item;
5. The economic tradeoff between the cost of scheduled maintenance and the benefits to be derived from it;
6. A multiple failure, resulting from a sequence of independent failures, may have consequences that would not be caused by any one of the individual failures alone. These consequences are taken into account in the definition of the failure consequences for the first failure; and
7. A default strategy will continue to govern decision making in the absence of full information or agreement. This strategy provides for conservative initial decisions, to be revised on the basis of information derived from operating experience.

FRA believes that a variety of qualitative approaches, such as a Failure Modes, Effects, Criticality Analysis (FMECA) may be useful in evaluating the potential consequences of a functional failure. FRA believes a qualitative approach may be used in complement and combined with a quantitative approach such as Probabilistic Risk Analyses (PRA) or Quantified Risk Analyses (QRA) which may include structured probabilistic Event Tree, Fault Tree, or Influence Diagram analyses to provide additional insight to railroads regarding the reliable use of their equipment. Quantitative approaches are useful to characterize the details of a system whereas qualitative approaches can provide characterization of the general performance quality of the system analyzed.[4] Component level reliability analysis centered around a quantitative, deterministic design approach such as Damage Tolerance Analysis (DTA) may be appropriate when information about the ability of a structural component to sustain anticipated loads in the presence of fatigue, corrosion, or accidental damage is required.[5]

FRA expects that analyses of individual components investigated as a part of the reliability assessment process may require equipment owners to collect and consider information regarding: a component's physical features and conditions; a component's actual operating use; the existence of manufacturing defects and tolerances; the effects of repairs or modifications made to the component; and capabilities of available nondestructive evaluation methods used for inspection. Management of effective reliability-based maintenance programs requires an organized information system for surveillance and analysis of the performance of each component under the known operating conditions. FRA believes that the information derived from such operating experience can provide information of failures that could affect operating safety; failures that have operational consequences; the failure modes of units removed as a result of failures; as well as the general condition of unfailed parts in units that have failed and serviceable units inspected as samples.

As stated above, at the time of the development of default maintenance intervals, FRA used the available information to determine the inspection intervals necessary to protect safety. However, FRA believes that the optimum inspection tasks, methods, and intervals as well as the applicability of age or life limits will be best obtained from reliability analyses based on additional service-based data collection, in some cases coupled with appropriate deterministic analyses to both ensure safety and maximize reliability. For further information regarding sources of reliability theory and analysis, FRA recommends that the following materials be considered:

- ANSI (American National Standards Institute)/ASQC (American Society for Quality) S2 (1995) Introduction to Attribute Sampling;
- ANSI/ASQC Z1.4 (1993) Sampling Procedures and Tables for Inspection by Attributes;
- ANSI/ASQC Z1.9 (1993) Sampling Procedures and Tables for Inspection by Variables for Percent Nonconforming;
- Handbook of Reliability Engineering and Management, W. G. Ireson, McGraw Hill, 1996;
- MIL–STD–414 (1957) Sampling Procedures and Tables for Inspection by Variables for Percent Nonconforming;
- MIL–STD–1234A (1974) Single and Multi-Level Continuous Sampling Procedures and Tables for Inspection by Attributes;
- Reliability-Centered Maintenance, F. S. Nowlan and H. F. Heap, Final Report for Contract MDA 903–75–C–0349, Office of Assistant Secretary of Defense, Washington, D.C., 1978;
- Reliability-Centered Maintenance, A. M. Smith, McGraw Hill, 1992;
- Reliability-Centered Maintenance, J. Moubray, McGraw Hill, 1997; and
- Reliability in Engineering Design, K.C. Kapur and L. R. Lamberson, John Wiley & Sons, 1977.

Paragraph (e) contains the recordkeeping requirements related to the performance of periodic mechanical inspections. FRA believes that proper and accurate recordkeeping is the cornerstone of any inspection process and is essential for ensuring the performance and quality of the required inspections. Without such records, the inspection requirements would be difficult to enforce. Although recordkeeping was discussed in the Working Group and FRA believes it to be an integral part of any inspection requirement, FRA inadvertently omitted any such requirements in the NPRM specifically related to mechanical inspections. This omission was brought to FRA's attention through verbal and written comments provided by various interested parties and has been corrected. This paragraph specifically permits a railroad to maintain the required records either in writing or electronically. Whatever format the railroad elects to use to record the information, it must contain the specific information listed in this paragraph.

Section 238.309 Periodic Brake Equipment Maintenance

This section contains the requirements related to the performance of periodic brake maintenance for various types of passenger equipment, referred to in the industry as clean, oil, test, and stencil (COT&S). Although FRA has considered the concerns raised by certain labor representatives during this rulemaking, FRA does not agree with the conclusions drawn by these commenters with regard to the testing and data submitted to FRA regarding modest extensions of the COT&S intervals for equipment utilizing certain types of brake valves. All of the COT&S intervals contained in this section are based, at least in part, on current operations under existing waivers and on data and information which FRA believes provide substantial support that the valves can be safely operated for the periods of time provided in this section. Furthermore, FRA believes that the stringent inspection and testing regiment and the single car test requirements contained in this final rule also provide sufficient additional safeguards to permit modest increases in the COT&S intervals for equipment outfitted with certain brake valves and other equipment having generally shown the ability to operate for longer periods without failure.

Paragraph (b) extends the periodic maintenance interval for MU locomotive fleets that are 100 percent equipped with air dryers and modern brake systems from 736 days to 1,104 days. The requirement remains 736 days for fleets that are not 100 percent equipped with air dryers or that are equipped with older brake systems. FRA bases this extension on tests conducted by Metro-North and monitored by FRA field inspectors. These tests revealed that after three years brake valves on MU locomotives equipped with air dryers were very clean and showed little or no signs of deterioration. Based on the results of these tests, FRA is confident that these valves can safely operate for three years between periodic maintenance. FRA believes this extension of the periodic maintenance interval will result in a cost savings to those railroads that operate MU locomotives equipped with air dryers.

Paragraph (c) extends the periodic maintenance interval on conventional locomotives equipped with 26–L or equivalent types of brakes from the current standard of 736 days to 1,104 days. The required periodic maintenance interval remains at 736 days for locomotives equipped with other types of brake systems. This requirement merely makes universal a practice that has been approved by waiver for several years. *See* H–80–7. FRA believes that locomotives equipped with 26–L brakes have demonstrated an ability to operate safely for three years between periodic maintenance.

Paragraph (d) extends the periodic maintenance interval on passenger coaches and other unpowered vehicles equipped with 26–C or equivalent brake systems from 1,104 days to 1,476 days. This extension is based on tests

[4] Evaluation Approaches & Quantification (Chapter 8), ''The Role of Human Error in Design, Construction, and Reliability of Marine Structures.'' Robert G. Bea, Report No. SSC–378, U.S. Coast Guard, Washington, D.C. 1994, pp. 127–149.

[5] ''Reliability and Risk Analysis for Design and Operations Planning of Offshore Structures.'' T. Moan, Sixth ICOSSAR, Innsbruck, August 1993.

performed by Amtrak. Based on these tests, FRA granted Amtrak a waiver for this extension on July 26, 1995. *See* FRA Docket No. PB 94–3. Amtrak has operated under the terms of this waiver for several years with no problems. Consequently, based on Amtrak's experience, FRA believes all passenger cars with 26–C equipment can safely be operated for four years between periodic maintenance.

Paragraph (e) recognizes that the same extensions applicable to locomotives and passenger coaches should be applied to control cab cars that use brake valves that are identical to the 26–C valves used in passenger cars or the 26–L valves used on locomotives. Consequently, based on the information and tests conducted on those valves as well as waivers currently existing, FRA is extending the periodic maintenance interval for cab cars to 1,476 days or 1,104 days for those cab cars that use brake systems identical to the 26–C and 26–L, respectively. This extension is consistent with recent requests for waivers received by FRA.

In paragraph (a)(2) FRA provides that a railroad may petition FRA, under § 238.21, to approve alternative maintenance procedures providing equivalent safety. Under this provision, railroads could propose using periodically scheduled single car tests to extend the time between required periodic maintenance on passenger coaches. FRA believes that the single car test provides a good alternative to more frequent periodic maintenance. In fact, in the 1994 NPRM on power brakes, FRA proposed the elimination of time-based COT&S and in its stead proposed time intervals for conducting single car tests, ranging from three to six months, depending on the utilization rate of the passenger equipment. *See* 59 FR 47690–91, 47710–11, and 47740–41. However, comments received and discussions with members of the Working Group revealed that many passenger railroads would rather perform periodic maintenance than more frequent single car tests. One reason for this is that some operators would rather take equipment out of service every few years and perform the overhaul of the brake system than have equipment out of service for shorter periods every few months. Therefore, FRA has retained periodic maintenance intervals but provided the alternative to railroads to propose single car testing intervals in order to reduce the frequency with which the periodic maintenance is performed. Consequently, railroads are afforded some flexibility to determine the type of maintenance approach that best suits their operations. However, in response to concerns raised by a labor commenter, it should be noted that FRA would likely not completely eliminate the need to perform COT&S on a periodic basis but might consider extending the interval between such attention depending on the frequency of the single car test intervals proposed by a railroad.

Section 238.311 Single Car Test

This section contains the requirements for performing single car tests on all nonself-propelled passenger cars and all unpowered vehicles used in passenger trains. As previously discussed in the general preamble, FRA is modifying the requirements related to the performance of single car tests from those that were proposed in the 1997 NPRM. In paragraph (a), based on the recommendations of representatives from both rail labor and rail management, FRA is referencing the single car testing procedures which were developed by APTA PRESS rather than the AAR single car testing procedures referenced in the 1997 NPRM. The single car test procedures were issued by APTA on July 1, 1998, and are contained in APTA Mechanical Safety Standard SS–M–005–98. The single car test procedures issued by APTA are more comprehensive and better address passenger equipment than the older AAR recommended practices. In paragraph (a), FRA is also slightly modifying the applicability of this section for clarity. In the 1997 NPRM, FRA proposed to require the performance of single car tests on all passenger cars and other unpowered vehicles used in passenger trains. However, the definition of passenger cars includes self-propelled vehicles such as MU locomotives, to which FRA did not intend the single car test requirements to apply. Consequently, FRA has modified the language of paragraph (a) to clarify that the testing requirements apply to nonself-propelled passenger cars and unpowered vehicles used in passenger trains.

Paragraph (b) requires that all single car tests be performed by a qualified maintenance person. A single car test is a comprehensive brake test that requires the skills and knowledge of a highly trained and skilled person with mechanical expertise. Railroads currently use personnel which would generally meet the definition of ''qualified maintenance person'' as defined by this part to perform single car tests, and FRA believes that this practice should continue.

FRA is also modifying some of the circumstances under which a single car test is required to be performed in paragraphs (c) through (e). FRA agrees with several of the commenters that the 1997 NPRM may have been over-inclusive in listing the components whose repair, replacement, or removal would trigger the performance of a single car test. Paragraph (c) lists the wheel defects that would trigger the requirement to perform a single car test. FRA believes that the wheel defects contained in this paragraph generally tend to indicate some type of braking equipment problem. FRA believes that merely changing a wheel to correct a wheel defect that is actually caused by a brake system problem will only lead to a continuation of the problem on the new wheel and will increase repair costs to the railroad. A test that checks for the root cause of the defect is not only a good safety practice, but is a good business practice that will lead to reduced operating costs. However, in accordance with the discussions conducted with the Working Group in mid-December of 1997, paragraph (d) makes clear that FRA will not mandate the performance of a single car test for wheel defects, other than a built-up tread, if the railroad can establish that the wheel defect is due to a cause other than a defective brake system. Thus, the burden will fall on the railroad to establish and maintain sufficient documentation that a wheel defect is due to something other than a brake-related cause. FRA makes clear that if the railroad cannot establish the specific non-brake related cause for a wheel defect, it is required to perform a single car test.

Paragraph (e) requires a railroad to conduct a single car test if one or more of the identified brake system components is removed, repaired, or replaced. This paragraph also requires that a single car test be performed if a passenger car or vehicle is placed in service after having been out of service for 30 or more days. FRA believes that these requirements will ensure that brake system repairs have been performed correctly and that the car's brake system will operate as intended after repairs are made or after the car has been in storage for extended periods. As noted above, FRA has amended the list of brake components to include only those circumstances where a relay valve, service portion, emergency portion, or pipe bracket is removed, repaired, or replaced. Whenever any other component previously contained in the 1997 NPRM is removed, repaired, or replaced, paragraph (g) requires that only that portion that is renewed or replaced be tested. FRA believes that the items contained in paragraph (g) can generally be removed, replaced, or repaired without affecting other portions of the brake system, thus reducing the need to perform a single car test. FRA believes that the requirements contained in paragraphs (e) and (g) are more consistent with the current practices of most passenger railroads than the requirement proposed in the 1997 NPRM.

Paragraph (f) provides that if a single car test cannot be made at the point where repairs are made, the car may be moved in service to the next forward location where the test can be made. This paragraph requires that at a minimum the single car test be completed prior to, or as a part of, the car's next calendar day mechanical inspection. As noted previously, labor representatives object to permitting cars to be used in passenger service after a repair is made without the required single car test being performed. These commenters contend that the performance of a single car test is necessary prior to using the vehicle in order to determine whether any other unknown defects to the brake system exist. Although FRA recognizes the concerns of labor representatives with regard to this provision, FRA believes that it is necessary to provide railroads the flexibility to make the necessary repairs to a piece of equipment and then move it to a location which is most conducive to performing the required single car test. However, in order to address labor's concerns and to ensure the safe movement of such equipment, FRA has added a visual inspection requirement and a tagging requirement that must be met prior to the railroad being allowed to haul a car in the fashion provided in this paragraph. Consequently, this paragraph requires that prior to moving a car in passenger service for the purposes of conducting a single car test, a visual inspection verifying the application and release of the brakes on both sides of the repaired car must be conducted and the car must be appropriately tagged to indicate the need to perform a single car test.

Section 238.313 Class I Brake Test

This section contains the requirements related to the performance of Class I brake tests. The requirements in this section apply to all passenger coaches, control cab cars, MU locomotives, and all nonself-propelled vehicles that are part of a passenger train. After consideration of the comments and information submitted, FRA intends to make very minor changes to the requirements regarding Class I brake tests from those that were previously proposed in the 1997 NPRM.

Paragraph (a) of this section requires that a Class I brake test be performed at least once each calendar day that a piece of equipment is placed in service. As noted previously in the 1997 NPRM, the Working Group discussed and debated when and how a Class I brake test should be performed. Labor representatives stressed the need for a thorough brake test performed by qualified mechanical inspectors on every passenger train. These representatives strongly contended that this brake test must be performed prior to the first daily departure of each passenger train. On the other hand, representatives of passenger railroads expressed the desire to have flexibility in conducting a comprehensive brake inspection, arguing that safety would be better served if railroads were permitted to conduct these inspections on a daily basis. Although FRA agrees with the position advanced by many labor representatives that some sort of car-to-car inspection must be made of the brake equipment prior to the first run of the day in most circumstances, FRA does not agree that it is necessary to perform a full Class I brake test in order to ensure the proper functioning of the brake equipment. As FRA views a Class I brake test as a comprehensive inspection of the braking system, FRA believes that commuter and short-distance intercity passenger train operations must be permitted some flexibility in conducting these inspections. Consequently, paragraph (a) requires that commuter and short-distance intercity passenger train operations perform a Class I brake test sometime during the calendar day in which the equipment is used.

FRA also recognizes the differences between commuter or short-distance intercity operations and long-distance intercity passenger train operations. Long-distance intercity passenger trains do not operate in shorter turnaround service over the same sections of track on a daily basis for the purpose of transporting passengers from major centers of employment. Instead, these trains tend to operate for extended periods of time, over long distances with greater distances between passenger stations and terminals. Further, these trains may operate well over 1,000 miles in any 24-hour period, somewhat diminishing the opportunity for conducting inspections on these trains. Therefore, FRA believes that a thorough inspection of the braking system on these types of operations must be conducted prior to the trains' departure from an initial starting terminal. Consequently, paragraph (b) retains the proposed requirement that a Class I brake inspection be performed on long-distance intercity passenger trains prior to departure from an initial terminal. FRA does not believe there would be any significant burden placed on these operations as the current regulations require that an initial terminal inspection be performed at these locations. Furthermore, virtually all of the initial terminal inspections currently conducted on these types of trains are performed by individuals who would be considered qualified maintenance persons pursuant to § 238.5.

Paragraph (b) also retains the requirements proposed in the 1997 NPRM related to the performance of Class I brake tests on long-distance intercity passenger trains every 1,500 miles or every calendar day, whichever comes first. After reviewing the information and comments submitted by labor representatives, the information and comments provided by Amtrak, and based upon the independent information developed by FRA, FRA believes that the enhanced inspection scheme contained in this final rule will ensure the continued safety of long-distance intercity passenger trains. (See previous discussion of comments in general preamble portion of this document.)

Contrary to the statements made in the comments submitted by some labor representatives, FRA is not merely increasing the distance between brake inspections for these types of trains. Rather, FRA is increasing both the quality and the content of the inspections that must be performed on long-distance intercity passenger trains and, thus, increasing the safety of such trains. Under the current regulations these passenger trains are required to receive an initial terminal brake inspection at the point where they are originally assembled, and from that point the train must receive an intermediate brake inspection every 1,000 miles. The current 1,000-mile inspection merely requires the performance of a leakage test, an application of the brakes and the inspection of the brake rigging on each car to ensure it is properly secured. *See* 49 CFR 232.12(b). The current 1,000-mile brake inspection does not require 100 percent operative brakes prior to departure and does not require piston travel to be inspected. The current regulations also do not require the performance of any type of mechanical inspection on passenger equipment at 1,000-mile inspection points or at any other time in the train's journey. Thus, under the current regulations a long-distance intercity passenger train can travel from New York to Los Angeles on one initial terminal inspection, a series of 1,000-mile inspections, and no mechanical inspections.

Whereas, this rule will require the performance of a Class I brake test, which is more comprehensive than the current initial terminal inspection, at the point where the train is originally assembled and will require the performance of another Class I brake test every 1,500 miles or every calendar day thereafter, whichever comes first, by highly qualified inspectors. Thus, at least every 1,500 miles or every calendar day a long-distance passenger train will be required to receive a brake inspection which is more comprehensive than the current initial terminal inspection and which requires that the train have 100 percent operative brakes and have piston travel set within established limits. Furthermore, this rule will require the performance of an exterior and interior mechanical inspection every calendar day that the train is in service. Consequently, the inspection scheme proposed in the 1997 NPRM and retained in this final rule will, in FRA's view, increase the safety and better ensure the integrity of the brake and mechanical components of long-distance passenger trains.

FRA also believes that some recognition must be given to the various types of advanced braking system technologies used on many long-distance intercity passenger trains. Many of these advanced technologies are not found with any regularity in freight operations and thus the reliability and performance of brake systems on these passenger trains enhance the safety of these trains and, when combined with other aspects of this discussion, support FRA's belief that these brake systems can safely be operated with the inspection intervals that were proposed in the 1997 NPRM. Dynamic brakes are typically employed on these types of trains to limit thermal stresses on friction surfaces and to limit the wear and tear on the brake equipment. Furthermore, the brake valves and brake components used on today's long-distance passenger trains are far more reliable than was the case several decades ago. Other technological advances utilized with regularity by these passenger trains include:

- The use of brake cylinder pressure indicators which provide a reliable indication of the application and release of the brakes.
- The use of disc brakes which provide shorter stopping distances and decrease the risk of thermal damage to wheels.
- The ability to effectuate a graduated release of the brakes due to a design feature of the brake equipment which permits more flexibility and more forgiving train control.
- The ability to cut out brakes on a per-axle or per-truck basis rather than a per car basis, thus permitting greater use of those brakes that are operable.
- Brake ratios that are 2½ times greater than the brake ratios of loaded freight cars.

Although some of the technologies noted above have existed for several decades, most of the technologies were not in wide spread use until after 1980. Furthermore, most of the noted technological advances just started to be integrated into one efficient and reliable braking system within the last decade. Consequently, the technology incorporated into the brake equipment used in today's long-distance intercity passenger trains has increased the reliability of the braking system and permits the safe operation of the equipment for extended distances even though a portion of the braking system may be inoperative or defective.

FRA also disagrees with the contentions raised by certain labor representatives that the facts and data do not support the 500 mile extension in the brake inspection interval even with the more comprehensive inspection scheme. These commenters recommend that the current 1,000-mile brake inspection interval be retained together with the increased inspection regiment. These commenters contend that due to the large number of defects being found at 1,000-mile inspections the need to retain the inspection is justified. As an example and support for this position, the BRC submitted information containing numerous defective conditions compiled by carmen stationed at Union Station in Washington D.C. from January 1996 through February of 1997 that the carmen allegedly found on trains traveling through Union Station. After reviewing the documentation submitted, FRA does not believe the information supports the conclusion that 1,000-mile brake inspections must be maintained and that it would be unsafe to extend the distance between brake inspections under the inspection scheme contained in this final rule.

Due to the lack of detail contained in the information submitted by the BRC, it is impossible to determine whether the vast majority of the alleged defective conditions were defective under the Federal regulations or whether the conditions were merely in excess of Amtrak's voluntary maintenance standards or operating practices. In addition, based on the description of some of the conditions, they would not be considered defective conditions under current Federal regulations. Furthermore, the vast majority of the conditions alleged in the document were not power brake defects, and thus, under the current regulations, would not have been required to have been inspected at a 1,000-mile inspection. Nor do the current regulations mandate any type of mechanical inspection on passenger equipment (other than on locomotives under 49 CFR part 229, of course). Moreover, as the vast majority of the alleged conditions were mechanical and wheel defects, FRA believes that these types of defective conditions will be addressed by the exterior calendar day mechanical inspection contained in this final rule which will be required to be performed every calendar day that a piece of equipment is in service.

FRA agrees with the comments submitted by the BRC that the data and information submitted by Amtrak regarding the allegedly defective equipment found at Washington, D.C., does not fully address whether the cars identified by carmen at that location were defective and does indicate that at least many of the cars were repaired for the defective condition noted within several days after moving through Washington, D.C. However, contrary to the conclusions reached by labor representatives, the fact that a car remained in service with an alleged defective mechanical or brake condition does not necessarily mean the train involved was in an unsafe condition or that the equipment was being moved illegally. The current regulations regarding freight mechanical equipment and the existing statutory mandates regarding the movement of equipment with defective safety appliances and brakes permit the movement of a certain amount of defective equipment to certain locations provided it is determined by a qualified person that such a movement can be made safely or that a sufficient percentage of the brakes remain operative. *See* 49 U.S.C. 20303, 49 CFR 215.9. As this final rule will specifically address the inspection of the mechanical components on passenger equipment and the movement of defective mechanical components, which is not covered by existing regulations, FRA believes that the amount of defective equipment being operated will be reduced significantly and/or handled safely in revenue trains. Although FRA agrees that the information submitted by Amtrak regarding the number of cars set out at 1,000-mile inspection points does not reflect the true number of defects being found during the inspections, FRA does find it significant that a very small percentage of cars set-out by Amtrak are set-out at 1,000-mile inspection locations and that most set-outs occur en route.

FRA also finds it necessary to make clear that the number of cars alleged to have been found in defective condition at Union Station in Washington, D.C. is not indicative of a safety problem on long-distance intercity passenger trains. Assuming that all of the cars contained in BRC's submission were in fact defective as alleged, it appears that approximately 750 cars were defective. However, the information also reveals that approximately 1,300 trains were inspected; thus, using a conservative estimate of 10 cars per train, approximately 13,000 cars were inspected. As a result, approximately only 6 percent of the cars inspected were found to contain either a mechanical or brake defect. Furthermore, of the approximate 750 cars alleged to have been found defective, only approximately 20 percent of those contained a power brake-related defect. Consequently, only about 1–2 percent of the total cars inspected contained a power brake-related defect. Moreover, from the information provided it appears that none of the trains contained in the BRC submission were involved in any type of accident or incident related to the defective conditions alleged.

FRA believes that the key to any inspection scheme developed for long-distance intercity passenger trains is the quality of the inspection which is performed at a train's point of origin. FRA is convinced that if a train is properly inspected with highly qualified inspectors and has 100 percent operative brakes at its point of origin, then the train can easily travel up to 1,500 miles between brake inspections without significant deterioration of the braking system. FRA independently monitored a few long-distance intercity passenger trains running from New York to Miami, New York to New Orleans, and New York to Chicago and found that when the trains departed from their points of origin with a brake system that was defect free they arrived at destination without any defective conditions existing in their brake systems. These findings are consistent with FRA's experience in inspecting long-distance intercity passenger trains over the last several years. It should be noted that during this independent monitoring, FRA did find some trains that after receiving initial terminal inspections still contained some defective conditions in the brake system. Although FRA believes that none of the defective conditions found would have prevented the safe operation of the trains, FRA recognizes that FRA as well as the railroads must be vigilant in ensuring that quality brake system inspections are performed on a train at its point of origin and at each location where a Class I brake test is required to be performed. Consequently, due to the comprehensive nature of Class I brake tests and the exterior calendar day mechanical inspection combined with the technological advances incorporated into the braking systems utilized in these types of trains and after a review of the data and information provided and based on FRA's experience with these types of operations, FRA is retaining the proposed 1,500 mile interval for the performance of Class I brake tests in this final rule.

Paragraph (c) contains a provision that was not proposed in the 1997 NPRM to address the inspection of cars added to an en route train. FRA has modified the Class I brake test requirements to ensure the proper operation of all cars added to a train while en route. This paragraph requires the performance of a Class I brake test on each car added to a passenger train at the time it is added to the train unless documentation is provided to the train crew that a Class I brake test was performed on the car within the previous calendar day and the car has not been disconnected from a source of compressed air for more than four hours prior to being added to the train. This requirement has been included in order to address the concerns raised by various labor representatives that no provisions were provided in the 1997 NPRM to address circumstances when cars are added to an en route train. Section 238.317 makes clear that if a car has received such inspection, the railroad will be required to perform a Class II brake test at the time the car is added to the train. FRA believes that these provisions are necessary to ensure the integrity of the brake system on every car added to an existing train and should not be a burden for railroads since cars are generally added to passenger trains at major terminals with the facilities and personnel available for conducting such inspections. Furthermore, these inspection requirements are very similar to what is currently required when a freight car is added to a train while en route. *See* 49 CFR § 232.13.

Paragraph (d) requires that the Class I brake tests be performed by qualified maintenance persons. As FRA intends for Class I brake tests to be in-depth inspections of the entire braking system, which most likely will be performed only one time in any given day in which the equipment is used, FRA believes that these inspections must be performed by individuals possessing the knowledge to not only identify and detect a defective condition in all of the brake equipment required to be inspected but also the knowledge to recognize the interrelational workings of the equipment and have a general understanding of what is necessary to repair the equipment. Furthermore, most passenger railroads currently have a daily brake test performed by highly qualified mechanically trained employees so this requirement is not really a departure from current industry practice. (For a detailed discussion of ''qualified maintenance person'' see the section-by-section analysis for § 238.5 and the general preamble discussion related to qualified maintenance persons.)

Paragraph (e) provides railroads with the option to perform the Class I brake test either separately or in conjunction with the calendar day mechanical inspections. FRA has retained this provision simply to clarify that the two inspections need not be done at the same time or location as long as they are both performed sometime during the calendar day that a piece of equipment is in use.

Paragraph (f) prohibits a railroad from using or hauling a passenger train in passenger service from a location where a Class I brake test has been performed, or was required to have been performed, with less than 100 percent operating brakes. (*See* section-by-section analysis of § 238.15 for a detailed discussion of movement of defective equipment for purposes of repair or sale.)

Paragraph (g) contains a list of the safety-related items that must be inspected, tested, or demonstrated as part of a Class I brake test. This list was developed based on the experience and knowledge of FRA's motive power and equipment field inspectors familiar with the operations and inspection practices of passenger operations. The Working Group extensively discussed the items contained in this paragraph. Very few comments were submitted which addressed the specific items contained in this paragraph. One commenter did recommend that a few of the provisions be clarified to specifically address tread brakes. Therefore, paragraph (g) generally retains all of the requirements proposed in the 1997 NPRM except to the extent that a few requirements have been slightly modified for clarity. Paragraph (g)(1) requires that an inspection be conducted on each side of each car to verify the application and release of each brake. This requirement is consistent with FRA's longstanding interpretation of what the current regulations require when conducting initial terminal and 1,000 mile brake inspections pursuant to § 232.12. For clarity and consistency, FRA has explicitly incorporated the requirement into this final rule. Minor modifications have been made to paragraphs (g)(3), (g)(5), and (g)(11) in order to clarify the intent of the requirements to brake systems utilizing tread brakes. It should be noted that the requirement contained in paragraph (g)(14) would bar the use of a train that current regulations allow to be placed in service. This paragraph requires that brake indicators must function as intended. Although this provision may require railroads to make more frequent repairs than are currently required, FRA believes these added costs are necessitated by—and offset by—the ability to use brake indicators during the performance of certain brake tests in lieu of direct observation of the brakes.

Paragraph (h) requires the qualified maintenance person that performs a Class I brake test to record the date, time and location of the test as well as the number of the controlling locomotive of the train. It should be noted that a requirement to record the total number of cars inspected during the Class I brake test has been added at paragraph (h)(4). FRA believes this information is necessary to ensure that the required inspection has been performed on all the cars in a train and provides a method for the tracking of cars added to en route trains. This minimal information is required to be available in the cab of the controlling locomotive to demonstrate to the train crew and future inspectors that the train is operating under a current Class I brake test. Furthermore, the use of such records or ''brake slips'' as they are known in the industry is the current practice of virtually all passenger railroads. FRA believes that this recordkeeping requirement adds necessary reliability, accountability, and enforceability to the inspection requirements contained in this section.

Paragraph (i) allows long distance, intercity passenger trains that miss a scheduled Class I brake test due to a delay en route to proceed to the point where the scheduled brake test was to be performed. This flexibility prevents Amtrak or other operators of long distance trains from having to dispatch qualified maintenance persons to the location of a delayed train merely to meet the calendar day Class I brake test requirement. This is a common sense exception that will not compromise safety.

Section 28.315 Class IA Brake Test

This section contains the requirements regarding the performance of Class IA brake tests. As mentioned previously, although FRA agrees with the position advanced by many labor representatives that some sort of car-to-car inspection must be made of the brake equipment prior to the first run of the day, FRA does not agree that it is necessary to perform a full Class I brake test in order to ensure the proper functioning of the brake equipment in all situations. However, contrary to the position espoused by several railroad representatives, FRA believes that something more than just a determination that the brakes on the rear car set and release is necessary in many situations.

Currently, the quality of initial terminal tests performed by train crews is likely adequate to determine that brakes apply on each car. However, most commuter equipment utilizes ''tread brake units'' in lieu of cylinders and brake rigging of the kind prevalent on freight and some intercity passenger cars. It is undoubtedly the case that train crewmembers do not verify application of the brakes by tapping brake shoes while the brakes are applied—the only effective means of determining that adequate force is being applied. This is one reason why the subject railroads typically conduct redundant initial terminal tests at other times during the day. Further, train crews are not asked to inspect for wheel defects and other unsafe conditions, nor should they be asked to do so, given the conditions under which they are asked to inspect and the training they receive.

As noted previously, FRA is modifying the requirements for when a Class IA brake test must be performed from that which was proposed in the 1997 NPRM. FRA continues to believe that some type of car-by-car inspection must be performed prior to a passenger train's first run of the day if the train was used in passenger service the previous day without any brake inspection being performed after it has completed service and before it lays-up for the evening. However, FRA tends to agree with the comments submitted by APTA representatives that the need for such an inspection is minimized if a Class I brake test is performed within a relatively short period of time prior to the first run of the day and the train has not been used in passenger service since the performance of that inspection. From a safety standpoint, it appears to be overkill to require the performance of a second comprehensive brake test when the equipment has not been used in passenger service and has remained on a source of compressed air since the last comprehensive brake test was performed. In such circumstances, FRA believes that the performance of a Class II brake test would be sufficient to determine if there are any problems with the braking system due to vandalism or other causes since the last comprehensive Class I brake test. Furthermore, as APTA's comments point out, commuter railroads have been safely operated in a fashion similar to this for a number of years. Consequently, paragraph (a)(1) of this section makes clear that a Class IA brake test is to be performed prior to the first morning departure of each commuter or short-distance intercity passenger train unless a Class I brake test was performed within the previous twelve hours and the train has not been used in passenger service and has not been disconnected from a source of compressed air for more than four hours since the performance of the Class I brake test. FRA believes that this exception is consistent with the concept of performing comprehensive brake and mechanical inspections at centralized locations as this provision affords railroads the ability to conduct a Class I brake test at the end of a train's daily operating cycle at a central location and then have the ability to move the train in non-passenger service to an outlying location without being required to perform a Class IA brake test prior to departure from the outlying terminal.

Paragraph (a)(2) requires that a Class IA brake test be performed prior to placing a train in service if that train has been off a source of compressed air for more than four hours. This requirement formalizes a long-standing agency interpretation of the existing power brake regulations but increases the time limit from two to four hours. Labor representatives maintain that any number of brake system problems can develop with equipment off air for only a short time, while management representatives contend that equipment can be left off air for extended periods of time with no problems. FRA believes the requirement contained in this paragraph is a fair compromise that allows railroads some operating flexibility, but does not allow equipment to be off air without a new brake test for extended periods of time. FRA agrees that its longstanding administrative interpretation of allowing cars to be ''off air'' for only two hours was established prior to the development of new equipment that has greatly reduced leakage problems. However, contrary to the contentions of some commenters, FRA does not believe that cars should be allowed to be ''off air'' for extended periods without being retested. The longer cars sit without a supply of compressed air attached, the greater the chances are that the integrity of the system will be compromised, either by weather conditions or vandalism.

Paragraph (b) allows a commuter or short-distance intercity passenger train that provides continuing late night service that began prior to midnight to complete its daily operating cycle after midnight without performing another Class I or Class IA brake test on the train prior to its first departure after midnight. This provision is included to make clear that a train is not required to be stopped during its operating cycle in order to receive a Class I or Class IA brake test prior to it first departure of a calendar day. FRA also makes clear that this provision does not relieve a railroad from its responsibility under § 238.313 to perform a Class I brake test on each calendar day that the train is in use. Thus, a train operating past midnight must receive a Class I brake test sometime on each of the two days it is in use.

Paragraph (c) allows a Class IA brake test to be performed at a shop or yard site without needing the test repeated at the first passenger terminal if the train remains on air and in the custody of the crew. This provision is an incentive for railroads to conduct the tests at locations where they can be performed more safely and easily. FRA believes that a shop or yard location is more conducive for conducting a proper brake test. Raised platforms and other conditions frequently found at terminals can make the performance of a brake test difficult, if not hazardous.

Paragraph (d) permits the Class IA test to be performed by either a qualified person or a qualified maintenance person. Paragraph (e) prohibits a railroad from using or hauling a passenger train from a location where a Class IA brake test has been performed, or was required to have been performed, with less than 100 percent operative brakes. (*See* section-by-section analysis of §§ 238.15–238.17 for a discussion of movement of defective equipment for purposes of repair or sale.) Paragraph (f) contains the specific tasks that must be performed when conducting a proper Class IA brake test. This paragraph makes clear that a Class IA brake test include: a check that each brake sets and releases; a test of the emergency brake application feature; a check of the deadman or other emergency control device; an observation that angle cocks and cutout cocks are properly set; an observation that brake pipe pressure changes are communicated to the rear of the train; and a test that the communicating signal system is known to be operative.

Paragraph (g) requires that the inspection of the set and release of the brakes be performed by walking the train so the inspector actually observes the set and release of each brake. Labor representatives strongly contended that this is the only way to do a proper brake test. They believe that observation of brake indicators does not give a reliable indication of effective brakes because the indicators sense brake cylinder pressure rather than the force of the brake shoe against the wheel or the pad against the disc. However, this paragraph allows an exception when railroads determine that direct observation of the set and release can place the inspector in danger. FRA acknowledges the contention of rail management representatives that conditions at certain locations where Class IA tests may be performed could place the inspector in danger if he or she is required to place himself or herself in a position to actually observe the set and release of each brake. Where railroads determine this to be the case, FRA will permit the use of brake indicators for the set and release step of the Class IA brake test as long as the inspector takes a position where an accurate observation of the indicators can be made.

Section 238.317 Class II Brake Test

This section contains the requirements regarding how a Class II brake test is to be performed and contains the conditions for when a railroad is required to perform the brake test. The Class II brake test provides passenger railroads the flexibility to continue to use train crew personnel to perform the limited brake tests required when minor changes to the train occur. Both labor and management representatives to the Working Group recognized that train crews are capable of performing the relatively simple checks required by a Class II brake test and that the operations of most commuter and passenger railroads require the flexibility of having operating personnel perform these tests.

Paragraph (a) contains the circumstances which require the performance of a Class II brake test. This paragraph has been modified from that which was proposed in the 1997 NPRM in order to clarify the requirements, to remain consistent with other provisions of this rule, and to address recent issues that have been raised with FRA regarding certain passenger train operations. Although paragraph (a)(1) retains the proposed requirement that a Class II brake test be performed whenever the control stand is changed, this paragraph has been modified in order to clarify that a Class II brake test need not be performed in circumstances where a train is being moved in non-passenger service from one track to another inside a terminal complex even though the changing of the control stand occurs during such movements. In order to effectuate such movements the control stand may be required to be changed several times. As these train movements are akin to switching movements in that they are performed over relatively short distances at very low speeds and pose minor safety hazards, FRA will not require the performance of multiple Class II brake tests in order to conduct such movements. It should be noted that § 238.319 requires the performance of a running brake test whenever the control stand is changed during these types of movements in order to ensure the operation of the brake system during these movements. This paragraph also requires the performance of a Class II brake test prior to the train's departure from the terminal complex with passengers.

Paragraph (a)(2) requires the performance of a Class II brake test prior to the first morning departure of a commuter or short-distance intercity passenger train where a Class I brake test remains valid as provided in § 238.315(a)(1). As discussed in the preceding section, FRA believes that in these limited circumstances the performance of a Class II brake test will adequately ensure the integrity of the brake system on the train since the performance of the last Class I brake test. Paragraph (a)(4) has been added in order to clarify that a Class II brake test is to be performed whenever cars or equipment are removed from a train. This provision is consistent with the concept that the proper operation of the brake system must be verified whenever an event occurs which may impact the integrity of the brake system and is consistent with current practice on virtually every railroad.

Paragraph (c) requires that passenger trains not depart from Class II brake tests which are performed at a terminal or a yard with any brakes cut-out, inoperative, or defective unless the equipment is moved in accordance with § 238.15. The language of this requirement has been slightly modified from the language proposed in the 1997 NPRM, in order to make the provision consistent with the movement for repair provisions contained in this final rule. *See* § 238.15. Many terminals and most yards are locations where brake repairs can be effectuated. Thus, passenger equipment containing defective brake equipment would not be permitted to depart those locations capable of making the necessary repairs until repaired. If the necessary repairs cannot be effectuated at such locations the equipment must be properly tagged and moved pursuant to the requirements contained in § 238.15.

Paragraph (d) requires that a Class II brake test consist of: a check that the brakes on the rear unit of the train apply and release in response to brake control signals or a check that brake pipe pressure changes are properly communicated at the rear of the train by observation of a gauge at the end of the train or in the cab of the rear unit; a test of the emergency brake application and a test of the deadman pedal or other emergency control device on MU equipment; and a test of the communicating signal system to ensure it is operating as intended. The proposed requirements for observing a set and release of the brakes on the rear car and for ensuring that brake pipe pressure changes are properly communicated at the rear of the train have been combined and stated in the alternative in this final rule, as FRA believes that the performance of either task indicates proper trainline continuity and to perform both would be redundant and unnecessary. It should also be noted that the requirement regarding the testing of the emergency application and deadman pedal or other emergency control devices is only applicable to MU equipment due to the ease of performing such an inspection on that equipment. The requirement that the communicating signal system be tested is part of both a Class I and a Class IA brake test and has been added to this brake inspection as FRA believes the proper operation of the communicating signal system is necessary for the safe operation of a train and can be easily tested in a very short amount of time. FRA believes that if the equipment receives a full Class I brake test and a calendar day mechanical inspection at some time during each operating day, then these simple checks are adequate to confirm brake system performance at intermediate terminals or turning points. This requirement basically codifies current industry practice.

Section 238.319 Running Brake Tests

This section contains the requirements for conducting running brake tests on the brakes of passenger trains. A running brake test is merely a brake application at the first safe opportunity to confirm that the brake system works as expected by the engineer. Paragraphs (a) and (c) require that a running brake test be performed in accordance with the railroad's established operating rules after the train has received a Class I, Class IA, or Class II brake test as safety permits. FRA believes that railroads are in the best position to determine when and where running tests can be safely performed. As most passenger railroads routinely conduct running brake tests, FRA believes that the requirements contained in this section capture an important safety check without changing current operating practice to any great extent. It should be noted that paragraph (b) has been added to this section to require the performance of a running brake test whenever the control stand used to control the train is changed to facilitate the movement of a passenger train from one track to another within a terminal complex while not in passenger service. As previously discussed, due to the special nature of these moves FRA believes that a running brake test adequately ensures the proper operation of the braking system during these movements and obviates the need to perform a Class II inspection each time the control stand is changed in these circumstances.

Subpart E—Specific Requirements for Tier II Passenger Equipment

Section 238.401 Scope

This subpart contains the design and performance requirements for Tier II passenger equipment—that is, passenger equipment operating at speeds exceeding 125 mph but not exceeding 150 mph. For the most part, compliance with the requirements of this section will be demonstrated by one-time analysis or initial acceptance tests.

The requirements contained in this subpart have their basis in discussions between Amtrak and FRA involving safety requirements for the operation of passenger trainsets at speeds up to 150 mph on the Northeast Corridor (NEC). Aware that FRA was considering the development of safety standards for high-speed passenger rail equipment, Amtrak asked FRA for assistance in developing a set of safety specifications for the procurement of high-speed trainsets which would address FRA's safety concerns. As a result, Amtrak's high-speed trainsets, scheduled to begin regular passenger service in 1999, will very likely comply with all of the safety standards in this subpart.

Amtrak's discussions with FRA led it to sponsor a risk assessment of high speed rail passenger systems on the north end of the NEC—from New York to Boston. The discussions also prompted FRA to sponsor computer modeling to predict the performance of various equipment structural designs and configurations in collisions. A copy of the risk assessment performed by Arthur D. Little, Inc., for Amtrak is included in the docket of this rulemaking. The risk assessment was based on existing and predicted future right-of-way configurations and traffic density patterns. The risk assessment concluded that a significant risk of collisions at speeds below 20 mph and a risk of collisions at speeds exceeding 100 mph exist over the 20-year projected operational life of the HSTs—due to heavy and increasing conventional commuter rail traffic, freight rail traffic on the NEC, 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, Amtrak and 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. Existing traffic and right-of-way configurations do 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 in the North American rail operating environment, a more crashworthy trainset design is needed. (FRA does note that on June 3, 1998, near Eschede in northern Germany, an ICE (Inter City Express) passenger train derailed at a speed of approximately 125 mph into the support structure of a highway bridge carrying traffic over the railroad right-of-way, collapsing the bridge. A number of the cars in the train were crushed, and 101 fatalities resulted from the derailment.) Accordingly, the set of structural requirements for Tier II passenger equipment in this final rule is more stringent than the current design practice for North American passenger equipment or for high-speed rail equipment in other parts of the world.

Section 238.403 Crash Energy Management Requirements

This section requires that each power car and trailer car be designed with a crash energy management system to dissipate kinetic energy during a collision.

During discussions with Amtrak for the safety provisions of its high-speed trainsets, FRA proposed very challenging crash energy management requirements based on predictions using computer modeling. Amtrak believed that meeting these requirements would be well beyond the current state of the art for passenger equipment design, and that an extensive and costly research and testing program would be required. As an alternative, Amtrak proposed a crash energy management design based on the demonstrated, commercially viable design developed in France and incorporated in the most recent design of the TGV trainset. FRA believes that Federal safety standards must be capable of implementation in the design of passenger equipment without driving the cost of implementation to the point that high-speed rail systems are no longer financially viable.

Paragraph (c) requires a Tier II train to have a crash energy management system capable of absorbing a minimum of 13 megajoules (MJ) of energy at each end of the train. The ability to absorb this energy must be partitioned as follows: a minimum of 5 MJ by the front end of the power car ahead of the operator's control compartment; a minimum of 3 MJ by the power car structure behind the operator's control compartment; and a minimum of 5 MJ by the unoccupied end of the first trailer car adjacent to the power car. This requirement can be met using existing technology. However, it will effectively prevent a conventional cab car from operating as the lead vehicle in a Tier II passenger train because such equipment cannot absorb 5 MJ of collision energy ahead of the train operator's position. Recent accidents involving trains operating with a cab car forward have demonstrated the vulnerability of this type of equipment in collisions. FRA believes such equipment should not be used in the forward position of a train that travels at speeds greater than 125 mph. FRA has also encouraged Amtrak to use an alternative lead vehicle where speeds exceed 110 mph and highway-rail grade crossings are prevalent. Further, FRA is specifically requiring in paragraph (f) that passenger seating be prohibited in the leading unit of a Tier II train.

In its comments on the NPRM, Talgo observed that the standards in this section may be unattainable using current technology. However, Amtrak's high-speed trainsets have been shown to meet the requirements of this section. Specifically, testing has shown the crash energy absorbing components of the power car and in the end of the first trailer car adjacent to the power car to absorb the energy as provided in paragraph (c).

Talgo further commented that because the kinetic energy of a running train is a function of its mass and speed, paragraph (c) should not state a fixed value of energy. Rather, it believed paragraph (c) should state a value with respect to a specified speed to allow some flexibility for trains of varying mass and yet preserve the same level of safety. FRA recognizes that the kinetic energy of a running train is a function of its mass and speed, and if Tier II trains were at no risk of colliding with other trains of greater weight, then adopting Talgo's comment may be possible. However, the Tier II safety standards are intended to apply to high-speed passenger trains that, as necessitated by the United States rail operating environment, will operate commingled with heavier trains, especially heavy and long freight trains that may themselves operate at speeds up to 80 mph. In the event of a collision with a heavier train, a Tier II passenger train must confront the energy possessed by that train. FRA believes that a Tier II passenger train must have a crash energy management system capable of absorbing the minimum energy levels specified in paragraph (c) to protect the train's occupants in light of the risks of colliding with heavier trains and other objects along the railroad right of way. As a result, FRA believes it is inappropriate to adopt Talgo's comment.

Additionally, in its comments on the NPRM, Talgo believed paragraphs (c)(1)–(3) should be rewritten so that the total energy that is required to be absorbed is dissipated through all inter-car connections, not just through the first few cars. FRA notes that one of the reasons the energy absorbing structures of the leading car in a Tier II passenger train (power car) and the adjacent trailer car must themselves absorb the energy specified in this section is to reduce the risk and effects of secondary collisions throughout the train's subsequent vehicles. Secondary collisions (i.e., impacts with interior objects) can seriously harm or, in extreme cases, kill train occupants. This risk of harm to a Tier II passenger train's occupants is, therefore, minimized overall by requiring the energy absorbing structures in the first two train cars to absorb collision energy before it poses a risk to the train's occupants.

Paragraph (d) requires that for a 30-mph collision of a train on tangent, level track with an identical stationary train, the deceleration of the occupied compartments of each trailer car shall not exceed 8g; and when seated anywhere in a trailer car, the velocity at which a 50th-percentile adult male contacts the seat back ahead of him shall not exceed 25 mph. A 50th-percentile adult male has been defined in § 238.5, based on the same characteristics for such a vehicle occupant's weight and dimensions specified in a NHTSA standard at 49 CFR § 571.208, S7.1.4. FRA does note that, for purposes of this requirement, the weight of the occupant is not particularly relevant, as weight generally should not affect how fast the occupant strikes the seat back ahead of him. In this regard, an occupant of heavier of lighter weight should be neither more nor less protected by the requirements of this paragraph.

In its comments on the NPRM, Simula did not recommend defining an occupant velocity in paragraph (d), noting that it is a function of the crash pulse, the distance between two rows of seats, as well as occupant position and size. FRA has specified that occupant velocity not exceed 25 mph in a secondary collision because an occupant travelling beyond that speed is at considerable risk of harm from a secondary impact. In fact, use of an occupant restraint system would likely have to be required to protect the train occupants in such a case. FRA believes that compliance with paragraph (d)(1) can be demonstrated, and that Amtrak's HTS complies with the rule based on information presented to FRA.

Simula additionally commented that if trailer cars are built to withstand 30 mph collisions and 10g decelerations, then the seats in these cars should also be designed to withstand these same forces. Specifically, Simula did not recommend requiring that the decelerations in trailer cars be limited in a 30 mph collision to 10g while requiring seats to withstand the impact of an occupant travelling at 25 mph and a longitudinal force of 8g, noting that the seats will not be able to withstand the 10g decelerations and consequently detach from the car.

FRA notes that Simula's comment relates to the seat strength requirements found in § 238.435. In the final rule, § 238.435(a) requires that the seat back and seat attachment in a passenger car be designed to withstand, with deflection but without total failure, the load associated with the impact into the seat back of an unrestrained 95th-percentile adult male initially seated behind the seat back, when the floor to which the seat is attached decelerates with a triangular crash pulse having a peak of 8g and a duration of 250 milliseconds. FRA agrees with Simula that it is possible that a seat in a trailer car may detach from the car when subjected to a force that is greater than that required to be withstood under proposed § 238.435(a) in the NPRM, and expressly permitted by proposed § 238.403(d). FRA has, therefore, decided to modify § 238.403(d) so as to limit the permissible decelerations in a trailer car to 8g under the conditions specified in that paragraph. FRA believes that meeting this requirement is feasible with current technology, and that Amtrak's HTS complies with § 238.403(d)(2) on the basis of information presented to FRA.

In its comments on the NPRM, Talgo believed that paragraph (d) should make allowances for the short-lived elevations in peak that may occur during a collision so that peaks exceeding 10g (as proposed) for a duration no longer than 10 milliseconds are acceptable. FRA believes that for purposes of demonstrating compliance with this paragraph through testing, deceleration measurements may be processed through a low-pass filter having a bandwidth of 50 Hz.

Paragraph (e) contains the analysis process to demonstrate that equipment meets these crash energy management performance requirements. The process allows simplifying assumptions to be made so that computer modeling techniques can be used to confirm compliance.

Section 238.405 Longitudinal Static Compressive Strength

This section contains the requirements for longitudinal compressive strength of power cars and trailer cars. Paragraph (a) requires the compressive strength of the underframe of the power car cab to be a minimum of 2,100,000 pounds without yielding. To form an effective crash refuge, this strength is needed to take advantage of the strength of the power car's two end frames. Alternate design approaches that provide equivalent protection are allowed, but the equivalent protection must be demonstrated through analysis and testing and be approved by FRA under the provisions of § 238.21.

In its comments on paragraph (a), Bombardier believed that a design requirement based on the ultimate strength of the structure, as proposed in the NPRM, makes the analysis more difficult and testing the structure impractical and potentially dangerous. According to Bombardier, the specified test load should be based on the yield strength of the structure rather than the ultimate strength, as this would also be consistent with the Amtrak high-speed trainset specifications. FRA has revised this section pursuant to Bombardier's comment. FRA notes that the effect of this revision is to require a stronger power car cab than originally proposed in the rule.

Bombardier additionally commented that clarifying text should be added to define the structural loading conditions so that the 2,100,000-pound load shall be resisted at the height of the underframe at the rear of the cab as follows: 300,000 pounds at each rear cab corner post location; and 750,000 pounds at each rear cab collision post location. FRA does not believe it necessary to incorporate Bombardier's comment into the rule, and doing so may result in confusion. As discussed in § 238.411, FRA believes that each corner post structure on the rear end of a power car cab must resist a 300,000-pound load at the structure's joint with the underframe, and each collision post structure must resist a 750,000-pound load in the same manner. These loads may not be resisted solely at the underframe as a test of the strength of the corner and collision post structures; otherwise, the actual ability of the collision and corner post structures to resist shearing would not be implicated. Further, the load testing criteria for corner and collision post structures in the rule is based on ultimate strength; whereas the longitudinal compressive strength requirement in this paragraph, as revised, is based on yield strength. In light of the separate requirements for testing corner and collision post structures, FRA believes it best not to expressly integrate those requirements with this section.

Paragraph (b) contains the requirements for the static compressive strength of the occupied volumes of trailer cars. This adopts the traditional North American design practice of a static strength of 800,000 pounds, without deformation of the underframe. Paragraph (c) makes clear that unoccupied volumes of power cars or trailer cars may have a static end strength of less than 800,000 pounds to accommodate crash energy management designs.

The crash energy management design requirement ensures that the stronger end structures and the stronger static compressive strength of the cab of a power car will not make Tier II passenger equipment incompatible with existing passenger equipment should a collision between the two different types of equipment occur. The crash energy management design causes a Tier II passenger train to appear as a softer collision surface to a conventionally designed train, owing to the collision energy absorbed by the Tier II train as its unoccupied volumes intentionally crush.

Section 238.407 Anti-Climbing Mechanism

This section contains the requirements for anti-climbing mechanisms on power and trailer cars. Paragraph (a) requires a power car to have a forward anti-climbing mechanism capable of resisting an upward or downward static vertical force of 200,000 pounds, without exceeding the ultimate strength of the material. This requirement is virtually identical to that required of locomotives by AAR S–580. However, designs are permitted that require the crash energy management controlled crushing to occur prior to the anti-climber fully engaging. FRA has revised this paragraph based on a comment from Bombardier that the rule text, as proposed, did not indicate that the 200,000-pound value is an ultimate load. Inasmuch as this requirement as stated in AAR S–580 is in fact based on an ultimate load acceptance criterion, FRA has modified the rule text accordingly.

Paragraph (b) requires that interior train coupling points between units, including between units of articulated cars or other permanently joined units of cars, have an anti-climbing device capable of resisting an upward or downward vertical force of 100,000 pounds without yielding. This is consistent with current design practice. FRA has revised this section based on a comment from Bombardier that the requirements in paragraph (b) are based on 49 CFR § 229.141(a)(2), and should thus include a yield strength acceptance criterion. FRA has modified the rule consistent with the requirements of 49 CFR § 229.141(a)(2).

Paragraph (c) requires the forward coupler of a power car to resist a vertical downward force of 100,000 pounds for any horizontal position of the coupler without yielding, and is virtually identical to that provided in 49 CFR § 229.141(a) for MU locomotives built new after April 1, 1956, and operated in trains having a total empty weight of 600,000 pounds or more.

Talgo commented on both this section and its Tier I counterpart in § 238.205. Talgo explained that it desired to avoid the implication that only couplers may properly function as anti-climbing mechanisms. Talgo also believed that in measuring the strength of the anti-climbing device, the operative variable should be vertical acceleration, expressed in gs, rather than load, expressed in pounds, to accommodate trains of different masses. FRA has discussed these comments earlier in the preamble.

Section 238.409 Forward End Structures of Power Car Cabs.

This section contains the requirements for forward end structures of power car cabs. The forward end structure of a power car cab is vital in a collision with another object. This structure must resist override, prevent the entry of fluids into occupied spaces of the cab, and allow the crash energy management system to function. The requirements in paragraphs (a)–(c) are based on a specific end structure design that consists of a full-height center collision post, two side collision posts located at approximately the one-third points laterally, and two full-height corner posts. This section also includes loading requirements that each of these structural members must withstand. However, the rule does permit flexibility for using other equipment designs that provide equivalent structural protection.

End structures meeting these requirements will provide considerably greater protection to the train operator than that provided by existing passenger equipment designs. For example, much stronger corner posts are required here than for Tier I passenger equipment. FRA believes these end structures help provide a degree of crashworthiness to compensate for the increased risk associated with operating at higher speeds.

The front end structure design also includes in paragraph (d) a skin requirement equivalent to that required by AAR S–580 and contained in § 238.209 for Tier I locomotives. FRA has revised paragraphs (a)(3) and (b)(2) based on a comment from Bombardier. Bombardier noted that the acceptance criterion proposed by FRA in these paragraphs is based on the yield or critical buckling stress; whereas the design of the forward end structures of the Amtrak high-speed power car cab is based on an ultimate load. FRA agrees that basing the acceptance criterion on ultimate strength is consistent with the Amtrak high-speed trainset design specification, and FRA has modified the rule in this regard.

Bombardier also commented that in paragraph (c)(2) FRA proposed requiring the corner post to resist a horizontal, lateral force of 100,000 pounds applied at a point 30 inches up from the underframe. Bombardier stated that the cab on the Amtrak high-speed trainset was designed to resist the 100,000-pound load at a point 18 inches up from the underframe, and believed this consistent with all current design practices for car end structural members. FRA has not modified the rule on this point. FRA has found no conflict between the proposal and the Amtrak high-speed trainset specification.

Both Bombardier and Talgo commented that FRA appeared to have specified the wrong value in paragraph (c)(3) of the proposed rule, as compared with the values contained in Figure 1. See 62 FR 49812–3. The commenters are correct that, as proposed, the paragraph wrongly required each forward corner post to resist a horizontal, longitudinal or lateral shear load of 150,000 pounds. As Figure 1 demonstrates, FRA intended each corner post to resist a horizontal, longitudinal or lateral shear load of 80,000 pounds. FRA has revised paragraph (c)(3) accordingly in the final rule.

Talgo additionally commented that in paragraph (d)(1), although the rule makes clear that its reference to a particular thickness of material does not preclude the use of thinner materials having a higher yield strength, it would be preferable to avoid specifying a thickness altogether. Instead, Talgo suggested that the skin strength requirement could be stated in terms of a specified impact resistance, as FRA proposed in § 238.421 on safety glazing. FRA recognizes that it may be possible to specify an impact resistance requirement, yet FRA has chosen a yield strength requirement based on AAR Standard No. 580 and the collective judgment of the railroad industry behind that standard. Accordingly, although FRA would not preclude an equipment design based on impact resistance that provides equivalent safety, FRA will defer consideration of specifying such an impact resistance until Phase II of the rulemaking. FRA does note that the strength of the material, in terms of its resistance to shear, is also important to ensure occupant protection.

Section 238.411 Rear end Structures of Power Car Cabs.

The rear end structure of a power car cab provides protection to crewmembers from intrusion of locomotive machinery or trailing cars into the cab's occupied volume as a result of a collision or derailment. The requirements in this section are based on a specific end structure design that consists of two full-height corner posts (paragraph (a)) and two full-height collision posts (paragraph (b)). In addition, this section specifies loading requirements that each of these structural members must withstand. Of course, the rule does permit flexibility for using other equipment designs that provide equivalent structural protection.

The required rear end structural protection will provide considerably greater protection to the train operator than that provided by existing passenger equipment designs. Together, the front and rear end structural protection required in this rule for a power car cab make the cab a highly survivable crash refuge.

In commenting on the NPRM, Bombardier recommended that in paragraph (b) the 750,000-pound force at the rear end cab structure collision posts be applied at the height of the centerline of the underframe, and not at the collision posts' joint with the underframe. FRA disagrees, and believes it necessary to test the strength of the collision post structure at its joint with the underframe to demonstrate the actual ability of the collision post structure to resist shearing. Otherwise, if the strength of the collision post structure were tested at the height of the centerline of the underframe, the collision post connection would not be loaded and the ability of the collision post structure to resist shearing would not be tested.

Bombardier also suggested that the horizontal, shear load value of 750,000 pounds specified in paragraph (b)(1) that the collision post is required to resist be changed to 500,000 pounds. Bombardier believed this modification necessary to be consistent with the shear strength requirements for the front collision posts specified both in the rule as well as in the Amtrak high-speed trainset specifications. FRA disagrees with this comment, and has not revised the rule on this point. The 750,000 pounds that each of the two collision posts at the rear of a power car cab must individually resist—1,500,000 pounds in the aggregate—is consistent with the 500,000 pounds that each of the three collision posts at the forward end of the power car cab must individually resist—again 1,500,000 pounds in the aggregate—under § 238.409(a) and (b) of this rule. Further, FRA believes these values to be consistent with the Amtrak high-speed trainset design specification.

Section 238.413 End Structures of Trailer Cars

The requirements in paragraph (a) are based on a specific end structure design that consists of two full-height corner posts and two full-height collision posts. The requirements include loading requirements that each of these structural members must withstand. The rule allows flexibility for other designs that provide protection structurally equivalent to the specified design.

Paragraph (b) in the final rule contains an additional requirement for trailer cars designed with an end vestibule. Such designs provide an opportunity for additional corner post structures inboard of the vestibule side doors. These corner posts can be supported by the side sill and therefore be structurally more substantial than the corner posts ahead of the side doors. This paragraph includes loading requirements that these additional full-height corner posts must withstand. Overall, the double corner post design provides significantly increased protection to passengers in trailer cars with end vestibules.

In its comments on the rule, Bombardier stated that, to be consistent with the design requirements for Amtrak's high speed trainsets, the corner post loads in paragraphs (a)(1)(ii), (b)(2), and (b)(3) (as numbered in the final rule) should be applied at 18 inches up from the underframe, rather than at 30 inches. FRA agrees that these values are consistent with Amtrak's previous undertakings for the high-speed trainsets, and has modified the final rule accordingly.

In the 1997 NPRM, FRA proposed an exception from the requirements of paragraph (a) for a trailer car (or, more appropriately, a consist of trailer cars) made up of multiple articulated units not designed for uncoupling other than in a maintenance shop. *See* 62 FR 49814, proposed § 238.413(b). FRA proposed that the end structure requirements in paragraph (a) apply only to the two ends of the entire articulated assembly (or consist) of units, and that the interior ends of the individual units of the articulated assembly need not be equipped with an end structure meeting the requirements in paragraph (a). Articulated assemblies have a history of remaining in line during derailments and collisions and, if not designed to be uncoupled, only the outside ends of the entire assembly should be exposed to the risks of override. (In this regard, FRA should have only proposed an exception for such equipment from the collision post requirements in paragraph (a) and not from the corner post requirements as well since collision posts—not corner posts—principally protect against override and telescoping of passenger equipment. Corner posts, by their very definition and location, protect against hazards along the railroad right-of-way in a way that collision posts cannot.) However, none of the relevant recent experience is on the North American continent, and the ability of articulated connections to remain intact during a high-speed collision with North American passenger equipment, freight rolling stock, or a fixed obstruction has not been demonstrated analytically. FRA noted the weakness in the proposed exception (§ 238.413(b) of the NPRM) while preparing the final rule. FRA has deleted proposed paragraph (b) in its entirety, and has not provided an exception due to the high operating speeds of Tier II passenger equipment.

Section 238.415 Rollover Strength

This section contains the requirements for the rollover strength of passenger cars and power cars. If the occupied volumes of these vehicles remain intact when they roll onto their side or roof structures, occupant injury from vehicle collapse will be avoided. This section essentially requires the vehicle structure to support twice the deadweight of the vehicle as it rests on its side or roof. Passenger equipment constructed to North American design practice performs well in rollover situations. FRA believes this requirement captures this industry practice.

FRA has revised paragraph (a) to make clear that its requirements apply to passenger cars. This revision is consistent with the section-by-section analysis of proposed § 238.415 in the NPRM, see 62 FR 49779, which explained that this section included rollover strength requirements for both power cars and trailer cars. (The term trailer car is in fact a more inclusive definition under the rule than the term passenger car.) FRA has also made clear in paragraph (a) that minor localized deformations to the outer side skin of the passenger car or power car are allowed provided such deformations in no way intrude upon the occupied volume of each car. As in the NPRM, paragraph (b) states that deformation to the roof sheathing and framing is allowed to the extent necessary for the vehicle to be supported directly on the top chords of the side frames and end frames.

As Bombardier suggested in its comments on the NPRM, FRA has also made a minor clarification to this section by substituting the words ''in the structural members of the'' in place of the word ''for'' in the phrase which originally read in the NPRM, ''the allowable stress for occupied volumes .* * *.'' *See* 62 FR 49816.

Section 238.417 Side Loads

This section contains the requirements intended to resist penetration of the side structure of a passenger car by a highway or rail vehicle. The objective is to make the side of the passenger car strong enough so that the car derails rather than collapses when struck in the side by a highway or rail vehicle. If the passenger car can move sideways (derail), less structural damage and potential to injure train occupants will result.

In its comments on the NPRM, Bombardier stated that for practical reasons and to be consistent with the Amtrak high-speed trainset design specifications, local yielding of the side sill should be allowed in calculating the allowable stress in paragraph (c). FRA agrees that local yielding of the side skin adjacent to the side sill and belt rail, and local yielding of the side sill bend radii at the crossbearer and floor-beam connections is permissible. FRA has modified paragraph (c) accordingly, and notes that such local yielding is permissible provided the resulting deformations do not intrude upon the occupied volume of the passenger car.

Section 238.419 Truck-to-Car-Body and Truck Component Attachment

Paragraph (a) requires the truck-to-car-body attachment on Tier II passenger equipment to resist without failure a minimum vertical force equivalent to 2g acting on the mass of the truck and a minimum force of 250,000 pounds acting in any horizontal direction on the truck. The intent of the requirement to resist without failure the minimum vertical force equivalent to 2g acting on the mass of the truck is to prevent the truck from separating from the car body during a rollover. The intent of the requirement to resist without failure the minimum force of 250,000 pounds acting in any horizontal direction on the truck is to resist the forces that act upon the truck during a collision or derailment that would tend to shear the truck from the car body. If the truck separates from the car body it may become a hazardous projectile that will intrude upon the occupied volume of a passenger car or locomotive. Further, the truck will not be able to serve, in effect, as an anti-climbing device if it separates from the car body in a collision or derailment.

Paragraph (b) requires that each component of the truck must remain attached to the truck when a force equivalent to 2g acting on the mass of the component is exerted in any direction on that component. Whereas paragraph (a) is intended to keep the truck attached to the car body, paragraph (b) is intended to keep truck components attached to the truck.

Bombardier, in its comments on the NPRM, requested that FRA modify paragraph (a) so that the truck-to-car-body attachment must resist the specified vertical and horizontal forces only as individual loads applied separately. However, FRA has retained the requirement that the truck-to-car-body attachment resist the specified vertical and horizontal forces as applied at the same time. Requiring the truck-to-car-body attachment to resist the vertical and horizontal forces applied at the same time reflects actual conditions experienced during a collision or derailment. For this reason, FRA believes it inappropriate to adopt Bombardier's comment.

Section 238.421 Glazing

This section contains the glazing requirements for Tier II passenger equipment. FRA believes that the higher speed of Tier II passenger equipment necessitates more stringent glazing standards than currently required by 49 CFR part 223. As a result, FRA proposed specific standards for end-facing exterior glazing, side-facing exterior glazing, and interior glazing (which is not addressed in part 223) on windows installed in Tier II passenger equipment. *See* 62 FR 49817. In response to the NPRM, however, FRA received a number of comments questioning the appropriateness of FRA's proposals, as well as the existing glazing standards in part 223. Having considered these comments, FRA has decided to focus the final rule principally on more stringent glazing requirements for end-facing exterior windows installed in Tier II passenger equipment. In the second phase of this rulemaking, FRA will reexamine the glazing requirements for all windows installed in Tier II passenger equipment. FRA notes that this final rule does not amend the requirements of 49 CFR part 223, although FRA had proposed to amend the application section of that part in the NPRM. *See* 62 FR 49791. Such an amendment is no longer appropriate in light of the requirements of this section (§ 238.421) in the final rule. The requirements of this section and the modifications from the proposed rule are discussed below in detail.

The requirements of paragraph (a) apply to all exterior windows on power car cabs and passenger cars. Windows on such equipment are required to meet the glazing standards contained in 49 CFR part 223, except as provided in paragraphs (b) and (c) of this section. Part 223 contains requirements for both end-facing and side-facing window glazing, and employs different testing methods than specified in this section. As recommended by Bombardier in its comments on the NPRM, instead of applying the glazing requirements in this section generally to power cars as proposed in the NPRM, FRA has decided to limit the application of the glazing requirements in this section to power car cabs. This modification is consistent with the glazing requirements in part 223, *see, e.g.*, 49 CFR § 223.9(a). Bombardier had noted that one of the side windows on the Amtrak high-speed power cars will lead to an equipment room, which FRA understands will not be occupied while the power car is in service.

Paragraph (a) relates to paragraph (b) in that paragraph (b) contains additional requirements for end-facing exterior window glazing on power car cabs and passenger cars. First, under paragraph (b)(1), end-facing exterior window glazing shall resist the impact of a 12-pound solid steel sphere traveling at the maximum speed of the vehicle in which the glazing will be installed. The test must be conducted so that the sphere strikes the window glazing at an angle of 90 degrees (perpendicular) to the window surface. To successfully pass the test, the window must neither spall nor be penetrated by the sphere. This test is similar to the requirements imposed under European glazing standards for high-speed trains, and should be much more repeatable than the cinder block test specified in 49 CFR part 223.

In the NPRM, FRA had proposed that end-facing exterior windows resist an impact with a 12-pound steel sphere at an angle equal to the angle between the window glazing surface as installed and the direction of travel of the train. *See* 62 FR 49817. In commenting on the NPRM, Automotive Glass Engineering (Automotive Glass) explained that impact angle depends upon variables such as the vector of the projectile, the vector of the train, and the angle at which the subject glazing is installed. Automotive Glass then observed that it would have no advance knowledge of the angle at which an object would strike the window glazing when installed in the train. Automotive Glass recommended that the rule require that tests be conducted at an angle perpendicular to the surface—noting this would constitute the most severe impact—unless the rule specifies the method for determining the angle of incidence. FRA has adopted the comment of Automotive Glass by revising the rule text to require that the window glazing resist the impact with the 12-pound steel sphere at an angle 90 degrees to the window surface. This should result in a requirement as strict or stricter than that proposed in the NPRM.

Under paragraph (b)(1), end-facing exterior window glazing shall demonstrate anti-spalling performance by the use of a 0.001 aluminum witness plate, placed 12 inches from the glazing surface during all impact tests. The witness plate must not contain any marks from spalled window glazing particles after any impact test. This requirement was originally proposed as § 238.421(a)(3)(ii) in the NPRM. When impacted on the exterior surface, window glazing currently used in railroad equipment tends to spall from the inside surface. Several eye injuries to crewmembers have resulted. FRA believes that the witness plates used in conducting the spalling tests to qualify current glazing are too thick and have allowed glazing that actually spalled to pass the test. The witness plate specified in this paragraph is much thinner and, therefore, more sensitive to detecting spall.

In commenting on the NPRM, Automotive Glass stated that the performance of a witness plate is critically dependent on the amount of tension in which it is held, and that a uniform tension procedure would enhance consistency. Automotive Glass therefore recommended that the test protocol specify the minimum tension of the foil in terms of some unit of measure, other than "taut," which it considered an aspiration not a specification. FRA notes that in testing required under 49 CFR part 223, the witness plate must have a "taut"surface. *See* 49 CFR part 223, Appendix A, b.(6). In the NPRM, proposed § 238.421(a)(3)(ii) is silent as to the tension of the witness plate. As "taut" has been the witness plate tension specification used in all safety glazing testing required by FRA, use of a "taut" witness plate is not inconsistent with the requirements of this section. FRA believes that this issue may be reexamined in the second phase of the rulemaking.

Automotive Glass also commented that total elimination of spalling will result in additional weight, additional cost, loss of durability, or some combination of these three. According to Automotive Glass, unessential weight above the center of gravity is detrimental because high-speed trains should have less inertia and a lower center of gravity. Automotive Glass believed FRA could sacrifice too much by averting the slight hazard created by the possibility of minor spalling in an extremely unlikely event. Under the final rule, of course, only end-facing exterior glazing on Tier II passenger equipment is subject to the particular requirements of this paragraph. Side-facing exterior glazing is subject to the requirements contained in 49 CFR part 223. As a result, only a relatively small number of the windows on a Tier II passenger train will be required to comply with the more stringent requirements specified in this paragraph. In this regard, FRA believes that the changes made to the final rule render these comments less significant.

Automotive Glass further commented that under the proposed rule no spalling of glass is allowed, and noted that under 49 CFR part 223 spalling is permitted unless it is severe enough to penetrate the prescribed foil witness plate. Additionally, Automotive Glass stated that constructing foil witness plates requires great care to avoid creating indentations in the foil, and that microscopic examination of the surface could be required to locate indentations to determine whether they were preexisting or produced by spall. To the extent no spalling is allowed, Automotive Glass suggested replacing the witness plate with a capture box that would capture glass fragments in the box. Automotive Glass believed that use of a capture box would result in a simpler and more reliable determination whether spalling occurred. In addition, if the rule would permit minor spalling, Automotive Glass recommended use of a thinner witness plate positioned closer to the glazing material to reduce the severity of allowable spalling and permit determination based on penetration instead of indentation.

FRA desires that no spalling occur, however, and recognizes that the specified requirement is stricter than that provided in part 223. Further, FRA believes that use of a capture box is not necessarily a superior method of testing for spalling, as the integrity of the test results depend in large part on the attentiveness of the operator examining the capture box for spalled glass. FRA notes that Automotive Glass also provided several other comments regarding the testing protocols specified in this section and 49 CFR part 223. To the extent that these comments address testing protocols in part 223, they concern issues affecting glazing tests for both freight and passenger equipment. Such issues need to be addressed in a broader regulatory forum than this final rule on passenger equipment safety. FRA does make clear, nevertheless, in response to a comment from Automotive Glass, that it is not proper to certify that a segment of window glazing meets the requirements of this section or part 223, or both, unless that window segment is composed of the same material and manufactured in the same manner as the window segment that underwent the testing required by this section or part 223, or both.

Paragraph (c) contains an alternative to the glazing standards specified in paragraphs (a) and (b). The alternative standards specified in paragraph (c) represent proposed '' §§ 238.421(a) and (b) in the NPRM. FRA has included this paragraph in the final rule in recognition that the safety glazing standards proposed in § 238.421 were developed in consultation with Amtrak for use on Amtrak's HTS, and FRA believed these standards would provide sufficient protection for the safety of the train occupants. However, the option to use the alternative standards in paragraph (c) only applies to exterior window glazing in passenger equipment ordered prior to May 12, 1999. Further, the option to comply with paragraph (c) is no longer available once the window needs to be replaced and the railroad has exhausted its inventory of glazed windows conforming to the requirements of paragraph (c) as held prior to May 12, 1999. In this manner, exterior window glazing complying with the requirements in this paragraph will be phased out over time.

Paragraph (d) is similar to § 238.221(b) in this final rule. FRA did not receive any specific comments on this section and, for clarity, FRA has restated the requirements proposed in §§ 238.421(c) and (d) in the NPRM, *see* 62 FR 49817, as § 238.421(d) in this final rule. The focus of paragraph (d) in the final rule is clearly on the ability of each exterior window to remain in place, however the window may be secured, and not have the window become a potential projectile itself. FRA notes that it is separately evaluating whether securement of window glazing in existing passenger equipment is sufficient to withstand pressure differences associated with passing high-speed trains.

Paragraph (e) is a stenciling requirement which FRA has revised in this final rule as proposed originally in § 238.421(f).

As noted, FRA has decided not to impose on all Tier II passenger equipment in this final rule the particular requirements for side-facing exterior window glazing on Tier II passenger equipment which FRA had proposed in the NPRM. Instead, Tier II power car cabs and passenger cars must comply with the existing side-facing exterior window glazing requirements specified in 49 CFR part 223, or comply with the alternative standards specified in paragraph (c), as appropriate. However, FRA has included the following comments received on the proposed side-facing exterior window glazing standards for purposes of advancing the discussion of these standards in the second phase of the rulemaking.

FRA had generally proposed requiring that side-facing exterior window glazing in Tier II passenger equipment resist the impact of a 12-pound solid steel sphere traveling at 15 mph and impacting at an angle of 90 degrees to the surface of the glazing, with no penetration or spall. *See* proposed § 238.421(a)(2)(i), 62 FR 49817. FRA intended this test to be more stringent than the large object impact test required for side-facing exterior glazing under 49 CFR part 223, and to demonstrate whether the side-facing glazing can protect occupants from a relatively heavy object thrown against the side of the train. In response to this proposal, GE Plastics (of the General Electrical Company) commented that, although the energy resulting from the proposed test would be greater than that required under part 223, the momentum produced would not be greater. Noting that tests have shown momentum to be as significant a factor as energy in the consequences of an impact, GE Plastics did not believe the proposed test could be considered more stringent than the current requirement in 49 CFR part 223. Instead of FRA's proposed test, GE Plastics recommended a test involving a steel sphere weighing 24 to 25 pounds travelling at 15 mph, so that energy and momentum would be greater than the current requirement.

FRA had also proposed generally requiring that side-facing exterior window glazing in all Tier II passenger equipment resist the impact of a granite ballast stone weighing a minimum of 0.5 pounds, traveling at 75 mph, at a 90-degree angle to the glazing surface, with no penetration or spall. *See* proposed § 238.421(a)(2)(ii). FRA intended this test to demonstrate whether the glazing could protect occupants against impact from a common stone found along the railroad thrown at a speed slightly faster than a human could throw such an object. In response, Automotive Glass commented that, because ballast stones are irregular geometrically and structurally, reproducible tests would not be possible unless the granite spheres used in the tests were machined and polished. Second, Automotive Glass stated that the proposed test would not impose a significantly higher kinetic energy load than that imposed by the test involving a 12-pound steel sphere impacting the glazing surface at 15 mph, and also it would not have greater spall generation potential than the proposed test involving a 9 mm bullet. Automotive Glass added that, if a higher kinetic energy test is desired, it would be more reasonable to increase the impact velocity of the proposed test involving the 12-pound steel sphere to at least 16 mph.

FRA has also decided to defer imposing a new requirement for ballistic testing of exterior window glazing on all power car cabs and passenger cars. In the NPRM, FRA proposed requiring that all exterior glazing resist the single impact of a 9-mm, 147-grain bullet traveling at an impact velocity of 900 feet per second, with no bullet penetration or spall. See proposed § 238.421(a)(3)(i). FRA noted that this bullet is a much more common handgun round than the 22-caliber bullet specified in 49 CFR part 223. In response to the proposal, GE Plastics commented that it had seen no data indicating that people shoot at trains more frequently with 9 mm bullets, although it agreed that a 9 mm bullet is a more common handgun round than a .22 caliber bullet. Further, GE Plastics questioned why a 147 grain bullet was specified, noted that a bullet's shape and composition affect its penetrating ability, and believed that more detail is needed to determine which bullet is appropriate. Moreover, GE Plastics expressed concern about the wording of the proposed test in that it believed a bullet will rarely be travelling exactly at 900 feet per second during testing. GE Plastics recommended specifying a minimum and a maximum velocity, instead, as well as examining the wording of existing ballistic test standards.

In commenting on the proposal, Automotive Glass noted its belief that the .22 caliber projectile specified in 49 CFR part 223 represents the threat of accidental injury from young people hunting or ''plinking'' along a railroad right-of-way, while the proposed 9 mm projectile represents the threat of injury intentionally inflicted by vandals or terrorists. Automotive Glass believed that if FRA were to adopt a policy of requiring any level of protection against intentionally inflicted injury, it would seem to constitute a departure from previous policy. If FRA were to adopt this approach, then Automotive Glass recommended that the proposed test protocol require each subject glazing specimen to withstand three 9 mm bullets within a circle eight inches in diameter, as vandals or terrorists are more likely to fire short bursts. Further, Automotive Glass observed that any level of ballistic resistance required of glazing which exceeds that provided by the body panel construction below the glazing would contribute only to a false sense of security. In the end, Automotive Glass suggested that individual railroads be given the discretion whether to utilize glazing with greater ballistic resistance based on the threat and severity of vandalism or terrorism each faces. Again, FRA has decided to defer until the second phase of the rulemaking consideration of imposing a new requirement for ballistic testing on all exterior window glazing used on power car cabs and passenger cars. Of course, a railroad may avail itself of the alternative requirements specified in paragraph (c) at its option, to the extent paragraph (c) is applicable.

The final rule does not contain a standard covering interior window glazing, as FRA has decided to defer consideration of imposing such a standard until the second phase of this rulemaking. In the NPRM, FRA had proposed requiring that interior glazing meet the minimum requirements of AS1 type laminated glass as defined in American National Standard ''Safety Code for Glazing Materials for Glazing Motor Vehicles Operating on Land Highways,'' ASA Standard Z26.1–1966. *See* 62 FR 49817. (Bombardier commented that it believed the latest revision to this standard occurred in 1990 rather than 1966.) FRA intended that the proposed requirement would alleviate the need for interior window glazing to meet the stringent impact resistance requirements placed on exterior glazing, while ensuring that the glazing will shatter in a safe manner like automotive glazing. In response to this proposal, GE Plastics commented that requiring the glass to meet the AS1 requirements would exclude recognized safety glazing materials for reasons unrelated to the glazing's ability to break safely, such as light transmission, light distortion, and abrasion resistance. GE plastics further commented that specifying a requirement for laminated glass would exclude many established safety glazing materials. GE Plastics recommended that, if safety glazing is desired, FRA incorporate instead the 1984 version of the ANSI Z97.1 safety glazing standard for use in buildings, which defines safety glazing as ''Glazing materials so constructed, treated, or combined with other materials that, if broken by human contact, the likelihood of cutting and piercing injuries that might result from such contact is minimized.''

AtoHaas Americas, Inc., (AtoHaas) similarly commented that the AS1 standard incorporated in FRA's interior glazing proposal is an external glazing standard that contains requirements which may not be needed for internal glazing, such as light stability, luminous transmittance, and abrasion resistance. Likewise, AtoHaas commented that specifying a requirement for laminated glass would exclude other materials able to meet the safety needs here for internal glazing. AtoHaas noted that there are many types of glazing that would shatter or break in a safe manner, and urged FRA to examine the American National Standard for Safety Glazing Used in Buildings for products meeting FRA's safety needs. FRA will consider these recommendations with the Working Group in the second phase of the rulemaking, and presents them here to advance discussion on potential requirements for interior window glazing in Tier II passenger equipment.

Section 238.423 Fuel Tanks

This section contains the requirements for fuel tanks for fossil-fueled Tier II passenger equipment. This section should be read with the discussion of locomotive fuel tanks in the preamble. This section contains separate requirements for external fuel tanks, which extend outside the car body structure, and for internal tanks, which do not extend outside the car body.

In commenting on the proposed rule, Bombardier recommended that the same requirements proposed for Tier I fuel tanks apply to Tier II equipment as well. Bombardier stated that early consensus was reached to do so in the Tier II working group during development of the NPRM. Bombardier maintained that this consensus was based on the fact that there are no fuel tanks on the electric trainsets being built for the NEC; the maximum speed for a fossil-fueled version of the trainsets would be 125 mph; and no data exists to support the need for different fuel tank requirements for Tier I and Tier II equipment. Further, Bombardier stated that the requirements for Tier I fuel tanks incorporate the most current industry practices for diesel electric locomotive fuel tanks.

In response to Bombardier's comment, FRA believes that different fuel tank requirements for Tier I and Tier II equipment may be appropriate based on the different maximum speeds at which the equipment can travel. However, FRA recognizes that the specific differences between the proposed Tier I and Tier II fuel tank requirements have not been tightly justified. Accordingly, the final rule requires compliance with Tier I requirements for internal fuel tanks, and includes a requirement for

FRA review and approval of any Tier II external fuel tank for safety equivalence with Tier I performance.

As Bombardier pointed out in its comments, the NPRM did contain a technical mistake in proposed § 238.223(b)(2), which had as its Tier II counterpart proposed § 238.423(b)(3). Accordingly, these paragraphs have been corrected in the final rule to reflect that the 25,000-lb yield strength described in the proposals is in fact a 25,000-lb per-square-inch yield strength.

Section 238.425 Electrical System.

FRA did not receive any specific comments on this section, and it is adopted as proposed. This section contains the requirements for the electrical system design of Tier II passenger equipment. These requirements reflect common electrical safety practice and are widely recognized as good electrical design practice. They include provisions for:

- Circuit protection against surges, overload and ground faults;
- Electrical conductor sizes and properties to provide a margin of safety for the intended application;
- Battery system design to prevent the risk of overcharging or accumulation of dangerous gases that can cause an explosion;
- Design of resistor grids that dissipate energy produced by dynamic braking with sufficient electrical isolation and ventilation to minimize the risk of fires; and
- Electromagnetic compatibility within the intended operating environment to prevent electromagnetic interference with safety-critical equipment systems and to prevent interference of the rolling stock with other systems along the right-of-way.

Section 238.427 Suspension System

In response to comments on the 1997 NPRM and for purposes of clarification, FRA has revised the requirements of this section. Changes from the NPRM are noted below in the general discussion of this section.

As explained in the NPRM, safety requirements concerning the wheel-rail interface have traditionally been addressed as part of the track safety standards. In parallel with the Tier II Equipment Subgroup's effort to develop high-speed equipment safety standards, the RSAC Track Working Group developed a final rule on track safety standards which includes high-speed track standards. *See* 63 FR 33992, June 22, 1998. In October 1996, FRA sponsored a joint meeting of the Tier II Equipment Subgroup and members of the Track Working Group focusing on the development of high-speed track standards to ensure that the two sets of standards not conflict at the wheel-rail interface, where they overlap. FRA did receive a comment on the passenger equipment NPRM that the two sets of standards do in fact conflict, and this comment is addressed in particular in the discussion of Appendix C to this part (Suspension System Safety Performance Standards).

To ensure safe, stable performance and ride quality, paragraph (a) requires suspension systems to be designed to reasonably prevent wheel climb, wheel unloading, rail rollover, rail shift, and a vehicle from overturning. These requirements must be met in all operating environments, and under all track and loading conditions as determined by the operating railroad. In addition, these requirements must be met under all track speeds and track conditions consistent with the Track Safety Standards (49 CFR part 213), up to the maximum operating speed and maximum cant deficiency of the equipment. These broad suspension system performance requirements address the operation of equipment at both high speed over well maintained track and at low speed over lower classes of track. Suspension system performance requirements are needed at both high and low speeds as exemplified by incidents where stiff, high-speed suspension systems caused passenger equipment to derail while negotiating curves in yards at low speeds.

Compliance with paragraph (a) must be demonstrated during pre-revenue service acceptance testing of the equipment and by complying with the safety performance standards for suspension systems contained in Appendix C to this part. Because better ways to demonstrate suspension system safety performance may be developed in the future, the rule allows the use of alternative standards to those contained in Appendix C if they provide at least equivalent safety and are approved by the FRA Associate Administrator for Safety under the provisions of § 238.21.

Paragraph (b) requires the steady-state lateral acceleration of passenger cars to be less than 0.1g, as measured parallel to the car floor inside the passenger compartment, under all operating conditions.

Paragraph (c) requires each truck to be equipped with a permanently installed lateral accelerometer mounted on the truck frame. If hunting oscillations are detected, the train must be slowed. FRA has revised this section to specify that hunting oscillations are considered a sustained cyclic oscillation of the truck which is evidenced by lateral accelerations in excess of 0.4g root mean square (mean-removed) for 2 seconds. In its comments on the rule, Talgo had recommended that the permissible limits of hunting oscillations be specified in the rule text and not in the definitions section, § 238.5, as proposed in the NPRM. See definition of *hunting oscillations* in proposed § 238.5, 62 FR 49793. FRA has adopted Talgo's suggestion for clarity. However, FRA has not adopted Talgo's alternative specification. Talgo commented that, using the formulation in the NPRM in defining hunting oscillations for Tier II passenger equipment, lateral oscillations should apply on a peak basis, rather than on a peak-to-peak basis. Talgo explained that oscillations would be considered dangerous if the amplitude of six consecutive peaks exceeded 0.8g. Talgo added that this approach is followed in Europe, citing UIC–515, and believed it more reasonable than the proposed formulation. FRA has revised the definition of hunting oscillations to make it consistent with the definition of truck hunting in 49 CFR § 213.333, Note 4 to the table of Vehicle/Track Interaction Safety Limits. FRA determined that the approach using the root mean square (mean-removed) was the preferred indicator of the forces associated with truck hunting, and takes into consideration the oscillatory nature of truck hunting. FRA believes this definition of truck hunting removes the uncertainty in counting the number of sustained oscillations.

FRA has further revised the rule to specify that the accelerometer measurements shall be processed through a filter having a band pass of 0.5 to 10 Hz. Talgo also commented the rule should state that in measuring the amplitude of lateral oscillations, the signal should be filtered with a band pass of 4 to 8 Hz so that irrelevant signals are excluded. FRA has adopted Talgo's recommendation in general, yet has specified a pass band consistent with the track safety standards. *See* 49 CFR § 213.333, Note 3 to table of Vehicle/Track Interaction Safety Limits.

Paragraph (d) provides ride vibration (quality) limits for vertical accelerations, lateral accelerations, and the combination of lateral and vertical accelerations. These limits must be met while the equipment is traveling at the maximum operating speed over its intended route. In commenting on the NPRM, Bombardier noted that the values proposed in this paragraph were not fully consistent with the values found in the then-proposed track safety standards, and requested that they be made consistent. FRA has revised the requirements of this paragraph accordingly. For clarity, as used in paragraph (d)(1)(iii), the formula ($a_L^2+a_V^2$) can be restated as the sum of the square of both accelerations.

FRA has combined paragraph (e) of proposed § 238.427 into paragraph (d) of the final rule as paragraph (d)(2). This provision requires that compliance with the requirements of this paragraph be demonstrated during the equipment's pre-revenue service qualification tests required under § 238.111 and § 213.345 of the federal track safety standards. One of the most important objectives of pre-revenue service qualification testing is to demonstrate that suspension system performance requirements have been met. FRA makes clear that the requirements of paragraph (d)(2) need only be shown during pre-revenue service qualification testing of the equipment.

FRA has added paragraph (d)(3) to make clear that, for purposes of paragraph (d), acceleration measurements shall be processed through a filter having a band pass of 0.5 to 10 Hz. In its comments on the NPRM, Talgo observed that the signal filter to use in performing the limit calculations had not been specified in this paragraph, and suggested using a band pass filter of 0.4 to 10 Hz. FRA has effectively adopted Talgo's comment.

Paragraph (e) requires wheelset journal bearing overheat sensors to be provided either on board the equipment or at reasonable intervals along the railroad's right-of-way. FRA prefers sensors to be on board the equipment to eliminate the risk of a hotbox that develops between wayside locations. However, FRA does recognize that onboard sensors have a history of falsely detecting overheat conditions, causing significant operating difficulties for some passenger railroads.

FRA has clarified paragraph (e) based on a comment from Bombardier that this provision should apply to each wheelset journal bearing, and not to each equipment bearing as stated in § 238.427(f), *see* 62 FR 49818. This is in accord with FRA's original intent.

Section 238.429 Safety Appliances

This section contains the requirements for safety appliances for Tier II passenger equipment. FRA has attempted to simplify and clarify how the Safety Appliance Standards contained in 49 CFR part 231 and 49 U.S.C. 20302(a) will be applied to Tier II passenger equipment. The requirements contained in this section are basically a restatement of existing requirements but tailored specifically for application to this new and somewhat unconventional equipment. They represent the consensus recommendation of the Tier II Equipment Subgroup.

This final rule has retained all of the requirements proposed in the 1997 NPRM. The only modification to the safety appliance requirements is in response to one commenter's recommendation that the requirements related to sill steps be made more consistent with existing regulations. As a result, the requirement contained in paragraph (e)(7), regarding the maximum height of the lowest sill step tread, has been changed to be consistent with existing regulations and practice.

This same commenter also recommended that a specific grade of steel be designated in the requirements for the steel or other materials used for handrails, handholds, and sill steps, and that the grade of SAE (Society of Automotive Engineers) bolt to be used as mechanical fasteners be specified as well. FRA believes that steel or other materials used for handrails, handholds, and sill steps should at least be equivalent to specification ASTM A–576, Grade 1015–1020 steel. However, to the extent this need be specified as a requirement, FRA believes it would be more appropriate to consider doing so for safety appliances on all passenger equipment—not just Tier II passenger equipment. FRA had not made such a proposal in the NPRM; and this issue may be reexamined in Phase II of the rulemaking. As for the strength of mechanical fasteners, the final rule states that mechanical fasteners must have a mechanical strength at least equivalent to that of a ½ inch diameter SAE grade steel bolt, as FRA had proposed in the NPRM. FRA believes that any SAE grade of steel bolt will satisfy this requirement, and, as a result, FRA has not modified the final rule in this regard.

Paragraph (b) deserves special mention; it requires that Tier II passenger trains be provided with a parking or hand brake that can be set and released manually and can hold the equipment on a 3-percent grade. A hand brake is an important safety feature that prevents the rolling or runaway of parked equipment.

Section 238.431 Brake System

This section contains the brake system design and performance requirements for Tier II passenger equipment, and, except for one provision, represents the consensus recommendation of the Tier II Equipment Subgroup. The provisions contained in this section are virtually identical to the requirements proposed in the 1997 NPRM. Except for one commenter's recommendation that leeway be provided on the number of locations in a vehicle that must be equipped with a means to effectuate an emergency brake application on shorter equipment, no substantive adverse comments were received on the provisions contained in this section and, thus, they have been retained without change.

As noted in the 1997 NPRM, the main issue of concern among Subgroup members involved the capability of sensor technology used to monitor the application and release of brakes. Labor representatives maintained that a technology that actually measures the force of brake shoes and pads against wheels and brake discs is required for a reliable indication of brake application and release. Railroad operators contended that this technology is not commercially available and that monitoring pressure in brake cylinders does provide a reliable indication of brake application and release, particularly when those cylinders are directly adjacent to the point where brake friction surfaces are forced together. FRA agrees that the technology suggested by certain labor commenters is not currently available and that brake system piston travel or piston cylinder pressure indicators have been used with satisfactory results for many years. Although FRA agrees that these indicators do not provide 100 percent certainty that the brakes are effective, they have proven effective enough to be preferable to requiring an inspector to assume a dangerous position while inspecting a train's brake system.

Aside from this issue, the rest of the brake system design and performance requirements contained in this section received widespread support. In fact, several of the requirements were contained in written positions provided by both rail labor and management members of the Subgroup, and virtually all of the requirements were discussed in the high-speed passenger equipment section of the 1994 NPRM on power brakes. *See* 59 FR 47693–94, 47699–47700, and 47730. Many of the requirements in this section are similar to the requirements for Tier I passenger equipment contained in § 238.231, thus the discussion related to that section should be read in conjunction with the following discussion.

Paragraph (a) of this section is virtually identical to the requirement related to the braking systems of Tier I passenger equipment in § 238.231(a).

Paragraph (b) contains a requirement similar to that in § 238.231(b) and is