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49 CFR Parts 213 and 238

Vehicle/Track Interaction Safety Standards; High-Speed and High Cant  
Deficiency Operations; Final Rule

**DEPARTMENT OF TRANSPORTATION****Federal Railroad Administration****49 CFR Parts 213 and 238**

[Docket No. FRA-2009-0036, Notice No. 2]

RIN 2130-AC09

**Vehicle/Track Interaction Safety Standards; High-Speed and High Cant Deficiency Operations**

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

**ACTION:** Final rule.

**SUMMARY:** FRA is amending the Track Safety Standards and Passenger Equipment Safety Standards to promote the safe interaction of rail vehicles with the track over which they operate under a variety of conditions at speeds up to 220 m.p.h. The final rule revises standards for track geometry and safety limits for vehicle response to track conditions, enhances vehicle/track qualification procedures, and adds flexibility for permitting high cant deficiency train operations through curves at conventional speeds. The rule accounts for a range of vehicle types that are currently in operation, as well as vehicle types that may likely be used in future high-speed or high cant deficiency rail operations, or both. The rule is based on the results of simulation studies designed to identify track geometry irregularities associated with unsafe wheel/rail forces and accelerations, thorough reviews of vehicle qualification and revenue service test data, and consideration of international practices.

**DATES:** This final rule is effective July 11, 2013. The incorporation by reference of a certain publication listed in the rule is approved by the Director of the **Federal Register** as of July 11, 2013. Petitions for reconsideration must be received on or before May 13, 2013. Comments in response to petitions for reconsideration must be received on or before June 26, 2013.

**ADDRESSES:** *Petitions for reconsideration and comments on petitions for reconsideration:* Any petitions for reconsideration or comments on petitions for reconsideration related to Docket No. FRA-2009-0036, Notice No. 2, may be submitted by any of the following methods:

- *Web site:* The Federal eRulemaking Portal, [www.regulations.gov](http://www.regulations.gov). Follow the Web site's online instructions for submitting comments.
- *Fax:* 202-493-2251.

- *Mail:* Docket Management Facility, U.S. Department of Transportation, 1200 New Jersey Avenue SE., Room W12-140, Washington, DC 20590.

- *Hand Delivery:* Docket Management Facility, U.S. Department of Transportation, 1200 New Jersey Avenue SE., Room W12-140 on the Ground level of the West Building, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

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

*Docket:* For access to the docket to read background documents, petitions for reconsideration, or comments received, go to [www.regulations.gov](http://www.regulations.gov) anytime or visit the Docket Management Facility, U.S. Department of Transportation, 1200 New Jersey Avenue SE., Room W12-140 on the Ground level of the West Building, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

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**I. Executive Summary**

Having considered the public comments in response to FRA's May 10, 2010, proposed rule on vehicle/track interaction safety, *see* 75 FR 25928, FRA issues this final rule amending the Track Safety Standards, 49 CFR part 213, and the Passenger Equipment Safety Standards, 49 CFR part 238, applicable to high-speed and high cant deficiency train operations. (As explained more fully in the preamble, below, train operations at cant deficiency involve traveling through curves faster than the balance speed; the higher the train speed is above the balance speed, the higher the cant deficiency.) Since FRA's high-speed track safety standards and passenger equipment safety standards were issued in the late 1990s, FRA and interested industry members have identified various issues for possible future rulemaking. Some of these issues resulted from the gathering of operational experience in applying the safety standards to Amtrak's high-speed, Acela Express (Acela) trainsets, as well as to higher-speed commuter railroad operations. Other issues arose from research conducted, allowing FRA to gather new information with which to evaluate the safety of high-speed and high cant deficiency rail operations.

FRA has addressed these issues with the assistance of the Railroad Safety Advisory Committee (RSAC), which unanimously recommended the requirements contained in this final rule.

Among the final rule's main accomplishments, the rule:

- Revises performance standards and specifications for track geometry for the higher-speed track classes, track Classes 6 through 9 (speeds greater than 80 miles per hour (m.p.h.) for freight and 90 m.p.h. for passenger operations). FRA has reviewed the performance standards in light of advanced simulations that were developed to support the rulemaking effort, as discussed in Section IV, below, and is refining those standards to focus on identified safety concerns and remove any unnecessary costs.
- Adds flexibility through procedures for safely permitting high cant deficiency operations on the lower-speed track classes, track Classes 1 through 5, without the need for obtaining a waiver. In order to take advantage of high cant deficiency operations and the resultant savings in travel time, the equipment must be qualified and the track must be maintained to more stringent standards to permit the higher speeds through curves.
- Institutes more cost-effective equipment qualification and in-service monitoring requirements. Railroads can discontinue annual use of instrumented wheelsets for in-service validation as a general requirement and avoid some tests that have not provided useful data. Further, the final rule makes it easier to qualify vehicles on additional segments of track once they are qualified on any track, extending territories in which qualified equipment may operate.
- Clarifies that individuals qualified to inspect track need only understand the portions of the regulation relevant to the inspections they conduct and the work they perform, given, in particular, the provisions added for high cant deficiency operations in lower-speed track classes.

In analyzing the economic impacts of the final rule, FRA does not find that any existing operation will be adversely affected by these changes, nor does FRA find that the changes will induce any net costs.

FRA expects three types of benefits: Benefits related to equipment procurement for passenger trains at speeds exceeding 90 m.p.h., benefits from operations at high cant deficiency from operations at speeds up to 90 m.p.h., and benefits from streamlined testing requirements. Under the rules

existing before this final rule, a railroad could insist that a carbuilder provide trainsets that could meet acceleration requirements on track at the maximum allowable deviations. FRA is unaware of any such trainsets that are available that would have complied with the former rule under all permitted conditions and also meet other requirements for service in the United States. This final rule makes it more likely that railroads will specify equipment that is currently produced, and thus could reduce the costs of procurements, although Amtrak disagrees in its comments (and FRA believes that, even without procurement benefits, the costs of the rule are still justified by the benefits). Operations at high cant deficiency allow trains to operate more rapidly around curves. This can dramatically reduce the time required for any given trip. Streamlined testing requirements make it much easier to qualify a trainset on additional track once it has been qualified on any track, and provide more flexibility for monitoring trainset performance in service.

Nothing in the rule will increase the overall costs of procuring equipment or of testing that equipment to validate compliance with the rule. In fact, the rule will reduce those costs.

Although the provisions for high cant deficiency operations on all track classes are permissive in nature and create no additional net costs, railroads that avail themselves of these provisions will incur some costs. The first will be the one-time cost of programming the software of automated track inspection vehicles to include the new standards required by the rule, and the second will be the cost of maintaining the track in curves to tighter geometric standards. FRA conservatively estimates that it will cost \$292,000 as a one-time expense to update track inspection software to reflect the changes in this rule. However, FRA is not certain whether overall maintenance costs will be higher or lower with high cant deficiency operations, as trains otherwise would have more frequently slowed down from the line speed before entering curves and then accelerated back to the line speed after exiting the curves, adding wear and tear to both equipment and track. In any case, the difference in maintenance costs is not included as a factor in the analysis.

The rule creates net benefits and will facilitate the expansion of passenger rail service.

## II. Statutory Background

### A. Track Safety Standards

The first Federal Track Safety Standards were published on October 20, 1971, following the enactment of the Federal Railroad Safety Act of 1970, Public Law 91-458, 84 Stat. 971 (October 16, 1970), in which Congress granted to FRA comprehensive authority over "all areas of railroad safety." See 36 FR 20336. FRA envisioned the new Standards to be an evolving set of safety requirements subject to continuous revision allowing the regulations to keep pace with industry innovations and agency research and development. The most comprehensive revision of the Standards resulted from the Rail Safety Enforcement and Review Act of 1992, Public Law 102-365, 106 Stat. 972 (Sept. 3, 1992), later amended by the Federal Railroad Safety Authorization Act of 1994, Public Law 103-440, 108 Stat. 4615 (November 2, 1994). The amended statute is codified at 49 U.S.C. 20142 and required the Secretary of Transportation (Secretary) to review and then revise the Track Safety Standards, which are contained in 49 CFR part 213. The Secretary has delegated such statutory responsibilities to the Administrator of FRA (see 49 CFR 1.89), which as discussed below, carried out the review and the rulemaking proceedings.

### B. Passenger Equipment Safety Standards

In September 1994, the Secretary convened a meeting of representatives from all sectors of the rail industry with the goal of enhancing rail safety. As one of the initiatives arising from this Rail Safety Summit, the Secretary announced that DOT would develop safety standards for rail passenger equipment over a 5-year period. In November 1994, Congress adopted the Secretary's schedule for implementing rail passenger equipment safety regulations and included it in the Federal Railroad Safety Authorization Act of 1994. Congress also authorized the Secretary to consult with various organizations involved in passenger train operations for purposes of prescribing and amending these regulations, as well as issuing orders pursuant to them. Section 215 of this Act is codified at 49 U.S.C. 20133.

### III. Proceedings to Date

#### A. Proceedings To Carry Out the 1992/1994 Track Safety Standards Rulemaking Mandates

To help fulfill the statutory mandates described in Section II.A, FRA decided that the proceeding to revise part 213 should advance under RSAC, which was established on March 11, 1996. (A fuller discussion of RSAC is provided below.) In turn, RSAC formed the Track Working Group, comprised of approximately 30 representatives from railroads, rail labor organizations, trade associations, State government, track equipment manufacturers, and FRA, to develop and draft a proposed rule for revising part 213. The Track Working Group identified issues for discussion from several sources, in addition to the statutory mandates issued by Congress in 1992 and in 1994. Ultimately, the Track Working Group recommended a proposed rule to the full RSAC body, which in turn formally recommended to the Administrator of FRA that FRA issue the proposed rule as it was drafted.

On July 3, 1997, FRA published an NPRM that included substantially the same rule text and preamble as that developed by the Track Working Group. The NPRM generated comment, and following consideration of the comments received, FRA published a final rule in the **Federal Register** on June 22, 1998, *see* 63 FR 33992, which, effective September 21, 1998, revised the Track Safety Standards in their entirety.

To address the modern railroad operating environment, the final rule included standards specifically applicable to high-speed train operations in a new subpart G. Prior to the 1998 final rule, the Track Safety Standards had addressed six classes of track, Classes 1 through 6, that permitted passenger and freight trains to travel at speeds up to 110 m.p.h.; passenger trains had been allowed to operate at speeds over 110 m.p.h. under conditional waiver granted by FRA. FRA revised the requirements for Class 6 track, included them in new subpart G, and also added in it three new classes of track, track Classes 7 through 9, designating standards for track over which trains may travel at speeds up to 200 m.p.h. The new subpart G was intended to function as a set of “stand alone” regulations governing any track identified as belonging to one of these high-speed track classes.

#### B. Proceedings To Carry Out the 1994 Passenger Equipment Safety Standards Rulemaking Mandate

FRA formed the Passenger Equipment Safety Standards Working Group to provide FRA with advice in developing the regulations mandated by Congress. On June 17, 1996, FRA published an advance notice of proposed rulemaking (ANPRM) concerning the establishment of comprehensive safety standards for railroad passenger equipment. *See* 61 FR 30672. The ANPRM provided background information on the need for such standards, offered preliminary ideas on approaching passenger safety issues, and presented questions on various passenger safety topics. Following consideration of comments received on the ANPRM and advice from FRA’s Passenger Equipment Safety Standards Working Group, FRA published an NPRM on September 23, 1997, to establish comprehensive safety standards for railroad passenger equipment. *See* 62 FR 49728. In addition to requesting written comment on the NPRM, FRA also solicited oral comment at a public hearing held on November 21, 1997. FRA considered the comments received on the NPRM and prepared a final rule, which was published on May 12, 1999. *See* 64 FR 25540.

After publication of the final rule, interested parties filed petitions seeking FRA’s reconsideration of certain requirements contained in the rule. These petitions generally related to the following subject areas: Structural design; fire safety; training; inspection, testing, and maintenance; and movement of defective equipment. On July 3, 2000, FRA issued a response to the petitions for reconsideration relating to the inspection, testing, and maintenance of passenger equipment, the movement of defective passenger equipment, and other miscellaneous provisions related to mechanical issues contained in the final rule. *See* 65 FR 41284. On April 23, 2002, FRA responded to all remaining issues raised in the petitions for reconsideration, with the exception of those relating to fire safety. *See* 67 FR 19970. Finally, on June 25, 2002, FRA completed its response to the petitions for reconsideration by publishing a response to those petitions concerning the fire safety portion of the rule. *See* 67 FR 42892. (For more detailed information on the petitions for reconsideration and FRA’s response to them, please see these three rulemaking documents.) The product of this rulemaking was codified primarily at 49

CFR part 238 and secondarily at 49 CFR parts 216, 223, 229, 231, and 232.

#### C. Identification of Key Issues for Future Rulemaking

While FRA had completed these rulemakings, FRA and interested industry members began identifying various issues for possible future rulemaking. Some of these issues resulted from the gathering of operational experience in applying the new safety standards to Amtrak’s Acela trainsets, as well as to higher-speed commuter railroad operations. These included concerns raised by railroads and rail equipment manufacturers as to the application of the new safety standards and the consistency between the requirements contained in part 213 and those in part 238. Other issues arose from research conducted, allowing FRA to gather new information with which to evaluate the safety of high-speed and high cant deficiency rail operations. FRA decided to address these issues with the assistance of RSAC.

FRA notes that train operation at cant deficiency involves traveling through a curve faster than the balance speed. Balance speed for any given curve is the speed at which the lateral component of centrifugal force will be exactly compensated (or balanced) by the corresponding component of the gravitational force. When operating above the balance speed, there is a net lateral force to the outside of the curve. Cant deficiency is measured in inches and is the amount of superelevation that would need to be added to the existing track to balance this centrifugal force with this gravitational force to realize no net lateral force measured in the plane of the rails. For every curve, there is a balance speed at which the cant deficiency is zero based on the actual superelevation built into the track. The higher the train speed is above the balance speed, the higher the cant deficiency.

#### D. RSAC Overview

As mentioned above, in March 1996, FRA established RSAC as a forum for developing consensus recommendations to FRA’s Administrator on rulemakings and other safety program issues. The Committee includes representation from all of the agency’s major stakeholders, including railroads, labor organizations, suppliers and manufacturers, and other interested parties. A list of member groups follows:

- American Association of Private Railroad Car Owners (AAPRCO);
- American Association of State Highway and Transportation Officials (AASHTO);

- American Chemistry Council;
- American Petroleum Institute;
- American Public Transportation Association (APTA);
- American Short Line and Regional Railroad Association (ASLRRRA);
- American Train Dispatchers Association;
- Association of American Railroads (AAR);
- Association of Railway Museums;
- Association of State Rail Safety Managers (ASRSM);
- Brotherhood of Locomotive Engineers and Trainmen (BLET);
- Brotherhood of Maintenance of Way Employes Division (BMWED);
- Brotherhood of Railroad Signalmen (BRS);
- Chlorine Institute;
- Federal Transit Administration (FTA); \*
- Fertilizer Institute;
- High Speed Ground Transportation Association;
- Institute of Makers of Explosives;
- International Association of Machinists and Aerospace Workers;
- International Brotherhood of Electrical Workers;
- Labor Council for Latin American Advancement; \*
- League of Railway Industry Women; \*
- National Association of Railroad Passengers (NARP);
- National Association of Railway Business Women; \*
- National Conference of Firemen & Oilers;
- National Railroad Construction and Maintenance Association;
- National Railroad Passenger Corporation (Amtrak);
- National Transportation Safety Board (NTSB); \*
- Railway Supply Institute (RSI);
- Safe Travel America (STA);
- Secretaria de Comunicaciones y Transporte; \*
- Sheet Metal Workers International Association (SMWIA);
- Tourist Railway Association, Inc.;
- Transport Canada; \*
- Transport Workers Union of America (TWU);
- Transportation Communications International Union/BRC (TCIU/BRC);
- Transportation Security Administration (TSA); \* and
- United Transportation Union (UTU).

\* Indicates associate, non-voting membership.

When appropriate, FRA assigns a task to RSAC, and after consideration and debate, RSAC may accept or reject the task. If the task is accepted, RSAC

establishes a working group that possesses the appropriate expertise and representation of interests to develop recommendations to FRA for action on the task. These recommendations are developed by consensus. A working group may establish one or more task forces to develop facts and options on a particular aspect of a given task. The individual task force then provides that information to the working group for consideration. When a working group comes to unanimous consensus on recommendations for action, the package is presented to the full RSAC for a vote. If the proposal is accepted by a simple majority of RSAC, the proposal is formally recommended to FRA. FRA then determines what action to take on the recommendation. Because FRA staff members play an active role at the working group level in discussing the issues and options and in drafting the language of the consensus proposal, FRA is often favorably inclined toward the RSAC recommendation. However, FRA is in no way bound to follow the recommendation, and the agency exercises its independent judgment on whether the recommended rule achieves the agency's regulatory goal, is soundly supported, and is in accordance with policy and legal requirements. Often, FRA varies in some respects from the RSAC recommendation in developing the actual regulatory proposal or final rule. Any such variations would be noted and explained in the rulemaking document issued by FRA. However, to the maximum extent practicable, FRA utilizes RSAC to provide consensus recommendations with respect to both proposed and final agency action. If RSAC is unable to reach consensus on a recommendation for action, the task is withdrawn and FRA determines the best course of action.

#### *E. Establishment of the Passenger Safety Working Group*

On May 20, 2003, FRA presented, and RSAC accepted, the task of reviewing existing passenger equipment safety needs and programs and recommending consideration of specific actions that could be useful in advancing the safety of rail passenger service. The RSAC established the Passenger Safety Working Group (Working Group) to handle this task and develop recommendations for the full RSAC to consider. Members of the Working Group, in addition to FRA, include the following:

- AAR, including members from BNSF Railway Company (BNSF), CSX Transportation, Inc. (CSXT), and Union Pacific Railroad Company;
- AAPRCO;

- AASHTO;
- Amtrak;
- APTA, including members from Bombardier, Inc., Herzog Transit Services, Inc., Interfleet Technology, Inc. (Interfleet, formerly LDK Engineering, Inc.), Long Island Rail Road (LIRR), Maryland Transit Administration (MTA), Metro-North Commuter Railroad Company, Northeast Illinois Regional Commuter Railroad Corporation, Southern California Regional Rail Authority, and Southeastern Pennsylvania Transportation Authority (SEPTA);
- ASLRRRA;
- BLET;
- BRS;
- FTA;
- NARP;
- RSI;
- SMWIA;
- STA;
- TCIU/BRC;
- TSA;
- TWU; and
- UTU.

Staff from DOT's John A. Volpe National Transportation Systems Center (Volpe Center) attended all of the meetings and contributed to the technical discussions. Staff from the NTSB also participated in the Working Group's meetings. The Working Group has held 14 meetings on the following dates and in the following locations:

- September 9–10, 2003, in Washington, DC;
- November 6, 2003, in Philadelphia, PA;
- May 11, 2004, in Schaumburg, IL;
- October 26–27, 2004, in Linthicum/Baltimore, MD;
- March 9–10, 2005, in Ft. Lauderdale, FL;
- September 7, 2005, in Chicago, IL;
- March 21–22, 2006, in Ft. Lauderdale, FL;
- September 12–13, 2006, in Orlando, FL;
- April 17–18, 2007, in Orlando, FL;
- December 11, 2007, in Ft. Lauderdale, FL;
- June 18, 2008, in Baltimore, MD;
- November 13, 2008, in Washington, DC;
- June 8, 2009, in Washington, DC; and
- September 16, 2010, in Chicago, IL.

#### *F. Establishment of the Task Force*

Due to the variety of issues involved, at its November 2003 meeting the Working Group established four task forces—smaller groups to develop recommendations on specific issues within each group's particular area of expertise. Members of the task forces include various representatives from the

respective organizations that are part of the larger Working Group. One of these task forces was assigned to identify and develop issues and recommendations specifically related to the inspection, testing, and operation of passenger equipment as well as concerns related to the attachment of safety appliances on passenger equipment. An NPRM on these topics was published on December 8, 2005 (*see* 70 FR 73069), and a final rule was published on October 19, 2006 (*see* 71 FR 61835). Another of these task forces was assigned to develop recommendations related to window glazing integrity, structural crashworthiness, and the protection of occupants during accidents and incidents. The work of this task force led to the publication of an NPRM focused on enhancing the front end strength of cab cars and multiple-unit (MU) locomotives on August 1, 2007 (*see* 72 FR 42016), and the publication of a final rule on January 8, 2010 (*see* 75 FR 1180). Another task force, the Emergency Preparedness Task Force, was established to identify issues and develop recommendations related to emergency systems, procedures, and equipment. An NPRM on these topics was published on August 24, 2006 (*see* 71 FR 50276), and a final rule was published on February 1, 2008 (*see* 73 FR 6370).

The fourth task force, the Track/Vehicle Interaction Task Force (also identified as the Vehicle/Track Interaction Task Force, or Task Force), was established to identify issues and develop recommendations related to the safety of vehicle/track interactions. Initially, the Task Force was charged with considering a number of issues, including vehicle-centered issues involving wheel flange angle, tread conicity, and truck equalization; the necessity for instrumented wheelset tests for operations at speeds from 90 to 125 m.p.h.; consolidation of vehicle trackworthiness criteria in parts 213 and 238; and revisions of the track geometry standards. The Task Force was given the responsibility of addressing other vehicle/track interaction safety issues and to recommend any research necessary to facilitate their resolution. Members of the Task Force, in addition to FRA, include the following:

- AAR;
- AASHTO;
- Amtrak;
- APTA, including members from Bombardier, Interfleet, LIRR, LTK Engineering Services, Port Authority Trans-Hudson, and STV Inc.;
- BMWED; and
- BRS.

Staff from the Volpe Center attended all of the meetings and contributed to the technical discussions through their comments and presentations. In addition, staff from ENSCO, Inc., attended all of the meetings and contributed to the technical discussions, as a contractor to FRA. Both the Volpe Center and ENSCO, Inc., have supported FRA throughout this rulemaking.

The Task Force has held 32 meetings on the following dates and in the following locations:

- April 20–21, 2004, in Washington, DC;
- May 24, 2004, in Springfield, VA (technical subgroup only);
- June 24–25, 2004, in Washington, DC;
- July 6, 2004, in Washington, DC (technical subgroup only);
- July 22, 2004, in Washington, DC (technical subgroup only);
- August 24–25, 2004, in Washington, DC;
- October 12–14, 2004, in Washington, DC;
- December 9, 2004, in Washington, DC;
- February 10, 2005, in Washington, DC;
- April 7, 2005, in Washington, DC;
- August 24, 2005, in Washington, DC;
- November 3–4, 2005, in Washington, DC;
- January 12–13, 2006, in Washington, DC;
- March 7–8, 2006, in Washington, DC;
- April 25, 2006, in Washington, DC;
- May 23, 2006, in Washington, DC;
- July 25–26, 2006, in Cambridge, MA;
- September 7–8, 2006, in Washington, DC;
- November 14–15, 2006, in Washington, DC;
- January 24–25, 2007, in Washington, DC;
- March 29–30, 2007, in Cambridge, MA;
- April 26, 2007, in Springfield, VA;
- May 17–18, 2007, in Cambridge, MA;
- June 25–26, 2007, in Arlington, VA;
- August 8–9, 2007, in Cambridge, MA;
- October 9–11, 2007, in Washington, DC;
- November 19–20, 2007, in Washington, DC;
- February 27–28, 2008, in Cambridge, MA;
- August 5–6, 2010, in Rockville, MD;
- August 23, 2010, in Washington, DC (via teleconference);
- September 7, 2010, in Washington, DC (via teleconference); and

- June 29, 2011, in Washington, DC (via teleconference).

This list includes meetings of a technical subgroup comprised of representatives of the larger Task Force. These subgroup meetings were often convened the day before the larger Task Force meetings to focus on more advanced, technical issues. The results of these meetings were then presented at the larger Task Force meetings and, in turn, included in the minutes of those Task Force meetings. Minutes of each of these meetings have been made part of the public docket in this proceeding and are available for inspection.

#### *G. Development of the NPRM*

The NPRM was developed to address a number of the concerns raised and issues discussed during Task Force and Working Group meetings. The Task Force recognized that the high-speed track safety standards are based on the principle that, to ensure safety, the interaction of the vehicles and the tracks over which they operate must be considered within a systems approach that provides for specific limits for vehicle response to track perturbation(s). From the outset, the Task Force strove to develop revisions that would: Serve as practical standards with sound physical and mathematical bases; account for a range of vehicle types that are currently used and may likely be used on future high-speed or high cant deficiency rail operations, or both; and not present an undue burden on railroads. The Task Force first identified key issues requiring attention based on experience applying the Track Safety Standards and Passenger Equipment Safety Standards, and defined the following work efforts:

- Revise—
  - Qualification requirements for high-speed and high cant deficiency operations;
  - Acceleration and wheel/rail force safety limits;
  - Inspection, monitoring, and maintenance requirements; and
  - Track geometry limits for high-speed operations.
- Establish—
  - Necessary safety limits for wheel profile and truck equalization;
  - Consistent requirements for high cant deficiency operations covering all track classes; and
  - Additional track geometry requirements for cant deficiencies greater than 5 inches.
- Resolve and reconcile inconsistencies between the Track Safety Standards and Passenger Equipment Safety Standards, and

between the lower- and higher-speed Track Safety Standards.

Through the close examination of these issues, the Task Force developed proposals intended to result in improved public safety while reducing the burden on the railroad industry where possible. The proposals were arrived at through the results of computer simulations of vehicle/track dynamics, consideration of international practices, and thorough reviews of qualification and revenue service test data.

Nonetheless, in the NPRM published in the **Federal Register** on May 10, 2010, *see* 75 FR 25928, FRA made clear that the Task Force did not seek to revise comprehensively the high-speed Track Safety Standards in subpart G of part 213, and the NPRM did not propose to do so. For example, there was no consensus within the Task Force to consider revisions to the requirements for crossties, as members of the Task Force believed it was outside of their assigned tasks. Nor was there any real discussion about revisions to the requirements for ballast or other sections in subpart G that currently do not distinguish requirements by class of track. (See § 213.307 in the Section-by-Section Analysis, below, for further discussion on this point.) FRA therefore made clear that by not proposing revisions to these sections in the NPRM, FRA did not mean to imply that these other sections may not be subject to revision in the future, such as through a separate RSAC effort. Further, FRA invited comment on the need and rationale for changes to other sections of subpart G not specifically proposed to be revised through the NPRM, noting that based upon the comments received and their significance to the changes specifically proposed, FRA may consider whether revisions to additional requirements in subpart G are necessary in this final rule.

#### *H. Development of the Final Rule*

FRA notified the public of its options to submit written comments on the NPRM and to request a public, oral hearing on the NPRM as well. No request for a public hearing was received. However, a number of interested parties did submit written comments to the docket in this proceeding, and FRA considered all of these comments in preparing the final rule. Specifically, written comments were received from AAR, Amtrak, Bombardier, the European Union (EU), Florida Department of Transportation (FDOT), New Jersey Transit Corporation (NJ Transit), North Carolina Department

of Transportation (NCDOT), SEPTA, Société Nationale des Chemins de fer Français (French National Railway Company, shortened as SNCF), and a private citizen. As discussed below, FRA sought clarification from SNCF on SNCF's initial written comments to the docket, and SNCF supplemented its comments in response to FRA's request. FRA's request and SNCF's response have been made part of the public docket in this proceeding.

FRA convened the Task Force to discuss the comments received on the NPRM and to help achieve consensus on recommendations concerning their incorporation into this final rule. After four meetings and subsequent electronic communications, the Task Force reached consensus on recommendations for the text of the final rule. The recommendations were accepted by the Working Group and unanimously approved by the full RSAC as the Committee's recommendations to the FRA Administrator. Finding that the recommendations help fulfill the agency's regulatory goals, are soundly supported, and in accordance with policy and legal requirements, FRA has adopted these recommendations in this final rule.

FRA notes that throughout the preamble discussion of this final rule, FRA refers to comments, views, suggestions, or recommendations made by members of the Task Force, Working Group, or full RSAC, as they are identified or contained in meeting minutes or other materials in the public docket. FRA does so to show the origin of certain issues and the nature of discussions concerning those issues at the Task Force, Working Group, and full RSAC level. FRA believes this serves to illuminate factors it has weighed in making its regulatory decisions, as well as the rationale for those decisions.

#### **IV. Technical Background**

##### *A. Lessons Learned and Operational Experience*

Since the issuance of both the high-speed Track Safety Standards in 1998 and the Passenger Equipment Safety Standards in 1999, experience has been gained in qualifying a number of vehicles for high-speed and high cant deficiency operations and in monitoring subsequent performance in revenue service operation. These vehicles include Amtrak's Acela trainset; MTA's MARC-III multi-level passenger car; and NJ Transit's ALP-46 locomotive, Comet V car, PL-42AC locomotive, and multi-level passenger car. Considerable data was gathered by testing these vehicles at speed over their intended service routes

using instrumented wheelsets to measure forces directly between the wheel and rail and using accelerometers to record vehicle motions. During the course of these qualification tests, some uncertainties, inconsistencies, and potentially restrictive values were identified in the interpretation and application of the vehicle/track interaction (VTI) safety limits then specified in § 213.333 and § 213.345 for excessive vehicle motions based on measured accelerations and in the requirements of § 213.57 and § 213.329 for high cant deficiency operation. The information and experience in applying these requirements helped lay the foundation for a number of the changes made in this rulemaking, examples of which are provided below.

##### *Differentiate Between Sustained Oscillatory and Transient Carbody Acceleration Events*

During route testing of the MARC-III multi-level car at speeds up to 125 m.p.h. and at curving speeds producing up to 5 inches of cant deficiency, several short-duration, peak-to-peak carbody lateral accelerations were recorded that exceeded regulatory thresholds but did not represent unsafe guidance forces simultaneously measured at the wheel-to-rail interface. However, repeated (sustained) carbody lateral oscillatory accelerations and significant motions were measured on occasion at higher speeds in curves even though peak-to-peak amplitudes did not exceed the thresholds. A truck component issue was identified as a cause of the excessive accelerations and thereafter corrected.

To recognize and account for wider variations in vehicle design, this final rule divides the VTI acceleration limits into separate limits for passenger cars from those for other vehicles, such as conventional locomotives. In addition, new limits for sustained, carbody oscillatory accelerations have been added to differentiate between single (transient) events and repeated (sustained) oscillations. As a result, the carbody transient acceleration limits for single events, previously set conservatively to control for both single and repeated oscillations, are now more specific and, as appropriate, relaxed. FRA believes that this added specificity in the rule will reduce or eliminate altogether the need for railroads to provide clarification or perform additional analysis, or both, to distinguish between transient and sustained oscillations following a qualification test run. Based on the small energy content associated with high-frequency acceleration events of

the carbody, transient acceleration peaks lasting less than 50 milliseconds are excluded from the carbody acceleration limits. Other clarifying changes include the addition of minimum requirements for sampling and filtering of the acceleration data. These changes followed considerable research into the performance of existing vehicles during qualification testing and revenue operation. Overall, it was found that the carbody oscillatory acceleration limits need not be as stringent to protect against events leading to vehicle or passenger safety issues.

#### Establish Consistent Requirements for High Cant Deficiency Operations for All Track Classes

Several issues related to operation at higher cant deficiencies (higher speeds in curves) have also been addressed, based particularly on route testing of the Acela trainsets on Amtrak's Northeast Corridor. In sharper curves, for which cant deficiency was high but vehicle speeds were reflective of a lower track class, it was found that stricter track geometry limits were necessary, for the same track class, in order to provide an equivalent margin of safety for operations at higher cant deficiency. These stricter limits have been adopted in this final rule. Second, although the Track Safety Standards have prescribed limits on geometry variations existing in isolation, it was recognized that a combination of track alinement (also spelled "alignment" and literally meant to indicate "a line") and surface variations, none of which individually amounts to a deviation from the Standards, may nonetheless result in undesirable response as defined by the VTI limits. This finding was significant because trains operating at high cant deficiency increase the lateral force exerted on track during curving and, in many cases, may correspondingly reduce the margin of safety associated with vehicle response to combined track variations. Sections 213.65 and 213.332 have been added to the rule, as a result. Qualification of Amtrak's conventional passenger equipment to operate at cant deficiencies up to 5 inches also highlighted the need to ensure compatibility between the requirements for low- (§ 213.57) and high-speed (§ 213.329) cant deficiency operations; these requirements have been modified, accordingly.

#### Streamline Testing Requirements for Similar Vehicles

This final rule provides that vehicles with minor variations in their physical properties (such as suspension, mass,

interior arrangements, or dimensions) that do not result in significant changes to their dynamic performance (i.e., are dynamically similar) be considered of the same vehicle type for vehicle qualification purposes. Provided that this similarity can be established to FRA's satisfaction, these vehicles are not required to repeat full qualification testing of the vehicle type to which they belong, thereby saving the costs associated with full testing. In other cases, however, the variations between car parameters may warrant partial or full dynamic testing. For example, the approval process for NJ Transit's Comet V car to operate at speeds up to 100 m.p.h. exemplified the need for clarification of whether vehicles similar (but not identical) to vehicles that have undergone full qualification testing should be subjected to full qualification testing themselves. NJ Transit had sought relief from the instrumented wheelset testing required in § 213.345 by stating that the Comet V car was similar to the Comet IV car. The Comet V car was represented to FRA to have truck and suspension components nearly identical to the Comet IV car already in service and operating at 100-m.p.h. speeds for many years. However, examination by FRA revealed enough differences between the vehicles to at least warrant dynamic testing using accelerometers on representative routes. Results of the testing showed distinct behaviors between the cars and provided additional data that was necessary for qualifying the Comet V.

#### Refine Criteria for Detecting Truck Hunting

During route testing of Acela trainsets, high-frequency lateral acceleration oscillations of the coach truck frame were detected by the test instrumentation in a mild curve at high speed. However, the onboard sensors, installed per specification on every truck, did not respond to these events. Based on these experiences, the truck lateral acceleration safety limit, used for the detection of truck hunting, has been tightened from 0.4g to 0.3g and provides that the 0.3g value must be exceeded for more than 2 seconds for there to be an exceedance. Analyses conducted by FRA have shown that this change will better help to identify the occurrences of excessive truck hunting, while excluding high-frequency, low-amplitude oscillations that do not require immediate attention. In addition, to improve the process for analyzing data while vehicles are negotiating spiral track segments, the limit now requires that the RMSt (root mean squared with linear trend

removed) value be used rather than the RMSm (root mean squared with mean removed) value.

Finally, placement of the truck frame lateral accelerometer to detect truck hunting has been more rigorously specified to be as near an axle as is practicable. Analyses conducted by FRA have shown that when hunting motion (which is typically a combination of truck lateral motion and yaw) has a large truck yaw component, hunting is best detected by placing an accelerometer on the truck frame located above an axle. FRA has found that an accelerometer placed in the middle of the truck frame will not always provide early detection of truck hunting when yaw motion of the truck is large.

#### Revise Periodic Monitoring Requirements for Class 8 and 9 Track

Based on collected data, and so that the required inspection frequency better reflects experienced degradation rates, the periodic vehicle/track interaction monitoring frequency contained in § 213.333 for operations at track Class 8 and 9 speeds has been reduced from once per day to four times per week for carbody accelerations, and twice within 60 days for truck accelerations. In addition, a clause has been added to allow the track owner or railroad operating the vehicle type subject to the monitoring to petition FRA, after a specified amount of time or mileage, to eliminate the truck accelerometer monitoring requirement. Data gathered has shown that these monitoring requirements could be adjusted without materially diminishing operational safety. In this regard, FRA notes that safety is also provided pursuant to § 238.427 in that truck acceleration continues to be constantly monitored on each Tier II vehicle under the Passenger Equipment Safety Standards in order to determine if hunting oscillations of the vehicle are occurring during revenue operation.

#### B. Research and Computer Modeling

As a result of advancements made over the last few decades, computer models of rail vehicles interacting with track have become practical and reliable tools for predicting the behavior and safety of these vehicles under a variety of conditions. These models can serve as reliable substitutes for performing actual, on-track testing, which otherwise may be more difficult—and likely more costly—to perform than to model.

Models for such behavior typically represent the vehicle body, wheelsets, truck frames, and other major vehicle components as rigid bodies connected



with elastic and damping elements and include detailed representation of the non-linear wheel/rail contact mechanics (i.e., non-linear frictional contact forces between the wheels and rails modeled as functions of the relative velocities between the wheel and rail contacts, i.e., creepages). The primary dynamic input to these models is track irregularities, which can be created analytically (such as versines, cusps, etc.) or based on actual measurements.

There are a number of industry codes available with generally accepted approaches for solving the equations of motion describing the dynamic behavior of rail vehicles. These models require accurate knowledge of vehicle parameters, including the inertia properties of each of the bodies as well as the characteristics of the main suspension components and connections. To obtain reliable predictions, the models must also consider the effects of suspension non-linearities within the vehicles and in the wheel/rail contact mechanics, as well as incorporate detailed characterization of the track as input, including the range of parameters and non-linearities encountered in service.

In order to develop revisions to the track geometry limits in the Track Safety Standards, several computer models of rail vehicles have been used to assess the response of vehicle designs to a wide range of track conditions corresponding to limiting conditions allowed for each class of track. Simulation studies have been performed using computer models of Amtrak's AEM-7 locomotive, Acela power car, Acela coach car, and Amfleet coach equipment. In the time since the 1998 revisions to the track geometry limits, which were largely based on models of hypothetical, high-speed vehicles, models of the subsequently-introduced Acela power car and coach car have been developed. In the case of the Acela power car, the model has proven capable of reproducing a wide range of vehicle responses observed during

acceptance testing, including examples of potential safety concerns.

For purposes of this rulemaking, an extensive matrix of simulation studies involving all four vehicle types was used to determine the amplitude of track geometry alinement anomalies, surface anomalies, and combined surface and alinement anomalies that result in undesirable response. These simulations were performed using two coefficients of friction (0.1 and 0.5), two analytical anomaly shapes (bump and ramp), and combinations of speed, curvature, and superelevation to cover a range of cant deficiency. The results provided the basis for establishing the revisions to the geometry limits adopted in this final rule. For illustration purposes, two examples are provided of results from simulation studies that were performed for determining safe amplitudes of track geometry: One illustrates the effect of combined track alinement and profile defects; the other illustrates isolated track alinement defects.

Figure 1 depicts an example summarizing the modeling results of the Acela power car at 130 m.p.h. and 9 inches of cant deficiency over combined, 62-foot-wavelength defects. The darker-shaded squares represent a combination of track alinement and surface perturbations where at least one of the VTI safety criteria adopted in this final rule is exceeded, and the solid, black-lined polygon represents the track geometry limits that have been adopted in the final rule. Similar results for other vehicles, speeds and cant deficiencies, and defect wavelengths were created and reviewed. The track geometry limits for the combined perturbations (solid line) were developed following consideration of all of these results. Figure 1 displays how one example case compares with these track geometry limits. As shown, the combined perturbation limits address the most severe combination conditions, though for computational simplicity and implementation purposes, they do not

attempt to control all possible combinations. The figure shows that without the addition of the combined defect limits in the upper right and lower left quadrants, which effectively limit track geometry in the up-and-in and down-and-out cases, the single-defect limits would otherwise permit conditions that could cause the VTI safety criteria to be exceeded. For many of these high-speed and high cant deficiency conditions, the net axle lateral force safety criterion was found to be the limiting safety condition.

Figure 2 depicts an example summarizing the modeling results of the Acela power car on Class 7 track at 130 m.p.h. and 9 inches of cant deficiency over isolated track alinement defects having 124-foot wavelengths. Each vertical bar represents the amplitude of the largest alinement perturbation that will not cause an exceedance of one of the VTI safety criteria. Similar results for other vehicles, speeds and cant deficiencies, and defect wavelengths were created and reviewed using isolated, surface geometry defects. These example results show that, with two exceptions, the geometry limits in the 1998 Track Safety Standards have sufficiently protected against such exceedances under the modeled conditions. Specifically, the VTI limits for net axle lateral force and peak-to-peak carbody lateral acceleration were exceeded on track at the 124-foot, mid-chord offset (MCO) limit for alinement. The modeling showed this limit to be set too permissively for high cant deficiency operations. Consequently, FRA proposed to tighten this alinement limit from 1.25 inches to 1.0 inch for Class 7 track operations above 5 inches of cant deficiency to prevent unsafe vehicle dynamic response. FRA has adopted this proposal in this final rule.

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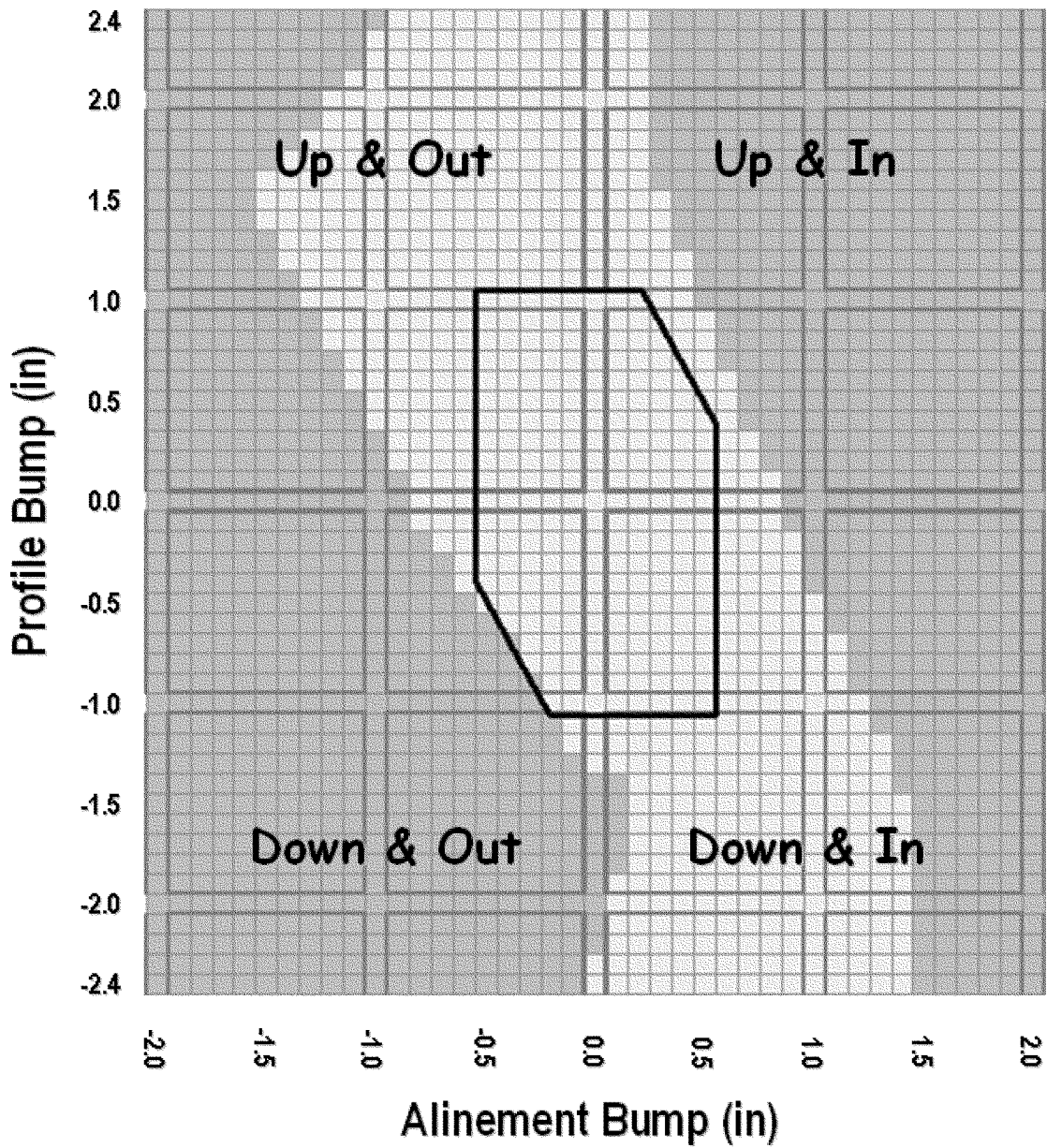
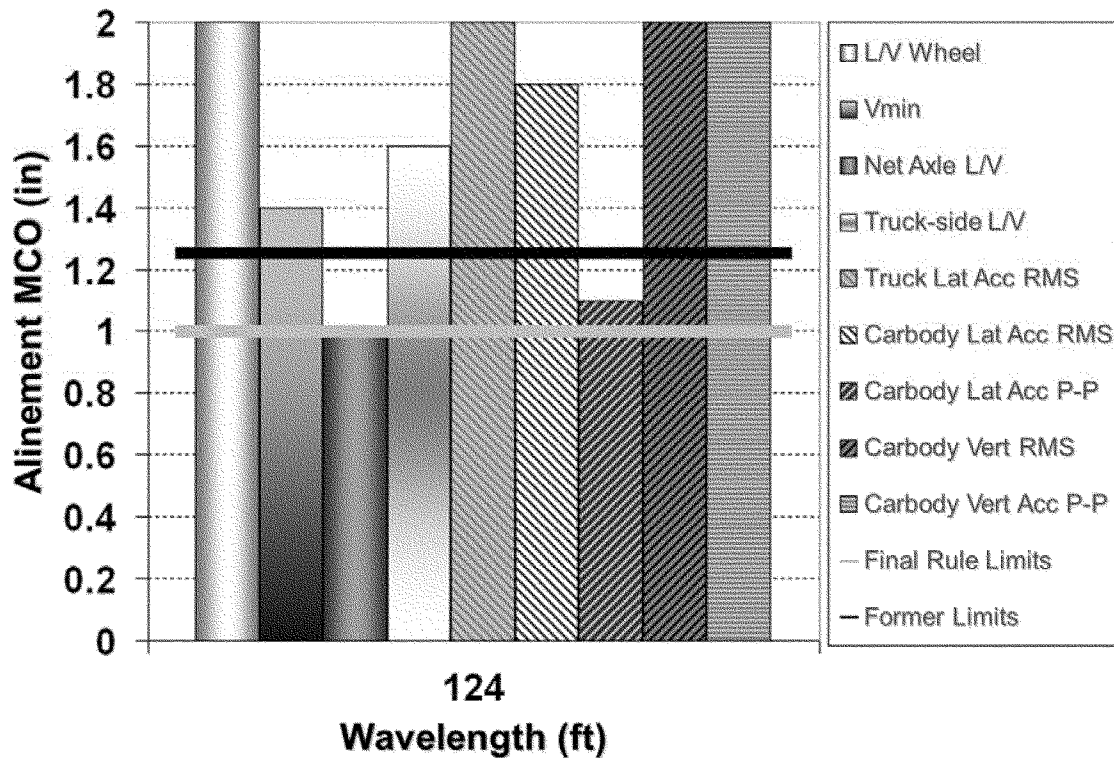


Figure 1. Example of Combined Alinement and Profile (Surface) Deviations, 62-Foot Wavelength, Acela Power Car, 130 m.p.h., 9 inches (in) of Cant Deficiency

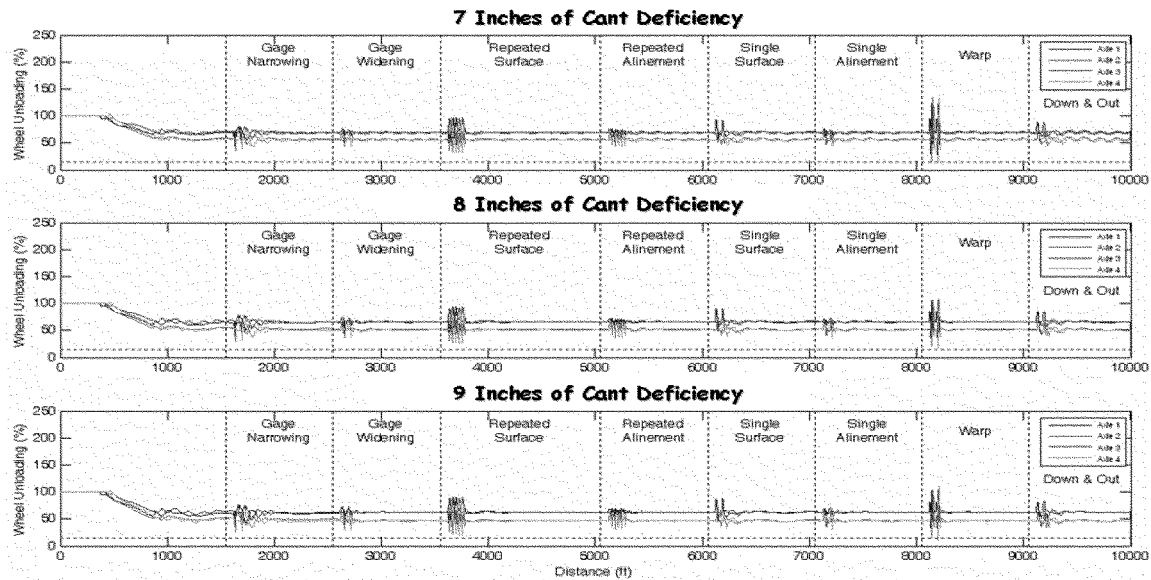


**Figure 2. Isolated Alinement Deviations, 124-Foot Wavelength, Acela Power Car, 130 m.p.h., 9 inches of Cant Deficiency**

As specified in this final rule, simulations using computer models are now required during the vehicle qualification process as an important tool for the assessment of vehicle performance. These simulations are intended not only to augment on-track, instrumented performance assessments but also to provide a means for identifying vehicle dynamic performance issues prior to service to validate the suitability of a vehicle design for operation over its intended route. In order to evaluate safety performance as part of the vehicle qualification process, simulations are required using both a measured track geometry segment representative of the full route, and an analytically defined

track segment containing geometry perturbations representative of minimally compliant track conditions for the respective track class—Minimally Compliant Analytical Track (or MCAT). MCAT is intended to be used to qualify both new vehicles for operation and vehicles previously qualified (on other routes) for operation over new routes. MCAT consists of nine sections; each section is designed to test a vehicle's performance in response to a specific type of perturbation (hunting perturbation, gage narrowing, gage widening, repeated and single surface perturbations, repeated and single alinement perturbations, short warp, and combined down-and-out perturbations). Typical simulation

parameters (that vary) include: Speed, cant deficiency, gage, and wheel profile. Figure 3 depicts time traces of the percent of wheel unloading for the Acela coach in a simulated run over MCAT segments for analyzing high cant deficiency curving performance at 160 m.p.h. In this example the most severe response occurs over the warp segment of track. At 9 inches of cant deficiency and a speed of 160 m.p.h., vehicle response exceeds the permitted limit for a wheel to unload to less than 15 percent of its static vertical wheel load for 5 or more continuous feet, as provided in table of VTI safety limits in § 213.333. Please see the Section-by-Section Analysis for a further discussion of MCAT.



**Figure 3.  $V_{min}$ , Acela Coach, 160 m.p.h., 31-Foot-Wavelength Perturbations**

## V. Discussion of Specific Comments and Conclusions

As noted above, FRA received written comments in response to the NPRM from a number of interested parties. Most of the comments are discussed in the Section-by-Section Analysis or in the Regulatory Impact and Notices portion of this final rule directly with the provisions and statements to which they specifically relate. Other comments apply more generally to the final rule as a whole, and FRA is discussing them here. Please note that the order in which the comments are discussed in this document, whether by issue or by commenter, is not intended to reflect the significance of the comment raised or the standing of the commenter.

### A. EU and SNCF Comments on Track Geometry Standards

FRA received comments from both the EU and SNCF expressing concerns that, in general, the proposed revisions to the Track Safety Standards would permit significantly larger track geometry variations than equivalent European limits. According to these commenters, such larger track geometry variations could compromise the safety of high-speed operations or have an impact on the achievable comfort values in high-speed service, or both.

FRA's track geometry standards are safety standards and specify minimum safety requirements (i.e., maximum allowable track geometry variations that do not compromise safety). The standards do not address ride comfort, except to the extent that they inherently

provide a level of ride comfort as well. However, FRA encourages and expects railroads to adopt their own internal, stricter track maintenance policies to address other concerns such as ride comfort. Thus, FRA expects that a high-speed rail system should normally operate well within the maximum allowable track geometry safety limits.

As discussed above, to establish the safety limits proposed in the NPRM, FRA conducted a set of engineering and vehicle/track dynamic interaction simulation studies, using a range of representative vehicles (i.e., not developed for a particular vehicle type) to identify specific track geometry limits that would provide for safety in the envisioned speed ranges. These studies modeled the effects of specific track geometry variations (consisting of a full range of wavelengths likely to affect vehicle dynamics) on the safe response of the candidate vehicles. In addition, comparisons were made between the proposed limits derived from these modeling results and the track geometry limits used by SNCF, to assess their validity. These comparisons were made for track Classes 6 through 9.

FRA sought clarification from SNCF on its comments on the NPRM, as noted above. FRA prepared a brief presentation outlining the general approach it followed in proposing the NPRM's safety limits, using the Class 9 limits as a specific example. This presentation was sent to SNCF along with three questions related to track geometry and safety criteria currently in use in the French high-speed rail

network. These questions were intended to clarify FRA's understanding of SNCF's practices (recognizing that both the track geometry standards used by SNCF, as well as the measurements and calculations used to evaluate compliance with its standards, are implemented in a manner different from FRA's standards) and gather any specific information SNCF has to indicate the need for track geometry limits stricter than those proposed in the NPRM.

Having considered the comments and supplemental response, FRA continues to believe that the approach taken in this rulemaking sets appropriate track geometry limits and safely accounts for vehicle behavior in response to track geometry conditions. Based on the information available to FRA, FRA does not find that more stringent track geometry limits are necessary for the purposes of safety. In this regard, SNCF's supplemental response noted inconsistencies with FRA's initial understanding of SNCF limits which, when taken into account, indicate that FRA's geometry limits actually provide tighter controls on alignment variations. Moreover, SNCF stated that it was about to start research to integrate vehicle dynamics more fully into its own track geometry limits, and expressed interest in SNCF and FRA combining their experience to share information and examine issues together. FRA welcomes the opportunity for such cooperation and a dialogue with SNCF is ongoing.

### *B. Wheel Unloading From Wind on Superelevated Curves*

Several comments were raised on FRA's proposal in §§ 213.57(b) and 213.329(b) of the NPRM that all vehicles requiring qualification of the vehicle/track system under § 213.345 demonstrate that when stopped on a curve having a maximum uniform elevation of 7 inches, no wheel unloads to a value less than 50 percent of its static weight on level track. This proposed modification to the 1998 Track Safety Standards was intended to address potential vehicle rollover and passenger safety issues from side-wind loading should a vehicle be stopped or traveling at very low speeds on highly superelevated curves, helping to prevent complete unloading of the wheels on the high (elevated) rail and incipient rollover.

In commenting on this proposal, Bombardier raised concern that only vehicles seeking qualification under § 213.345 would be subject to the proposed requirement, even though the underlying safety issue relates to all vehicle types operating at any speed and any cant deficiency—not just vehicles seeking qualification under § 213.345. Bombardier stated that a similar provision then contained in §§ 213.57 and 213.329 had been proposed to be removed for this reason. Bombardier also raised concern as to the effect the proposal would have on existing, qualified multi-level passenger equipment. Amtrak commented that only high-speed equipment would in effect be subject to the proposal, and yet the proposal had not been justified for any equipment, be it high-speed, conventional, or freight. NCDOT also commented that if rollover from side-wind loading when stopped on a superelevated curve is a safety issue, then the proposal should apply to either all vehicles, regardless of operating speed or cant deficiency, or none. Like Bombardier, NCDOT noted concern that the proposal could affect the procurement and qualification of bi-level passenger equipment.

After extensive discussion within the Task Force in response to these comments, FRA has decided not to adopt the proposal. The proposal would have effectively superseded the requirements in §§ 213.57 and 213.329 for vehicles seeking qualification under § 213.345, in that, for a vehicle stopped or traveling at very low speeds on a highly superelevated curve, it would have lowered the 60-percent unloading limit to 50 percent, since dynamic effects on wheel unloading would not be a factor, and would have eliminated

the 8.6-degree roll requirement for this stationary condition. However, FRA is not aware of passenger rail equipment currently in service in the United States that would not have met the proposal, and the proposal was therefore principally intended to ensure that new passenger rail equipment designs for high-speed or high cant deficiency operation would continue to address this wheel unloading concern. In this regard, FRA had suggested in the Task Force to limit the proposal only to new passenger cars—focusing the provisions on new passenger cars (or new passenger car types), particularly those with higher centers of gravity, to ensure that they do not excessively unload from wind when stationary on highly superelevated curves. Nevertheless, the Task Force could not reach agreement on criteria by which to evaluate such excessive unloading. FRA understood from the Task Force that the same criteria may not be appropriate for all railroads and would depend on specific operating characteristics and the operating environment (e.g., the criteria should account for the fact that the risk is higher in high-wind regions). Ultimately, the Task Force did not believe it necessary to specify a general FRA standard by which to determine whether the equipment poses a rollover-risk due to wind loading when stationary on a superelevated curve.

FRA does make clear in this final rule that for all equipment operating at cant deficiencies above 3 inches, §§ 213.57(d) and 213.329(d) continue to require that when positioned on track with a uniform superelevation equal to the proposed cant deficiency, no wheel of the vehicle may unload to a value less than 60 percent of its static value on perfectly level track. This 60-percent limit retains an allowance for the effects of wind loading on the risk of equipment rollover at the proposed cant deficiency. Please see the discussion of §§ 213.57(d) and 213.329(d) in the Section-by-Section Analysis, below. Nonetheless, FRA notes that the underlying safety issue of equipment rollover from wind loading when stationary on a superelevated curve is not otherwise addressed in the regulations. Consequently, in the absence of a specific Federal standard, FRA expects that each railroad will identify appropriate safety criteria by which to evaluate the risk of equipment rollover from wind loading when stationary on a superelevated curve, and then make the determination that the risk has been safely addressed using those criteria.

## **VI. Section-by-Section Analysis**

### *Proposed Amendments to 49 CFR Part 213, Track Safety Standards*

#### Subpart A—General

##### Section 213.1 Scope of Part

This section was amended in the 1998 Track Safety Standards final rule to distinguish the applicability of subpart G from that of subparts A through F, as a result of subpart G's addition to this part by that final rule. Subpart G applies to track over which trains operate at speeds exceeding those permitted for Class 5 track, which supports maximum speeds of 80 m.p.h. for freight trains and 90 m.p.h. for passenger trains. Subpart G was intended to be comprehensive, so that a railroad operating at speeds above Class 5 maximum speeds may refer to subpart G for all of the substantive track safety requirements for high-speed rail and need refer to the sections of the Track Safety Standards applicable to lower-speed operations only for general provisions, i.e., § 213.1 (Scope), § 213.3 (Application), and § 213.15 (Penalties). At the same time, railroads that do not operate at speeds in excess of the maximum Class 5 speeds need not directly refer to subpart G at all.

FRA is maintaining this general structure of part 213 for ease of use, and the requirements of subpart G continue not to apply directly to operations at Class 1 through 5 track speeds. However, in adding new requirements governing high cant deficiency operations for track Classes 1 through 5, certain sections of subparts C and D refer railroads operating at those high cant deficiencies to specific sections of subpart G. In such circumstances, only the specifically-referenced section(s) of subpart G apply, and only as provided. As discussed in this Section-by-Section Analysis, below, the addition of requirements for high cant deficiency operations over lower-speed track classes in this final rule permits railroads to operate at higher cant deficiencies over these track classes without requiring a waiver. Prior to this change in the regulation, railroads had to petition FRA for approval by waiver to operate at the higher cant deficiencies over the lower-speed track classes.

FRA believes that the approach in this rulemaking minimizes the addition of detailed requirements for high cant deficiency operations in subparts C and D. Moreover, with one exception noted below, FRA has not found it necessary to amend this section on the scope of this part, because only certain requirements of subpart G apply to lower-speed track classes and only indirectly for high cant deficiency

operations by cross-referencing the requirements. FRA believes that this approach is consistent with the organization of this part; for example, the 1998 Track Safety Standards final rule revised § 213.57 to reference subpart G for when a track owner or railroad operating above Class 5 track speeds requests approval to operate at greater than 4 inches of cant deficiency on curves in Class 1 through 5 track contiguous to the high-speed track. *See* 63 FR 33992, 34033.

In the NPRM, FRA invited both comment on the proposal and suggestions for any alternative approach for maintaining the ease of use of this part, including whether the subpart headings should be modified to make their application clearer to the rail operations they address, and, if so, in what way(s). FRA did receive a comment from the AAR suggesting that the phrase “Except as provided in section 213.65,” be added at the beginning of the second sentence in paragraph (a) of this section. The AAR noted that the second sentence in paragraph (a) provided that the requirements in part 213 apply to specific track conditions “in isolation,” while this rulemaking is adding new § 213.65 to address “combined” track alinement and surface deviations. Therefore, the AAR recommended adding the introductory text to make § 213.1 consistent with new § 213.65.

This final rule adopts the AAR’s recommendation to make this section consistent with the changes to this part. Yet, in this regard, more than § 213.65 is being added that addresses conditions existing in combination. For example, § 213.332 is also being added in subpart G to address combined track alinement and surface deviations for the higher-speed track classes, and the MCAT qualification requirements in new Appendix D address “combined perturbation.” As a result, the final rule modifies paragraph (a) by adding the introductory words “In general” at the beginning of the second sentence. While the requirements in this part do apply, in general, to track conditions existing in isolation, the provisions discussed above are not focused exclusively on track conditions in isolation, and this modification preserves flexibility for encompassing these and other similar provisions without specifically enumerating them. The Task Force, including the AAR, concurred with this modification to the final rule.

As a separate matter, FRA noted that it was not proposing to revise and re-issue the Track Safety Standards in full, as was done in the 1998 final rule. Instead, FRA is amending only certain

portions of the Track Safety Standards. Therefore, FRA explained in the NPRM that this final rule needs to ensure that both the new and revised sections appropriately integrate with those sections of this part that are not amended, and that appropriate time is provided to phase-in the new and amended sections. FRA noted that, in general, the Task Force recommended that both new and revised sections become applicable one year after the date the final rule is published, to allow the track owner or operating railroad, or both, sufficient time to prepare for and adjust to meeting the new requirements. Examples of such adjustments may include changes to operating, inspection, or maintenance practices, such as for compliance with §§ 213.57, 213.329, 213.332, 213.333 and 213.345, as amended.

FRA also explained that it was considering providing the track owner or operating railroad the option of electing to comply sooner with the new and amended requirements, upon written notification to FRA. FRA noted that such a request for earlier application of the new and amended requirements would indicate the track owner’s or railroad’s readiness and ability to comply with all of the new and amended requirements—not just certain of those requirements. Because of the interrelationship of the amendments, FRA believes that virtually all of them need to apply simultaneously to maintain their integrity. FRA invited comment on formalizing this approach for this final rule; however, no specific comment was received.

In preparing the final rule, FRA decided that the more appropriate way to implement the rule’s requirements is to make the rule effective 120 days after its publication, rather than generally make the revisions applicable one year after publication. While FRA did note in the NPRM that it intended the final rule to become effective 60 days after its publication, FRA also explained that since there cannot be two different sections of the same CFR unit in effect under the same section heading, a temporary appendix was being considered to separate revised sections from their former provisions to allow for continued compliance with those former sections for a track owner or railroad not electing to comply sooner with all of the revised sections of part 213. By lengthening the effective date of the final rule so that all of the changes go into effect simultaneously but at a later time, the rule is clearer and provides additional time in which to make preparations for complying with

the new requirements. FRA has further considered the preparations that may be necessary, including changes to operating, inspection, and maintenance practices, and believes that they can be completed (and implemented) within this period. In particular, FRA believes that it should take no more than a month of labor hours to prepare all of a railroad’s automated, vehicle-based inspection systems and software to measure and process the necessary parameters to determine compliance with this rule, based on the relatively limited changes to the existing safety limits and the number of new parameters that must be calculated. FRA also notes that the 1998 Track Safety Standards final rule took effect 90 days after its publication, *see* 63 FR 33991–33992, although certain provisions were made applicable at a later date.

#### Section 213.7 Designation of Qualified Persons to Supervise Certain Renewals and Inspect Track

This section recognizes that work on or about a track structure supporting heavy freight trains or passenger operations, or both, demands the highest awareness of employees of the need to perform their work properly. At the same time, the wording of this section has literally required that each individual designated to perform such work know and understand the requirements of this part, detect deviations from those requirements, and prescribe appropriate remedial action to correct or safely compensate for those deviations, regardless whether that knowledge, understanding, and ability with respect to all of this part were necessary for that individual to perform his or her duties. While qualified persons designated under this section have not been directly required to know, understand, or apply requirements applicable only to higher-speed track classes in subpart G (pursuant to § 213.1(b)), the addition of vehicle qualification and testing requirements for high cant deficiency operations in lower-speed track classes, in particular, adds a level of complexity that may be outside the purview of track foremen and inspectors in fulfilling their duties.

As a result, the Task Force recommended and FRA agrees that this rule add text clarifying that the requirements for a person to be qualified under this section concern those portions of this part necessary for the performance of that person’s duties. This section continues to require that a person designated under it possess the knowledge, understanding, and ability necessary to supervise the restoration and renewal of track, or to perform

inspections of track, or both, for which he or she is responsible. Yet, adding the text makes clear that the person is not required to know or understand specific requirements of this part not necessary to the fulfillment of that person's duties. In this regard, the AAR commented that these changes are particularly needed in light of the adoption of high cant deficiency requirements in this final rule. FRA does not believe that safety will be in any way diminished by these changes, and they were supported by the Task Force.

#### Section 213.14 Application of Requirements to Curved Track

This is a new section that is being added to help define the application of requirements for curved track, following publication of and comment on the NPRM. Rather than define what is meant by curved track in each section where requirements for curved track appear, FRA believes it more appropriate to provide the definition here for all of part 213. This new section states that, unless otherwise provided in this part, requirements specified for curved track apply only to track having a curvature greater than 0.25 degree. This definition is intended to apply in all sections where limits for curved track are specified, unless otherwise provided.

As further explanation, in its comments on the NPRM Bombardier observed that the track geometry alignment limits proposed in § 213.55(b) were those recommended by the Task Force, except for what was proposed as footnote 5—i.e., that curved track limits be applied only when track curvature is greater than 0.25 degree. See 75 FR 25957. Bombardier stated that this proposed footnote was not included in the rule text recommended by the Task Force and that FRA did not provide a technical justification for its inclusion in the proposed rule. Bombardier believed that this proposed footnote would only be applicable at very high speeds and would therefore be irrelevant. Consequently, Bombardier recommended the proposed footnote's deletion in § 213.55(b), as well as in the following sections regarding application of curved track limits: §§ 213.63(b), 213.327(b) and (c), and 213.331(a) and (b).

In discussing the proposed footnote with the Task Force, the Task Force recognized that the primary intent was to provide a definitive demarcation of curved track from tangent track so that track inspectors and automated track geometry measurement systems can properly apply the more stringent track geometry limits required for high cant

deficiency operation in track Classes 1 through 5. Continuing with the example of § 213.55, should track curvature be no greater than 0.25 degree, the limits in § 213.55(a) for tangent track apply. For practical consideration in the way curvature is determined, and based on dynamic simulations of VTI performance by and experience with Acela trainsets on Amtrak's Northeast Corridor, a 0.25-degree (15-minute) curvature was chosen as this demarcation. This same reasoning applies to the inclusion of this provision for the proper application of track geometry limits not only in § 213.55, but also in §§ 213.63, 213.327 and 213.331, as specifically cited by Bombardier. Therefore, the Task Force recommended applying this provision to each of these sections.

Additionally, in preparing the final rule FRA noted that since curved track limits apply elsewhere in this part, whether or not high cant deficiency operations are conducted over the track, this provision for determining when to apply curved track limits could apply to those sections as well. FRA examined all of part 213 and found it appropriate to apply this provision generally throughout the entirety of the part, unless otherwise specified. The Task Force concurred with this addition, but nevertheless recommended that FRA restate this section in subpart G to make clear that it applies together with the other provisions governing the high-speed track classes. FRA has therefore added an identical provision in subpart G; please see the discussion of § 213.313. FRA believes that these new sections will help to ensure that curved track limits are applied in a uniform and proper manner.

#### Subpart C—Track Geometry

##### Section 213.55—Track Alinement

This section specifies the maximum alinement deviations allowed for tangent and curved track in Classes 1 through 5. Alinement is the localized variation in curvature of each rail. On tangent track, the intended curvature is zero, and thus the alinement is measured as the variation or deviation from zero. In a curve, the alinement is measured as the variation or deviation from the "uniform" alinement over a specified distance. As proposed, the section heading has been modified so that it reads "Track alinement," instead of "Alinement," for clarity.

The former track alinement limits in this section have been redesignated as paragraph (a) and remain unchanged. Paragraph (b) has been added as a new provision containing tighter, single-

deviation geometry limits for operations above 5 inches of cant deficiency on curved track, and includes both 31-foot and 62-foot MCO limits. These limits are based on the results of simulation studies to determine the safe amplitudes of track geometry alinement variations. See *Technical Background*, Section IV.B, above. FRA believes that adding the track geometry limits in paragraph (b) is necessary to provide an equivalent margin of safety for operations at higher cant deficiency. FRA also notes that, as proposed, the requirements for track Classes 1 and 2 in paragraph (b) reference footnote 2 of paragraph (b), which provides that restraining rails or other systems may be required for derailment prevention.

As provided in § 213.14, limits for curved track in paragraph (b) apply only to track having a curvature greater than 0.25 degree. Consequently, it is unnecessary to add proposed footnote 5, which would have contained the same instruction. Please see § 213.14 for a full discussion of the application of curved track limits.

##### Section 213.57 Curves; Elevation and Speed Limitations

This final rule makes substantial changes to this section, which specifies the requirements for safe curving speeds in track Classes 1 through 5. Notably, changes have been made to the qualification requirements and approval procedures for vehicles intended to operate at more than 3 inches of cant deficiency. For consistency with the higher speed standards in subpart G, cant deficiency is no longer limited to a maximum of 4 inches in track Classes 1 through 5. Prior to this change, this section specified qualification requirements for vehicles intended to operate only up to 4 inches of cant deficiency on track Classes 1 through 5 unless the track was contiguous to a higher-speed track. Consequently, vehicles intended to operate at more than 4 inches of cant deficiency on routes not contiguous to a higher-speed track were only permitted to operate under a waiver in accordance with part 211 of this chapter. This section now includes procedures for such vehicles to operate safely at higher cant deficiencies without the necessity of obtaining a waiver.

Both portions of paragraph (a) are revised; the first portion is revised as proposed without any comment. The maximum elevation of the outside rail of a curve may not be more than 8 inches on track Classes 1 and 2, and 7 inches on track Classes 3 through 5. Formerly, the provision had been stated in terms of the maximum crosslevel of

the outside rail, with the same limits. As crosslevel is a function of elevation differences between two rails, and is specifically addressed by other provisions of this rule, specifically § 213.63, this clarification is intended to focus the provision on the maximum allowable elevation of a single rail.

Numerous comments were received on FRA's proposal concerning the second portion of paragraph (a), however, to restrict configuring track so that the outside rail of a curve is designed to be lower than the inside rail while allowing for a deviation up to the limits provided in § 213.63. In issuing the NPRM, FRA noted that the Task Force had recommended removing this portion of paragraph (a), which formerly stated that "[e]xcept as provided in § 213.63, the outside rail of a curve may not be lower than the inside rail." Concern had been raised in the Task Force that this statement potentially conflicted with the limits in § 213.63 for "the deviation from \* \* \* reverse crosslevel elevation on curves." Nonetheless, FRA had believed that these provisions complemented each other—rather than conflict—addressing both the designed layout of a curve and deviations from that layout through actual use. In the NPRM, FRA stated that the requirement in paragraph (a) was intended to be a design restriction against configuring track so that the outside rail of a curve is lower than the inside rail, while the limits at issue in § 213.63 were to govern local deviations from uniform elevation—i.e., from the designed elevation—that occur as a result of changes in conditions. However, as discussed below, FRA recognizes that its proposal should have been more complete, and FRA is modifying the final rule based on the comments received.

In commenting on the NPRM, SEPTA noted that there are at least two situations when it is desirable to incorporate minimal reverse elevation by design: (1) In grade crossings in which the roadway profile is opposed to the desired track elevation; and (2) in special trackwork where a turnout may be located in a slight curve which is opposite the turnout curve. SEPTA stated that in these situations incorporating reverse elevation may be desired to minimize the potential highway hazard in a grade crossing and properly accommodate connections to sidings and other facilities. Accordingly, SEPTA believed that criteria should be developed to permit a minimal amount of reverse superelevation by design.

NJ Transit also commented that the proposal would impact a significant number of switches in its system where

reverse elevation has been designed into curves. Specifically, NJ Transit cited switches in interlockings at several junctions such as its Roseville Avenue Interlocking, potentially impacting 65 daily trains destined to and from the Montclair Line; Amtrak's Hunter Interlocking, potentially impacting 53 daily NJ Transit trains destined to and from the Raritan Valley Line; its Far Hills Interlocking, potentially impacting 49 daily NJ Transit Gladstone Line trains; and other possible locations at junctions on the Northeast Corridor that would be potentially impacted. NJ Transit believed that future interlocking reconfigurations could also be affected if the physical characteristics preclude even the temporary location of a turnout in a curve that might involve reverse elevation, and therefore requested that the proposal not be adopted.

Likewise, Amtrak objected to the proposal, believing that it would represent a fundamental restructuring of basic track design and geometry tenets and that implementation of the proposed language would have enormous consequences for rail service (both passenger and freight) on the Northeast Corridor. Amtrak noted that there are more than 77 locations on the Northeast Corridor between Washington, Boston, and Harrisburg where reverse elevation exists in track by design. According to Amtrak, in the majority of these locations, the design has been in service for more than 100 years without causing any safety issues. Amtrak raised concern that compliance with the rule as proposed would engender myriad problems, such as forcing it to take large sections of the Northeast Corridor out of service that contain curves with reverse elevation by design. Amtrak cited the example of the River Interlocking north of Baltimore that would need to be taken out of service, inhibiting the Norfolk Southern Railway Company's access to the Port of Baltimore. Amtrak stated that reconstructing some or all of the existing reverse-elevated curves would be a massive, time-consuming and prohibitively expensive undertaking that would take years to implement and cost in excess of \$200 million.

The AAR also objected to the proposal, believing that it resulted from a misunderstanding as to when it is appropriate for the outside rail to be lower than the inside rail (for track Classes 5 and below). The AAR noted that there are times when, by design, the outside rail must be lower than the inside rail. For example, the AAR cited that at thousands of mainline locations the outside rail is lower than the inside rail where turnouts come off the

outsides of superelevated curves. According to the AAR, there is no realistic alternative to such designs, and they have been used for over a century. The AAR also cited the use of reverse superelevation on industrial or other tracks where there is a hard pull around sharp curves and reverse elevation is used to prevent "stringlining" derailments. The AAR maintained that FRA incorrectly asserted in the NPRM that § 213.63 is intended to address only those changes that occur "through actual use," stating that § 213.63 clearly is intended to address situations, as discussed above, that occur at the design stage as well. Nor did the AAR believe there to be a conflict between §§ 213.57(a) and 213.63. The AAR stated that § 213.57(a) addresses the general rule that the outside of the rail may not be lower than the inside of the rail, while § 213.63 addresses situations where the general rule does not apply. Noting that the proposed change was not part of the Task Force's consensus on the proposed rule, the AAR recommended that FRA either delete the second sentence in paragraph (a) or retain the original wording in the regulation.

After considering the comments on the proposal and discussing them with the Task Force, FRA is modifying the rule to state that the outside rail of a curve may not be lower than the inside rail by design, except when engineered to address specific track or operating conditions, and that the limits in § 213.63 apply in all cases. FRA continues to believe that the former rule text could give the mistaken impression that it is appropriate to design reverse elevation into curves as the nominal condition for all curves. Nonetheless, FRA appreciates the comments raised, noting that reverse elevation is designed into certain curves both out of necessity and for safety reasons. FRA did not intend its proposal to nullify such engineering design. As modified, the rule text addresses both the concerns raised by FRA and those raised by the commenters, and the Task Force concurred with the revision.

As explained in the discussion of specific comments and conclusions section of the preamble, above, what was proposed as paragraph (b) is not included in this final rule. Please see *Wheel Unloading from Wind on Superelevated Curves*, Section V.B., for an explanation of FRA's treatment of that proposal, as well as of paragraph (d), below. Instead, what was proposed as paragraph (c) is designated as paragraph (b) in this final rule.

As proposed, the  $V_{max}$  formula in paragraph (b) determines the maximum



allowable posted timetable operating speed for curved track based on the qualified cant deficiency (inches of unbalance),  $E_u$ , for the vehicle type. This final rule also amends paragraph (b) to reference a new footnote 2 to permit the vehicle type to operate at the cant deficiency for which it is approved,  $E_u$ , plus 1 inch, if the actual elevation of the outside rail,  $E_a$ , and the degree of track curvature,  $D$ , change as a result of track degradation. As modified, this paragraph is intended to provide a tolerance to account for the effects of local crosslevel or curvature conditions on  $V_{max}$  that may result in the actual cant deficiency exceeding the cant deficiency approved for the equipment, i.e., the actual operating speed may exceed the maximum allowable posted timetable operating speed. Without this tolerance, these track conditions could generate a limiting speed exception, and some railroads have adopted the approach of reducing the cant deficiency of the vehicle in order to avoid these exceptions. FRA believes that this 1-inch tolerance is supported by operational experience and complemented by related standards acting to mitigate safety concerns. For instance, the  $V_{max}$  formula is not intended to replace FRA's track geometry limits, which more clearly focus on individual track irregularities with shorter wavelengths. These track geometry limits apply independently and act independently to limit the maximum allowable speed for a track segment based on the condition of the track.

FRA noted in the NPRM that it was the consensus of the Task Force to clarify footnote 1 to state, in part, that actual elevation,  $E_a$ , for each 155-foot track segment in the body of a curve is determined by averaging the elevation for 11 points through the segment at 15.5-foot spacing—instead of for 10 points, as was stated in the original footnote. FRA explained that the Track Safety Standards Compliance Manual (Compliance Manual) provides that the “actual elevation and curvature to be used in the  $[V_{max}]$  formula are determined by averaging the elevation and curvature for 10 points, including the point of concern for a total of 11, through the segment at 15.5-[foot] station spacing.” See the guidance on § 213.57 provided in Chapter 5 of the Manual, which is available on FRA's Web site ([www.fra.dot.gov](http://www.fra.dot.gov)). FRA therefore believes that this clarification to footnote 1 makes the footnote more consistent with the manner in which the rule is intended to be applied.

In its comments on the NPRM, the AAR believed that FRA departed from

the RSAC consensus in proposing to change the way elevation is calculated. Further, the AAR did not find persuasive FRA's reliance on the Compliance Manual as a justification for changing the requirement, stating that the Compliance Manual is inconsistent with the rule text. In discussing these comments with the Task Force, the Task Force agreed that the proposed footnote be adopted in the final rule. While FRA stated in the NPRM that it was the consensus of the Task Force to clarify footnote 1, FRA recognizes that there was no such explicit consensus, as the AAR noted. Nevertheless, FRA believes that this clarification to footnote 1 does make the footnote more consistent with the manner in which the rule is intended to be applied, and it is not intended to add any requirement. In calculating elevation, 10 measurements are taken from the point of concern—5 on each side—so that 11 points are actually averaged, given that the point of concern is included in the calculated average. The AAR did not oppose adoption of this clarification after the Task Force discussion.

Former footnote 2 has been redesignated as footnote 3 without substantive change.

Paragraph (c), proposed as paragraph (d) in the NPRM, provides that all vehicle types are considered qualified for up to 3 inches of cant deficiency, as allowed by the former rule.

Paragraph (d), proposed as paragraph (e) in the NPRM, is being modified to specify the requirements for vehicle qualification over track with more than 3 inches of cant deficiency. Prior to this modification, “static lean” qualification requirements were specified for vehicles intended to operate up to an allowable 4 inches of cant deficiency on track Classes 1 through 5. These requirements limited the carbody roll to 5.7 degrees with respect to the horizontal when the vehicle was standing on track with 4 inches of superelevation, and limited the vertical wheel load remaining on the raised wheels to no less than 60 percent of their static level values and carbody roll to no more than 8.6 degrees with respect to the horizontal when the vehicle was standing (stationary) on track with 6 inches of superelevation. In the final rule, cant deficiency is no longer limited to a maximum of 4 inches in track Classes 1 through 5. The revised requirements, consistent with the higher-speed standards in § 213.329, limit the vertical wheel load remaining on the raised wheels to no less than 60 percent of their static level values and limit carbody roll for passenger cars to no more than 8.6 degrees with respect to the horizontal when the vehicle is

standing (stationary) on track with a uniform superelevation equal to the proposed cant deficiency. Consequently, the rule no longer imposes a 6-inch superelevation static lean requirement generally; rather, the amount of superelevation is dependent on the proposed cant deficiency. For example, if the proposed cant deficiency is 5 inches, the superelevation used for demonstrating compliance with this paragraph is also 5 inches.

The requirements in paragraph (d) may be met by either static or dynamic testing. In either case, the vehicle type must be tested in a ready-for-service condition. In consultation with the Task Force, FRA is clarifying that the vehicle type be tested in a ready-for-service condition, i.e., in the same vehicle/track performance condition in which it would be in passenger service. At the same time, FRA is clarifying paragraph (e), below, so that the load condition under which testing is performed is included in the description of the test procedure. For example, the vehicle type may or may not be loaded to simulate passengers on board, and this information would be necessary for a complete evaluation of the vehicle's performance.

As noted, the static lean test limits the vertical wheel load remaining on the raised wheels to no less than 60 percent of their static level values and limits the roll of a passenger carbody to 8.6 degrees with respect to the horizontal, when the vehicle is standing on track with superelevation equal to the proposed cant deficiency. The dynamic test limits the steady-state vertical wheel load remaining on the low rail wheels to no less than 60 percent of their static level values and limits the lateral acceleration in a passenger car to 0.15g steady-state, when the vehicle operates through a curve at the proposed cant deficiency. (Please note that steady-state, carbody lateral acceleration, i.e., the tangential force pulling passengers to one side of the carbody when traveling through a curve at higher than the balance speed, should not be confused with sustained, carbody lateral oscillatory accelerations, i.e., continuous side-to-side oscillations of the carbody in response to track conditions, whether on curved or tangent track.) This 0.15g steady-state lateral acceleration limit in the dynamic test is intended to provide consistency with the 8.6-degree roll limit in the static lean test, in that it corresponds to the lateral acceleration a passenger would experience in a standing vehicle whose carbody is at a roll angle of 8.6 degrees with respect to the horizontal. The former 5.7-degree roll limit, which

limited steady-state, carbody lateral acceleration to 0.1g, has been removed.

Measurements and supplemental research have indicated that a steady-state, carbody lateral acceleration limit of 0.15g is considered to be the maximum, steady-state lateral acceleration above which jolts from vehicle dynamic response to track deviations can present a hazard to passenger safety. While other FRA vehicle/track interaction safety criteria principally address external safety hazards that may cause a derailment, such as damage to track structure and other conditions at the wheel/rail interface, the steady-state, carbody lateral acceleration limit specifically addresses the safety of the interior occupant environment. For comparison purposes, it is notable that the International Union of Railways (UIC) Code 518, Testing and Approval of Railway Vehicles from the Point of View of Their Dynamic Behaviour—Safety—Track Fatigue—Ride Quality, Ed. 4 (2009), has adopted a steady-state, carbody lateral acceleration limit of 0.15g. FRA does recognize that making a comparison with such a specific limit in another body of standards needs to take into account what related limits are provided in the compared standards and what the nature of the operating environment is to which the compared standards apply. FRA therefore invited comment whether such a comparison is appropriate here—whether, for example, there are enhanced or additional vehicle/track safety limits that apply to European operations, either through industry practice or governing standards, or both.

In their comments on the NPRM, SNCF responded that, concerning curves and cant deficiency design, the limit of 0.15g for steady-state, carbody lateral acceleration is justified. SNCF stated that this value is usually considered a comfort limit for curve design and is the limit value accepted for passenger cars. SNCF further noted that for freight cars the accepted limit is 0.13g, and that, in European rules, the 0.15g value corresponds to an exceptional value of cant deficiency, while the recommended value is about 0.14g.

FRA notes that increasing the steady-state, carbody lateral acceleration limit from 0.1g to 0.15g allows for operations at higher cant deficiency on the basis of acceleration before tilt compensation is necessary. This increase in cant deficiency without requiring tilt compensation is larger for a vehicle design whose carbody is less disposed to roll on its suspension when subjected to an unbalance force, since carbody roll

on curved track has a direct effect on steady-state, carbody lateral acceleration. For example, a vehicle having a completely rigid suspension system ( $S = 0$ ) would have no carbody roll and could operate without a tilt system at a cant deficiency as high as 9 inches, at which point the steady-state, carbody lateral acceleration would be 0.15g, which would correlate to an 8.6-degree roll angle between the floor and the horizontal when the vehicle is standing on track with 9 inches of superelevation. The suspension coefficient “S” is the ratio of the roll angle of the carbody on its suspension (measured relative to the inclination of the track) to the cant angle of the track (measured relative to the horizontal) for a stationary vehicle standing on a track with superelevation. A suspension coefficient of 0 is theoretical but neither practical nor desirable, because of the need for flexibility in the suspension system to handle track conditions and provide for occupant comfort and safety. Assuming that a car has some flexibility in its suspension system, say  $S = 0.3$ , the car could operate without a tilt system at a cant deficiency as high as approximately 7 inches, at which point the steady-state, carbody lateral acceleration would be 0.15g, which would correlate to an 8.6-degree roll angle between the floor and the horizontal when the vehicle is standing on track with 7 inches of superelevation. To operate at higher cant deficiencies and not exceed the limits, the vehicle would need to be equipped with a tilt system so that the floor actively tilts to compensate for the forces that would otherwise cause the limits to be exceeded.

Under the former FRA requirements, using the above examples, a vehicle having a completely rigid suspension system ( $S = 0$ ) could operate without a tilt system at a cant deficiency no higher than 6 inches, at which point the steady-state, carbody lateral acceleration would be 0.1g, which would correlate to a 5.7-degree roll angle between the floor and the horizontal when the vehicle is standing on track with 6 inches of superelevation. Assuming that a vehicle has some flexibility in its suspension system, again say  $S = 0.3$ , the vehicle could operate without a tilt system at a cant deficiency no higher than approximately 4.7 inches, at which point the steady-state, carbody lateral acceleration would be 0.1g, which would correlate to a 5.7-degree roll angle between the floor and the horizontal when the vehicle is standing on track with 4.7 inches of superelevation.

FRA notes that the less stringent steady-state, carbody lateral acceleration limit and carbody roll angle limit adopted in this final rule will minimize both the need to equip vehicles with tilt systems at higher cant deficiencies and the costs associated with such features, as well. Moreover, by facilitating higher cant deficiency operations, savings may also result from shortened trip times. These savings may be particularly beneficial to passenger operations in emerging high-speed rail corridors, enabling faster operations through curves.

Of course, any such savings should not come at the expense of safety, and FRA has adopted additional track geometry requirements for operations above 5 inches of cant deficiency, whether or not the vehicles are equipped with tilt systems. These additional track geometry requirements were developed to control for undesirable vehicle response to track conditions that could pose derailment concerns. Nonetheless, the VTI limits on transient accelerations may need to be stricter when combined with higher steady-state lateral acceleration, to address passenger ride safety concerns. Additional research regarding passenger response to vibration is needed to establish this relationship and model this effect. While the tighter geometry limits at high cant deficiency that have been added in this final rule were not specifically developed to address such concerns, they may help to control transient, carbody acceleration events that could pose ride safety concerns for passengers subjected to higher steady-state lateral accelerations. These additional track geometry requirements apply only to operations above 5 inches of cant deficiency, where steady-state, carbody lateral acceleration may approach 0.15g for typical vehicle designs. In this regard, during Task Force discussions, Amtrak stated that Amfleet equipment has been operating at up to 5 inches of cant deficiency (with approximately 0.13g steady-state, carbody lateral acceleration levels) without resulting in passenger ride safety issues. FRA is also not aware of any general safety issue involving passengers losing their balance and falling due specifically to excessive steady-state, carbody lateral acceleration levels in current operations.

Nonetheless, a transient carbody acceleration event that poses no derailment safety concern could very well cause a standing passenger to lose his or her balance and fall. Although FRA is not aware of much published data on the effect that transient, carbody acceleration events have on passenger

ride safety, it is recognized that the presence of steady-state, carbody lateral acceleration will generally reduce the margin of safety for standing passengers to withstand transient, lateral acceleration events and not lose their balance. If such passenger ride safety issues were more clearly identified, additional track geometry or other limits could potentially be proposed to address them. However, based on the information available to the Task Force, the Task Force did not recommend additional limits to address potential passenger ride safety concerns that may result from transient, carbody acceleration events either alone or when combined with steady-state, carbody lateral acceleration. The Task Force also took into account that, as one of several modes of transportation offered to the general public, rail travel need provide a level of passenger comfort to both attract and retain riders. As a result, the riding characteristics of passenger rail vehicles should by railroad practice be subject to acceptable criteria for passenger ride comfort, and such criteria for passenger ride comfort should be more stringent than those for passenger ride safety. Nonetheless, to fully inform FRA's decisions in preparing the final rule, FRA specifically invited public comment on this discussion in the NPRM and the proposal to set the steady-state, carbody lateral acceleration limit at 0.15g. FRA requested specific comment on whether the proposed rule appropriately provided for passenger ride safety, and if not, requested that the commenters state what additional requirement(s) should be imposed, if any.

As noted above, in commenting on the NPRM, SNCF agreed that the limit of 0.15g for steady-state, carbody lateral acceleration is justified in that this value is usually considered a comfort limit for curve design and is the limit value accepted for passenger cars. SNCF specifically commented that, in European rules, the 0.15g value corresponds to an exceptional value of cant deficiency, while the recommended value is about 0.14g. FRA sees no conflict with these comments; measurements and supplemental research have indicated that a steady-state, carbody lateral acceleration limit of 0.15g is considered to be the maximum, steady-state lateral acceleration above which jolts from vehicle dynamic response to track deviations can present a hazard to passenger safety. For the foregoing reasons, FRA has therefore adopted the proposal in the final rule.

The changes to this section also separate and clarify the submittal

requirements to FRA to obtain approval for the qualifying cant deficiency of a vehicle type (paragraph (e)) and to notify FRA prior to the implementation of the approved higher curving speeds (paragraph (f)). As discussed above, FRA is clarifying paragraph (e) so that the load condition under which the testing is performed is included in the description of the test procedure. Additional clarification in paragraph (e) has been included for submitting suspension system maintenance information. The requirement for submitting suspension system maintenance information applies to vehicle types not subject to parts 238 or 229 of this chapter, such as a freight car operated in a freight train, and then only to safety-critical components. Paragraph (f) also clarifies that in approving the request made pursuant to paragraph (e), FRA may impose conditions necessary for safely operating at the higher curving speeds.

Former footnote 3 is being redesignated as footnote 4 and modified in conformance with the changes in this final rule. Former footnote 3 reflected that this section previously allowed a maximum of 4 inches of cant deficiency; hence, the static lean test requirement to raise and lower the car on one side by 4 inches. Former footnote 3 also specified a cant excess requirement to raise and lower the car on one side by 6 inches. As proposed, FRA is removing the 4-inch limit on cant deficiency, and the cant-excess requirement has been addressed, as explained above. Thus, this footnote, now footnote 4, refers to "the proposed cant deficiency" instead of 4 inches of cant deficiency. FRA also notes that, as proposed, it has removed the statement in the former footnote that the "test procedure may be conducted in a test facility." Testing may of course be conducted in a test facility, but the statement could cause confusion that testing may be conducted only in a test facility. No such limitation is intended. Separately, FRA has slightly modified the footnote from that proposed in the NPRM based on a concern raised during the Task Force's consideration of the draft final rule. The test procedure's testing sequence could be wrongly construed to indicate that the roll angle is measured after the wheels are lowered; FRA agrees and has corrected this ambiguity.

Former paragraph (e) is being moved to new paragraph (g), which was proposed as paragraph (h) in the NPRM. As revised, this paragraph (g) is identical to two other provisions in this final rule: § 213.329(g)—the subpart G counterpart to this section—and § 213.345(i). Please see the discussion of

§ 213.345(i), below. The Task Force agreed that the purpose of these provisions is the same and therefore recommended that the same text be included. FRA agrees and has modified the rule accordingly.

Paragraph (h) was proposed as paragraph (j) in the NPRM to clarify that vehicle types that have been permitted by FRA to operate at cant deficiencies,  $E_u$ , greater than 3 inches prior to the date of publication of the final rule in the **Federal Register** would be considered qualified under this section to operate at those permitted cant deficiencies over the previously operated track segment(s). Consequently, before the vehicle type could operate over another track segment at such cant deficiencies, FRA proposed that the vehicle be qualified as provided in this section. FRA made a similar proposal in § 213.329(i) (now § 213.329(h)).

In commenting on the NPRM, Amtrak stated the tests proposed in this section and in § 213.329 for the higher-speed track classes would be wasteful to repeat because, unlike the tests proposed for § 213.345, the tests proposed here would not have been conducted under "local" conditions but rather in a static testing facility having no connection to the location of the proposed service. Amtrak therefore wondered what types of conditions FRA believed would be uncovered during this testing process before permitting the vehicle types to operate at the same cant deficiencies on other track segments. Amtrak believed that it would be simply repeating the exact same test on the exact same car at the exact same test facility, and therefore found it difficult to find any justification for the proposed limitation.

FRA discussed the proposal and the comments received with the Task Force. The Task Force recommended that vehicle types that have been permitted by FRA to operate at cant deficiencies,  $E_u$ , greater than 3 inches but not exceeding 5 inches be considered qualified under this section to operate at those permitted cant deficiencies over all track segments—not only over previously operated segments. FRA agrees that extending the nature of the qualification in this way is appropriate given that the requirements of this section are static or steady-state and do not directly reflect the "local" interaction of the vehicle and the track. Paragraph (h)(1) adopts this recommendation, and FRA makes clear that it applies not only to previous permission by FRA to operate at these cant deficiencies, but also prospectively to vehicle types when they are approved

by FRA to operate at these cant deficiencies. Nonetheless, a requirement has been included in paragraph (h)(1) that written notice be provided to FRA no less than 30 calendar days prior to the proposed implementation of such curving speeds on another track segment in accordance with paragraph (f) of this section. This notice is intended to identify the new track segment(s) so that FRA is aware of the proposed operation, can ensure that appropriate permission has been provided for it, and otherwise administer the requirements of this rule.

FRA notes that pursuant to paragraph (i) of this section and § 213.345, Vehicle/track system qualification, dynamic testing is required when moving a vehicle type to a new track segment for operation at cant deficiencies exceeding 5 inches. Accordingly, paragraph (h)(2) makes clear that vehicle types that have been permitted by FRA to operate at cant deficiencies,  $E_u$ , greater than 5 inches shall be considered qualified under this section to operate at those permitted cant deficiencies only for the previously operated or identified track segments(s). Please also see the discussion regarding § 213.329(h).

As proposed, paragraph (i) is being added to reference pertinent sections of subpart G—namely, §§ 213.333 and 213.345—that contain requirements related to operations above 5 inches of cant deficiency. These sections include requirements for periodic track geometry measurements, monitoring of carbody acceleration, and vehicle/track system qualification. Specifically, in § 213.333(c)(1), FRA has added periodic inspection requirements using a Track Geometry Measurement System (TGMS) to determine compliance with § 213.53, Track gage; § 213.55(b), Track alinement; § 213.57, Curves; elevation and speed limitations; § 213.63, Track surface; and § 213.65, Combined track alinement and surface deviations. In sharper curves, for which cant deficiency was high but vehicle speeds were reflective of a lower track class, it was found that stricter track geometry limits were necessary, for the same track class, in order to provide an equivalent margin of safety for operations at higher cant deficiency. As proposed in the NPRM, FRA has also added periodic monitoring requirements for carbody accelerations, to determine compliance with the VTI safety limits in § 213.333. Moreover, the vehicle/track system qualification requirements in § 213.345 apply to vehicle types intended to operate at any curving speed producing more than 5 inches of cant deficiency, and include, as appropriate, a

combination of computer simulations, carbody acceleration testing, truck acceleration testing, and wheel/rail force measurements. FRA believes that these requirements are necessary to apply to operations at high cant deficiency on lower-speed track classes. Section 213.369(f) is also referenced, to make clear that inspection records be kept in accordance with the requirements of § 213.333, as appropriate.

Paragraph (j), which was proposed as paragraph (k) in the NPRM, is being added as a new paragraph to define “vehicle” and “vehicle type,” as used in this section. As the term “vehicle” is used elsewhere in this part and has a different meaning than the term “vehicle type,” both terms are defined here for the purposes of this section so that this section’s requirements may be properly understood and applied.

#### Section 213.59 Elevation of Curved Track; Runoff

This final rule makes a conforming change to this section’s reference to § 213.57(b), to reflect the changes adopted in that section. The need for this conforming change had been overlooked in the proposed rule. However, the AAR notified FRA and other Task Force members of the omission and suggested change during RSAC consideration of the final rule, and no objection was raised. FRA agrees that the language should conform so as to avoid confusion, and has modified paragraph (a) of this section accordingly. No other change is intended.

#### Section 213.63 Track Surface

Track surface is the evenness or uniformity of track in short distances measured along the running surface of the rails. Under load, the track structure gradually deteriorates due to dynamic and mechanical wear effects of passing trains. Improper drainage, unstable roadbed, inadequate tamping, and deferred maintenance can create surface irregularities, which can lead to serious consequences if ignored.

As proposed in the NPRM, this section is divided into two paragraphs. What was formerly the entirety of this section (the introductory text, table, and footnotes) is re-designated as paragraph (a). Paragraph (a) generally mirrors the former section but substitutes the date “June 22, 1998” for the words “prior to the promulgation of this rule” in the asterisked portion of the table concerning the variation in crosslevel on spirals due to physical restrictions on spiral length and operating practices and experience as determined by prior

engineering decisions. The asterisk was included in the 1998 final rule and refers to that final rule, which was promulgated on June 22, 1998, to address the practice on some railroads to design a greater runoff of elevation in spirals due to physical restrictions on the length of spirals. Spiral runoff in construction after the promulgation of that final rule must be designed and maintained within the generally-applicable limits identified in the table for the difference in crosslevel. Consequently, FRA has clarified this section so that the asterisked text effectively continues to refer to the 1998 final rule—not this very final rule.

The primary substantive change to this section is the addition of new paragraph (b), which contains tighter, single-deviation geometry limits for operations above 5 inches of cant deficiency on curved track. These limits include both 31-foot and 62-foot MCO limits and a new limit for the difference in crosslevel between any two points less than 10 feet apart. FRA believes that adding these track geometry limits is necessary to provide an equivalent margin of safety for operations at higher cant deficiency. These limits are based on the results of simulation studies to determine the safe amplitudes of track geometry surface variations. See *Technical Background*, Section IV.B, above.

FRA did not receive any comment on this section, other than the comment raised by Bombardier and discussed in § 213.14 as to the inclusion of proposed footnote 4 specifying that curved track surface limits apply only when track curvature is greater than 0.25 degree. As noted in the discussion of § 213.14, the text of the proposed footnote has been adopted as § 213.14 primarily to distinguish curved track from tangent track so that track inspectors and automated track geometry measurement systems can properly apply the more stringent track geometry limits required for high cant deficiency operation in track Classes 1 through 5. Should track curvature be less than 0.25 degree, the limits in paragraph (a) apply. Consequently, all of the proposals in this section have effectively been adopted in this final rule without substantive change.

#### Section 213.65 Combined Track Alinement and Surface Deviations

As proposed in the NPRM, FRA is adding this new section containing limits addressing combined track alinement and surface deviations for operations above 5 inches of cant deficiency on curved track. (In preparing the final rule, FRA added

“track” to the section heading for consistency with the section headings for § 213.55, Track alinement, and § 213.63, Track surface.) An equation-based safety limit is provided for track alinement and surface deviations occurring in combination within a single chord length of each other. The limits in this section are intended to be used only with a TGMS, and applied on the outside rail in curves.

Although the Track Safety Standards have prescribed limits on geometry variations existing in isolation, FRA has recognized that a combination of track alinement and surface variations, none of which individually amounts to a deviation from the requirements in this part, may nevertheless result in undesirable vehicle response. Moreover, trains operating at high cant deficiencies increase the lateral wheel force exerted on track during curving, thereby decreasing the margin of safety associated with the VTI safety limits in § 213.333. To address these concerns, simulation studies were performed to determine the safe amplitudes of combined track geometry variations. See *Technical Background*, Section IV.B, above. Results of this research showed that the addition of this equation-based safety limit is necessary to provide a margin of safety for vehicle operations at higher cant deficiencies.

One comment was raised on this section following publication of the NPRM. Bombardier commented that the references in the proposed equation identifying variables  $A_L$  and  $S_L$  should be clarified if the intent is to use the alinement and surface limits in §§ 213.55(a) and 213.63(a), respectively, when operating at cant deficiencies greater than 5 inches in curves not exceeding 0.25 degree. Bombardier noted that, alternatively, if its recommendation to remove the footnote concerning the application of curved track limits in §§ 213.55(b) and 213.63(b) were accepted, this concern would be resolved.

In response to this comment and as a result of Task Force discussions following publication of the NPRM, FRA has added § 213.14 to make clear that limits specified for curved track apply only to track having a curvature greater than 0.25 degree. As discussed in § 213.14, by defining curved track as track having a curvature greater than 0.25 degree, the rule makes clear when the requirements for curved track apply. This section is therefore adopted as proposed without substantive change.

#### Section 213.110 Gage Restraint Measurement Systems

This section specifies procedures for using a Gage Restraint Measurement System (GRMS) to assess the ability of track to maintain proper gage. As proposed, FRA has amended this section to make it consistent with the changes to the GRMS requirements in § 213.333, the counterpart to this section in subpart G. Specifically, FRA has replaced the former Gage Widening Ratio (GWR) with the Gage Widening Projection (GWP), which is intended to compensate for the weight of the testing vehicle. FRA believes that use of the GWP provides at least the same level of safety, and its inclusion is supported by research results documented in the report titled “Development of Gage Widening Projection Parameter for the Deployable Gage Restraint Measurement System” (DOT/FRA/ORD–06/13, October 2006), which is available on FRA’s Web site. Moreover, by making the criteria consistent with the changes to the GRMS requirements in § 213.333, a track owner or railroad does not need to modify a GRMS survey to calculate the GWR for track Classes 1 through 5, and then separately calculate the GWP for track Classes 6 through 9. The same GWP formula applies, regardless of the class of track.

In substituting GWP for GWR, FRA has also made a number of conforming changes to this section, principally to ensure that the terminology and references are consistent. These changes are generally more technical than substantive, and they are neither intended to diminish nor add to the requirements of this section. In this regard, as proposed in the NPRM, FRA has corrected the table in paragraph (l) to renumber the remedial action specified for a second level exception. The remedial action should have been designated as (1), (2), and (3) in the “Remedial action required” column, consistent with the manner in which remedial action is specified for a first level exception—not designated as footnote 2, (1), and (2). In addition, in preparing the final rule, FRA has reformatted the table to distinguish more clearly between first level and second level exceptions.

FRA has also added footnote 5 to this section, as proposed in the NPRM, stating that “GRMS equipment using load combinations developing L/V ratios that exceed 0.8 shall be operated with caution to protect against the risk of wheel climb by the test wheelset.” This footnote is identical in substance to what is now designated as footnote 10 (formerly footnote 7), which applies to

§ 213.333, Automated vehicle-based inspection systems, thereby promoting conformity between this section and its subpart G counterpart.

Paragraph (e) has been modified from the proposal in the NPRM. In its comments on the NPRM, Bombardier stated that in proposed paragraph (e), it appeared that the formula for the extrapolation factor “A” may have been incorrect since the lateral load “L” and the vertical load “V” were expressed in kips—not pounds. In this regard, Bombardier also suggested changing the proposed text describing the 24,000-pound lateral load and 33,000-pound vertical load to express the loads in kips, for consistency. The Task Force concurred with Bombardier’s comments and recommended revising the text and the equation accordingly. FRA agrees and is adopting the recommended changes in the final rule text. FRA is also making a conforming change to this section by modifying the text defining GWP in paragraph (p). Likewise, in § 213.333(i)(2), FRA is modifying the rule so that the units are correspondingly stated in kips.

#### Subpart G—Train Operations at Track Classes 6 and Higher

##### Section 213.305 Designation of Qualified Individuals; General Qualifications

This section recognizes that work on or about a track structure supporting high-speed train operations demands the highest awareness of employees of the need to perform their work properly. At the same time, the wording of this section has literally required that each individual designated to perform such work know and understand the requirements of this subpart, detect deviations from those requirements, and prescribe appropriate remedial action to correct or safely compensate for those deviations, regardless whether that knowledge, understanding, and ability with regard to all of subpart G were necessary for that individual to perform his or her duties. For example, knowledge and understanding of specific vehicle qualification and testing requirements may be unnecessary for the performance of a track inspector’s duties.

As a result, the Task Force recommended and FRA agrees that this rule clarify that the requirements for a person to be qualified under subpart G concern those portions of this subpart necessary for the performance of that person’s duties. This section continues to require that a person designated under it has the knowledge, understanding, and ability necessary to

supervise the restoration and renewal of subpart G track, or to perform inspections of subpart G track, or both, for which he or she is responsible. At the same time, adding the text makes clear that such a designated person is not required to know or understand specific requirements of this subpart not necessary to the fulfillment of that person's duties. FRA does not believe that safety is in any way diminished by these changes, and they were supported by the Task Force. FRA believes that these changes reflect what was intended when this section was established in the 1998 final rule.

#### Section 213.307 Classes of Track: Operating Speed Limits

The 1998 final rule added subpart G to provide for the operation of trains at progressively higher speeds up to 200 m.p.h. over four separate classes of track—Classes 6 through 9. Standards for the highest-speed track, Class 9 track, for speeds above 160 m.p.h. up to 200 m.p.h., were established looking ahead to the possibility that certain operations would achieve those speeds. In addition, a maximum limit of 160 m.p.h. was established for Class 8 track because trainsets had operated in this country safely up to that speed for periods of several months under waivers for testing and evaluation. See 63 FR 34015.

In developing the NPRM, the Task Force recommended that standards for Class 9 track be removed from this subpart and that the maximum allowable speed for Class 8 track be lowered from 160 m.p.h. to 150 m.p.h. Although it was viewed in the 1998 final rule that standards for Class 9 track were useful benchmarks for future planning with respect to vehicle/track interaction, track structure, and inspection requirements, the Task Force noted that operations at speeds in excess of 150 m.p.h. were authorized by FRA only in conjunction with a rule of particular applicability (RPA) addressing the overall safety of the operation as a system, per former footnote 2 of this section. It was thought that the vehicle/track interaction, track structure, and inspection requirements in an RPA would likely be specific to both the operation and the system components used, and track geometry measurement systems, safety criteria, and safety limits might be quite different than currently defined. The Task Force therefore recommended that the safety of operations above 150 m.p.h. be addressed using a system safety approach and regulated through an RPA specific to the intended operation, and that the safety

parameters in this subpart for general application to operations above 150 m.p.h. be removed.

Nonetheless, in the NPRM, FRA explained that it had identified the continued need for benchmark standards addressing the highest speeds likely to be achieved by the most forward-looking, high-speed rail projects. And, as a result, FRA and the Volpe Center had conducted additional research and vehicle/track interaction simulations at higher speeds and concluded that Class 9 vehicle/track safety standards can be safely extended to include the highest speeds proposed to date—speeds of up to 220 m.p.h. FRA therefore included these standards in the NPRM. FRA did note its intent to continue its discussions with the Task Force as any comments were addressed following the publication of the NPRM. FRA also noted that the Task Force did not consider a comprehensive revision of all of Subpart G, including those requirements that are not distinguished by class of track. In addition, FRA stated that the Class 9 standards would remain only as benchmark standards with the understanding that the final suitability of track safety standards for operations above 150 m.p.h. would be determined by FRA only after examination of the entire operating system, including the subject equipment, track structure, and other system attributes. FRA explained that direct FRA approval is required for any such high-speed rail operation, whether through an RPA or another regulatory proceeding.

As a separate matter, FRA noted that the rule would require the testing and evaluation of equipment for qualification purposes at a speed of 5 m.p.h. above the maximum intended operating speed, in accordance with § 213.345, and that, for example, this would require equipment intended to operate at Class 8 track's maximum speed of 160 m.p.h. to be tested at 165 m.p.h. Therefore, FRA made clear that operating at speeds up to 165 m.p.h. for vehicle qualification purposes under this subpart would necessarily be permitted to continue on Class 8 track, subject to the requirements for the planning and safe conduct of such test operations. These test operations are distinct from service operations on Class 8 track that would be limited to a maximum speed of 160 m.p.h.

Finally, FRA proposed to slightly modify the section heading so that it reads "Classes of track: operating speed limits," using the plural form of "class." This change is intended to make the section heading consistent with the heading for § 213.9, the counterpart to

this section for lower-speed track classes.

In its comments on the NPRM, Bombardier raised concern that FRA had not adopted the recommendation of the Task Force to remove standards for Class 9 track and reduce the maximum operating speed for Class 8 track to 150 m.p.h. In particular, Bombardier raised concern that FRA conducted research without the involvement of the Task Force, and that one of the principles used by the Task Force for evaluating any changes to the track geometry standards at high speed or high cant deficiency was to use representative vehicles that had actually been designed and qualified for such operations. Bombardier believed that the use of the Acela power car to determine track geometry standards for Class 9 track, by conducting simulations at 220 m.p.h. and 9 inches of cant deficiency, was inappropriate since the equipment was designed and qualified for operation at 150 m.p.h. Bombardier added that appropriate track geometry safety limits for speeds up to 220 m.p.h. can only be developed with a vehicle model that has been validated up to that speed, and that track standards developed based on an invalidated vehicle model could deter the implementation of some high-speed rail systems and provide a false sense of security.

Bombardier also noted that it was unsure what the term "benchmark standard" entails in a regulation and requested that FRA clarify this issue. Bombardier also asked for clarification as to FRA's statement that direct FRA approval is required for any such high-speed operation, whether through an RPA or another regulatory proceeding. Bombardier asked what other regulatory proceeding can be used, and noted that former footnote 2 indicated only an RPA proceeding. Bombardier reiterated the Task Force recommendation to eliminate track Class 9 requirements in all sections and to limit track Class 8 speeds to 150 m.p.h. Bombardier stated that safety standards for speeds above 150 m.p.h. should be contained in an RPA and be based on the maximum operating speed and specific equipment and track characteristics for the proposed high-speed rail system.

FDOT also commented on this section, and referenced the high-speed rail project then-planned for top speeds of 168 m.p.h. between Tampa and Orlando, and 186 m.p.h. between Orlando and Miami, Florida. FDOT understood that because the maximum operating speed would be above 150 m.p.h., the system would be regulated through an RPA that would be specific to the particular operation and

technology selected for this application. In this light, based on FRA's discussion in the NPRM and the need for FRA to ascertain the suitability of Class 9 standards for each proposed high-speed rail operation, it wasn't clear to FDOT whether the benchmark standards would prove beneficial or a deterrent to implementing high-speed rail in the United States. Noting FRA's intent to continue discussion with the Task Force, FDOT encouraged FRA and the Task Force to resolve any differences on this issue and to assure that the final rule will be compatible with the proven high-speed rail technologies and systems that will be contemplated for the high-speed rail systems planned in Florida and elsewhere in the United States. FDOT added that a final rule governing the operation of a high-speed rail system must be based on a systems approach that includes the characteristics of both the infrastructure and rolling stock. Consequently, to ensure compatibility of the various aspects of the system, the governing regulation should include requirements for such components as ballast and crossties, according to FDOT, and either be addressed in the Track Safety Standards or included in the governing RPA. FDOT expected that these requirements would be based on experience with proven high-speed rail systems around the world and with rolling stock compatible with "Tier V" operations, as defined in FRA's High-Speed Passenger Rail Safety Strategy.

Referencing FRA's mention in the NPRM of "flying ballast" as a potential issue for high-speed rail operations, FDOT also commented that slab track (ballastless track) is a modern form of track construction that has been used successfully throughout the world on various high-speed rail lines and would be considered as an option for the system then-planned in Florida. FDOT stated that this construction method not only addresses the flying ballast safety concern raised by FRA, it also brings several construction advantages and long-term performance benefits. Consequently, FDOT believed that any regulation governing high-speed rail operation should address the use of slab track. However, FDOT noted that it was not clear how this would be addressed by the NPRM, in that it appeared that the track geometry measurement systems, safety criteria, and inspection requirements contained in the NPRM were based on significant experience and simulations using ballasted track (and FRA-compliant Tier I and Tier II passenger equipment, in accordance with 49 CFR part 238). FDOT stated that

it is well known that allowable track geometry defects determined by simulation are highly dependent on both vehicle suspension and track stiffness characteristics and that, as such, the suitability of the safety geometry limits contained in the NPRM for high-speed equipment operating over slab track is very questionable, adding that the inspection and maintenance requirements for slab track are very different from those that are required for ballasted track. FDOT encouraged FRA to address this issue in the final rule or to clarify that the final rule only governs ballasted track. And, should the latter be the case, there would be a further need to regulate all vehicle/track interaction issues where slab track is used through an RPA.

The issues of the maximum speed limit for Class 8 track and standards for Class 9 track were the subject of much discussion within the Task Force. Ultimately, the Task Force concurred with FRA's proposal in the NPRM to maintain Class 8 track's maximum speed at 160 m.p.h., retain Class 9 track standards, and increase Class 9 track's maximum speed to 220 m.p.h. At the same time, the Task Force also concurred with revising footnote 2 of this section. As revised, footnote 2 provides that operating speeds in excess of 125 m.p.h. are authorized by this part only in conjunction with FRA regulatory approval addressing other safety issues presented by the railroad system. In addition, footnote 2 also provides that for operations on a dedicated right-of-way, FRA's regulatory approval may allow for the use of inspection and maintenance criteria and procedures in the alternative to those contained in this subpart, based upon a showing that at least an equivalent level of safety is provided.

The underlying purpose of footnote 2 is to indicate that compliance alone with the Track Safety Standards does not authorize operations at high speeds; other safety issues must be addressed in their own right for each high-speed rail system as elements of a comprehensive, system-safety-based regulatory approval and compliance program. While the reference in former footnote 2 to an RPA for regulating high-speed operations was appropriate when the Track Safety Standards were amended in 1998, based on subsequent developments, footnote 2 should more appropriately state that high-speed operations are subject to FRA regulatory approval. It is no longer necessary to specify that FRA regulatory approval be provided through an RPA. Likewise, this footnote should refer to high-speed rail operations as operations conducted at speeds above 125 m.p.h.—

not 150 m.p.h. Footnote 2 of this section was added together with the rest of subpart G to the Track Safety Standards in 1998—the year following FRA's issuance of a proposed RPA to establish safety standards for the Florida Overland eXpress (FOX) high-speed rail system. See 62 FR 65478, December 12, 1997. (The FOX rulemaking was terminated after the State of Florida withdrew financial support for the project, see 65 FR 50952, August 22, 2000.) Moreover, subpart G preceded the issuance of the Passenger Equipment Safety Standards in 1999, which require FRA regulatory approval for the operation of Tier II passenger equipment, i.e., passenger equipment operating at speeds above 125 m.p.h. and not exceeding 150 m.p.h. See, generally, 49 CFR 238.111(b) and 238.501, *et seq.* Amtrak's Acela operates at these Tier II speeds, and it has done so for over a decade through FRA approval. In this regard, FRA makes clear that the revisions to this footnote neither impose any new requirement on Acela, nor alter any aspect of FRA's regulatory approval of Acela.

Further, this very rulemaking on vehicle/track interaction was initiated before a more recent effort by FRA to consider and develop standards for the safe operation of another tier of high-speed rail service. That work is being carried out through the Engineering Task Force of the same RSAC Passenger Safety Working Group that has overseen the Vehicle/Track Interaction Task Force. FRA requested that the Engineering Task Force develop safety recommendations for the operation of passenger rail equipment at speeds up to 220 m.p.h., focusing on a new tier of passenger equipment safety standards in part 238: Tier III, which is predicated on passenger equipment operating in an exclusive right-of-way at speeds over 125 m.p.h., and in a shared right-of-way only at speeds not exceeding 125 m.p.h. This new tier of safety standards is intended to facilitate the nationwide deployment of a high-speed rail network, both maximizing the benefits inherent in dedicated high-speed rail operation while minimizing the costs involved by allowing for the sharing of infrastructure. These standards will expand FRA's overall regulatory framework for high-speed passenger rail safety, complementing FRA's existing standards for Tier II high-speed rail operations on shared rights-of-way. FRA has also been examining, with the assistance of RSAC, requirements for passenger railroad system safety planning that would further address safety issues in a comprehensive way,

and has issued a proposed rule to require commuter and intercity passenger railroads to develop and implement system safety programs (see 77 FR 55371; Sept. 7, 2012).

As noted, the Task Force concurred with the NPRM proposal to maintain Class 8 track's maximum speed at 160 m.p.h., retain Class 9 track standards, and increase Class 9 track's maximum speed to 220 m.p.h. Each of FRA's track classes is essentially based on the same foundation, with a set of progressively stricter safety limits as operating speeds increase. While standards for Class 9 track are the strictest, they follow the same fundamental approach as for the lowest-speed class of track, which is essential to support the operation of different types of rail service on the same track. Class 8 track speeds up to 160 m.p.h. have been validated not only through computer modeling, but also through actual testing and experience. FRA believes that retaining the 160-m.p.h. maximum speed is safe for supporting rail operations at that speed, given the requirements associated with Class 8 track speeds. Although FRA's passenger equipment safety standards in part 238 currently do not provide standards for operations above 150 m.p.h., FRA has been engaged in developing new Tier III high-speed safety standards for operations up to 220 m.p.h., as discussed above. FRA is also reexamining the current Tier II maximum speed of 150 m.p.h., which was established in 1999, with a view to safely extending that speed to permit higher-speed Tier II operations.

In retaining Class 9 track standards and extending the maximum speed to 220 m.p.h., footnote 2 now provides that for operations above 125 m.p.h. on a dedicated right-of-way, FRA's regulatory approval may allow for the use of inspection and maintenance criteria and procedures in the alternative to those contained in this subpart, based upon a showing that at least an equivalent level of safety is provided. This addition helps to place in clearer perspective what FRA intended by describing Class 9 track standards as "benchmark" standards in the NPRM, acknowledging the unique system attributes inherent in a dedicated right-of-way. Indeed, for this reason, the provision applies to Class 8 track in a dedicated right-of-way as well, allowing for FRA approval of alternative criteria and procedures that are appropriate and safe in such a defined operating environment. Moreover, together with the development of Tier III standards in Part 238, this provision is intended to harmonize the regulation of high-speed rail operations on dedicated rights-of-

way—facilitating innovation and efficiency, while protecting safety.

In addition, FRA intends to examine, with the assistance of RSAC members, those requirements of subpart G that it has not addressed in this rulemaking on vehicle/track interaction safety. FRA recognizes that while this rulemaking makes substantial revisions to the high-speed track standards in subpart G, it was not intended to result in a comprehensive revision of these standards. In this regard, FRA has noted that requirements in subpart G that are not distinguished by class of track, such as ballast, merit examination, which was amplified by FDOT in its comments concerning ballastless track. FRA is therefore interested in undertaking a future effort with the assistance of RSAC to consider revisions to subpart G not addressed in this rulemaking.

As a final matter, at the recommendation of the AAR, footnote 1 is being modified. Footnote 1 provides conditions under which freight may be transported at passenger train speeds. The second clause of footnote 1 references passenger locomotive axle loadings utilized in passenger service along with the freight. This clause is modified by adding the words "if any" after the reference to passenger service, to make clear that there need not be any passenger service on the same line with the freight service.

#### Section 213.313 Application of Requirements to Curved Track

This is a new section that is being added to help define the application of requirements for curved track, following publication of and comment on the NPRM. Please see the discussion of § 213.14, which is identical to this section. At the recommendation of Task Force members, FRA is restating this section in subpart G to make clear that it applies together with the other provisions in this subpart. Subpart G is intended to function as its own set of regulations governing any track identified as belonging to one of its (higher) track classes, and this section's addition is consistent with the comprehensiveness of this subpart.

#### Section 213.323 Track Gage

This section contains the minimum and maximum limits for gage, including limits for the change in gage within any 31-foot distance. As proposed in the NPRM, for Class 6 track FRA is modifying the limit for the change in gage within any 31-foot distance from 1/2 inch to 3/4 inch. During Task Force discussions in developing the NPRM, Amtrak had raised concern that for track constructed with wooden ties and cut

spikes, the 1/2-inch variation in gage limit was difficult to maintain. Tolerance values for the rail base, tie plate shoulders, and spikes can result in a 1/2-inch gage variation in track constructed with wooden ties, particularly due to daily temperature fluctuations of rail and associated heat-induced stresses. In response to Amtrak's concern, FRA conducted modeling of track with variations in gage up to 3/4 inch in 31-foot distances and found no safety concerns for the equipment modeled. Modeling was also conducted using 20 miles of actual measured track geometry with these variations in gage for speeds up to 115 m.p.h. without showing safety concerns for the equipment modeled. As a result, FRA believes that modifying this limit for the change of gage for Class 6 track, which has a maximum permitted speed of 110 m.p.h., will not diminish safety and reduces the burden on the track owner or railroad to maintain safe gage.

FRA notes that during Task Force consideration of the draft final rule, concern was raised by the AAR and Amtrak as to the application of the 1/2-inch limit for the change in gage within any 31-foot distance in Class 7 through 9 track. They suggested that clarification be provided to exclude up to a 1/4-inch, designed widening of the gage at switch point locations to enable the stock rail and the switch point to fit smoothly together. FRA believes that such an exclusion could have safety implications in these high-speed track classes, especially should the switch point geometry be poorly maintained, and that the need for such an exclusion would potentially arise only in very limited circumstances in these track classes, as perhaps when an emergency repair is made in a switch using wooden ties in place of concrete ties. Nonetheless, FRA agrees that an appropriate safety determination could be made upon inspection of the rail head profile at the local points of concern, and in applying the requirements will give consideration to design modifications that are made for the purpose of ensuring the proper functioning of switches where adjacent gage change occurs within 31 feet of the switch point. FRA will include such guidance in its Track Safety Standards Compliance Manual, which is available on FRA's Web site, as part of its overall revision of the Manual to reflect the changes made in this final rule.

No other issue was raised on this section, other than the general comment from Bombardier on the propriety of retaining Class 9 track standards. FRA has addressed Bombardier's comment in the general discussion of Class 9 track



standards in § 213.307. Consequently, FRA is adopting the rule text as proposed.

#### Section 213.327 Track Alinement

This section is the subpart G counterpart to § 213.55 and is intended for higher-speed track classes—Classes 6 through 9. As proposed, the section heading is being modified so that it reads “Track alinement,” instead of “Alinement,” for clarity.

Paragraph (a) remains substantively unchanged, as proposed in the NPRM.

FRA is revising the single-deviation, track alinement limits in paragraph (b) so as to distinguish between limits for tangent and curved track. Specifically, the 62-foot MCO limit for Class 6 curved track has been narrowed to  $\frac{5}{8}$  inch, while the tangent track limit remains at the value of  $\frac{3}{4}$  inch. This change is intended to provide consistency between the track alinement limits for track Classes 5 and 6, as the Class 5 limit for curved track in § 213.55 is  $\frac{5}{8}$  inch. The 62-foot MCO limits for Class 7 and Class 8 tangent track have been increased to  $\frac{3}{4}$  inch, while the curved track limits remain at the value of  $\frac{1}{2}$  inch. Further, the 124-foot MCO limit for Class 8 tangent track has been increased to 1 inch, while the curved track limit remains at the value of  $\frac{3}{4}$  inch. These changes are also based on the results of the simulation studies for determining safe amplitudes of track geometry alinement variations. See *Technical Background*, Section IV.B, above.

FRA is reformatting the table in paragraph (b) from that proposed in the NPRM. The AAR commented that the table in proposed paragraph (b) was missing a number of deviation limits for curved track that had been recommended by the Task Force. FRA believes that these limits were not clearly identified in the NPRM, and therefore appeared to have been omitted, due to the way the table was formatted for publication in the **Federal Register**. Consequently, the table is being revised to ensure that these values are properly displayed.

The former text of paragraph (c) has been moved to a new paragraph (d). In revised paragraph (c) FRA has added tighter, single-deviation geometry limits for operations above 5 inches of cant deficiency. These additions include 31-foot, 62-foot, and 124-foot MCO limits. The track geometry limits in revised paragraph (c) are based on the results of simulation studies to determine the safe amplitudes of track geometry alinement variations, discussed in Section IV.B above, which describes in particular the 124-foot MCO limit for Class 7 track.

FRA believes that adding these track geometry limits is necessary to provide an equivalent margin of safety for operations at higher cant deficiency.

FRA notes that Bombardier raised the same comment on this section as for other sections concerning the inclusion of proposed footnote 1 in paragraphs (b) and (c), specifying that curved track alinement limits apply only when track curvature is greater than 0.25 degree. In response to this comment and as a result of Task Force discussions following publication of the NPRM, FRA has added § 213.313 to make clear that limits specified for curved track apply only to track having a curvature greater than 0.25 degree, in lieu of adopting proposed footnote 1. By defining curved track as track having a curvature greater than 0.25 degree, the rule makes clear when the requirements for curved track apply.

As noted, the text of former paragraph (c) has been moved to new paragraph (d) and remains substantively unchanged.

FRA is adding new paragraph (e) to this section, as proposed. Paragraph (e) is an adaptation of footnotes 1 and 2 from § 213.55, and describes the ends of the chord and the line rail for purposes of complying with this section. Paragraph (e) applies to all of the requirements in this section and is consistent with current practice.

No other comment was received on this section, other than the general comment from Bombardier on the propriety of retaining Class 9 track standards. FRA has addressed Bombardier's comment in the general discussion of Class 9 track standards in § 213.307. Consequently, FRA adopts this section as proposed, with paragraph (b) reformatted and curved track defined in new § 213.313.

#### Section 213.329 Curves; Elevation and Speed Limitations

Determining the maximum speed that a vehicle may safely operate around a curve is based on the degree of track curvature, actual elevation, and amount of unbalanced elevation, where the actual elevation and curvature are derived by a moving average technique. This approach, as codified in this section, is as valid in the high-speed regime as it is in the lower-speed track classes, and § 213.57 is the counterpart to this section for track Classes 1 through 5. As in § 213.57, FRA has substantially revised this section, including both modifying and clarifying the qualification requirements and approval process for vehicles intended to operate at more than 3 inches of cant deficiency.

Paragraph (a) formerly provided that the maximum crosslevel on the outside rail of a curve may not be more than 7 inches. As proposed, this provision is being restated to provide that the maximum elevation of the outside rail of a curve may not be more than 7 inches. Crosslevel is a function of elevation differences between two rails, and is the focus of other provisions of this final rule, specifically § 213.331, Track surface. The clarification here is intended to limit the elevation of a single rail.

FRA is also revising the second requirement of paragraph (a), consistent with the revision to § 213.57(a). In the NPRM, FRA noted that the Task Force recommended moving to § 213.331 the second requirement of paragraph (a), which formerly provided that “[t]he outside rail of a curve may not be more than  $\frac{1}{2}$  inch lower than the inside rail.” Instead, FRA proposed that this requirement be re-written more clearly to restrict configuring track so that the outside rail of a curve is designed to be lower than the inside rail, while allowing for a deviation of up to  $\frac{1}{2}$  inch as provided in § 213.331, which also included a proposed limit for reverse crosslevel deviation. FRA explained in the NPRM that this requirement in paragraph (a) was intended to restrict configuring track so that the outside rail of a curve is lower than the inside rail, while the limits at issue in § 213.331 govern local deviations from uniform elevation—from the designed elevation—that occur as a result of changes in conditions. Rather than conflict, FRA stated these provisions complement each other, addressing both the designed layout of a curve and the deviations from that layout that result from actual use and wear.

The AAR commented on FRA's proposal to revise the second requirement of paragraph (a), stating that such a sweeping prohibition against the outside rail being lower than the inside rail is inappropriate. The AAR explained that turnouts off of gradual curves can have small reverse superelevation by design, even for track where speeds over 90 m.p.h. are permitted. The AAR also noted that the Task Force had recommended eliminating this requirement from paragraph (a), and that, if FRA were unwilling to adopt that recommendation, then the original language should be retained.

FRA has modified this provision to state that the outside rail of a curve may not be lower than the inside rail by design, except when engineered to address specific track or operating conditions, and that the limits in

§ 213.331 apply in all cases. FRA continues to believe that the former rule text could give the mistaken impression that it is appropriate to design reverse elevation into curves as the nominal condition for all curves. Nonetheless, FRA appreciates from the comments raised that reverse elevation is designed into certain curves both out of necessity and for safety reasons. FRA did not intend its proposal to nullify such engineering design—engineering design of which the track owner and railroad are aware in carrying out railroad operations and responsibilities safely. As modified, the rule text addresses both the concerns raised by FRA and those raised in the comments, and the Task Force concurred with this revision.

As explained in the discussion of specific comments and conclusions section of the preamble, above, what was proposed as paragraph (b) is not included in this final rule. Please see *Wheel Unloading from Wind on Superelevated Curves*, Section V.B., for a full explanation of FRA's treatment of that proposal. Rather, what was proposed as paragraph (c) is designated as paragraph (b).

As proposed, in paragraph (b) the  $V_{\max}$  formula determines the maximum allowable posted timetable operating speed for curved track based on the qualified cant deficiency (inches of unbalance),  $E_u$ , for the vehicle type. This paragraph also references a new footnote 7 to permit the vehicle type to operate at the qualified cant deficiency for which it is approved,  $E_u$ , plus  $\frac{1}{2}$  inch, if actual elevation of the outside rail,  $E_a$ , and degree of track curvature,  $D$ , change as a result of track degradation. This paragraph is intended to provide a tolerance to account for the effects of local crosslevel or curvature conditions on  $V_{\max}$  that may result in the operating cant deficiency exceeding that approved for the equipment, i.e., the actual operating speed may exceed the maximum allowable posted timetable operating speed. Without this tolerance, these track conditions could generate a limiting speed exception, and some railroads have adopted the approach of reducing the operating cant deficiency of the vehicle in order to avoid these exceptions. FRA believes that this  $\frac{1}{2}$  inch tolerance is supported by operational experience and complemented by related standards acting to mitigate safety concerns. For instance, the  $V_{\max}$  formula is not intended to replace FRA's track geometry limits, which more clearly focus on individual track irregularities with shorter wavelengths. These track geometry limits apply independently and act independently to limit the

maximum allowable speed for a track segment based on the condition of the track.

In addition, as proposed, former footnote 4 is being redesignated as footnote 6, and a statement within the former footnote is being removed regarding the application of the  $V_{\max}$  equation to the spirals on both ends of the curve if  $E_u$  exceeds 4 inches. The  $V_{\max}$  equation is intended to be applied in the body of the curve where the cant deficiency is the greatest, and the actual elevation and degree of curvature are determined according to the moving average techniques defined in footnote 6, as well as in footnote 8, discussed below. Within spirals, where the degree of curvature and elevation are changing continuously, local deviations from uniform elevation and degree of curvature are governed by the limits in § 213.327 and § 213.331.

Former footnote 5 is being redesignated as footnote 8 without substantive change.

Paragraph (c), which was proposed as paragraph (d) in the NPRM, provides that all vehicle types are considered to be qualified for up to 3 inches of cant deficiency, as allowed since the 1998 Track Safety Standards final rule.

Paragraph (d), which was proposed as paragraph (e) in the NPRM, is being modified to specify the requirements for vehicle qualification over track with more than 3 inches of cant deficiency in track Classes 6 through 9. This paragraph formerly specified two sets of static lean test requirements for vehicle qualification for more than 3 inches of cant deficiency. The first set of requirements limited both the vertical wheel load remaining on the raised wheels to no less than 60 percent of their static level values and the roll of a passenger carbody to 5.7 degrees with respect to the horizontal, for a vehicle standing on superelevation equal to the proposed cant deficiency. The second set of requirements addressed potential roll-over and passenger safety issues should a vehicle be stopped or traveling at very low speed on a curve with 7 inches of superelevation, by limiting both the vertical wheel load remaining on the raised wheels to no less than 60 percent of their static level values and the roll of a passenger carbody to 8.6 degrees with respect to the horizontal. In the final rule, the revised requirements, consistent with the revised standards in § 213.57 (for lower-speed track classes), limit both the vertical wheel load remaining on the raised wheels to no less than 60 percent of their static level values and carbody roll for passenger cars to no more than 8.6 degrees with respect to the

horizontal when the vehicle is standing (stationary) on track with a uniform superelevation equal to the proposed cant deficiency. Consequently, the rule no longer imposes a 7-inch superelevation static lean requirement generally; rather, the amount of superelevation is dependent on the proposed cant deficiency. For example, if the proposed cant deficiency is 6 inches, the superelevation used for demonstrating compliance with this paragraph is also 6 inches.

The requirements in paragraph (d) may be met by either static or dynamic testing, and are consistent with the requirements in § 213.57. As in § 213.57, the vehicle type must be tested in a ready-for service condition. In consultation with the Task Force, FRA is clarifying that the vehicle type be tested in a ready-for-service condition, i.e., in the same vehicle/track performance condition in which it would be in passenger service. At the same time, FRA is clarifying paragraph (e), below, so that the load condition under which testing is performed is included in the description of the test procedure. For example, the vehicle type may or may not be loaded to simulate passengers on board, and this information would be necessary for a complete evaluation of the vehicle's performance.

As noted, the static lean test limits the vertical wheel load remaining on the raised wheels to no less than 60 percent of their static level values and limits the roll of a passenger carbody to 8.6 degrees with respect to the horizontal, when the vehicle is standing on track with superelevation equal to the proposed cant deficiency. The dynamic test limits the steady-state vertical wheel load remaining on the low rail wheels to no less than 60 percent of their static level values and limits the lateral acceleration in a passenger car to 0.15g steady-state, when the vehicle operates through a curve at the proposed cant deficiency. This 0.15g steady-state lateral acceleration limit in the dynamic test is consistent with the 8.6-degree roll limit in the static lean test, in that it corresponds to the lateral acceleration a passenger would experience in a standing (stationary) vehicle whose carbody is at a roll angle of 8.6 degrees with respect to the horizontal. The former 5.7-degree roll limit, which limited steady-state, carbody lateral acceleration to 0.1g, has been removed.

FRA notes that the less stringent steady-state, carbody lateral acceleration limit and carbody roll angle limit adopted in this final rule will minimize both the need to equip vehicles with tilt

systems at higher cant deficiencies and the costs associated with such features, as well. Moreover, by facilitating higher cant deficiency operations, savings may also result from shortened trip times. These savings may be particularly beneficial to passenger operations in emerging high-speed rail corridors, enabling faster operations through curves.

Of course, any such savings should not come at the expense of safety, and FRA is adopting additional track geometry requirements for operations above 5 inches of cant deficiency, whether or not the vehicles are equipped with tilt systems. These additional track geometry requirements were developed to control for undesirable vehicle response to track conditions that could pose derailment concerns. Nonetheless, the VTI limits on transient accelerations may need to be stricter when combined with higher steady-state lateral acceleration, to address passenger ride safety concerns. Additional research on passenger response to vibration is necessary to establish this relationship and model this effect. While the tighter geometry limits at high cant deficiency that have been added in this final rule were not specifically developed to address such concerns, they may help to control transient, carbody acceleration events that could pose ride safety concerns for passengers subjected to higher steady-state lateral accelerations. These additional track geometry requirements apply only to operations above 5 inches of cant deficiency, where steady-state, carbody lateral acceleration may approach 0.15g for typical vehicle designs. FRA does note that higher cant deficiencies are necessary to support high-speed operations on curved track, and, as a result, the additional track geometry requirements contained in this final rule for such high cant deficiency operations are likely to be implicated. Moreover, FRA is not aware of any general safety issue involving passengers losing their balance and falling due to excessive steady-state, carbody lateral accelerations in current operations.

Yet, as explained in the discussion of § 213.57(d), FRA is concerned in particular about the effect transient, carbody lateral acceleration events that pose no derailment safety concerns may nonetheless have on passenger ride safety when combined with increased steady-state, carbody lateral acceleration forces. Consequently, to fully inform FRA's decisions in preparing this final rule, FRA specifically invited public comment on the proposal to set the steady-state, carbody lateral acceleration

limit at 0.15g. FRA requested specific comment on whether the proposed rule would appropriately provide for passenger ride safety, and if not, requested that the commenters state what additional requirement(s) should be imposed, if any.

As noted above, in commenting on the NPRM, SNCF agreed that the limit of 0.15g for steady-state, carbody lateral acceleration is justified in that this value is usually considered a comfort limit for curve design and is the limit value accepted for passenger cars. SNCF specifically commented that, in European rules, the 0.15g value corresponds to an exceptional value of cant deficiency, while the recommended value is about 0.14g. FRA sees no conflict with these comments; measurements and supplemental research have indicated that a steady-state, carbody lateral acceleration limit of 0.15g is considered to be the maximum, steady-state lateral acceleration above which jolts from vehicle dynamic response to track deviations can present a hazard to passenger safety. FRA has therefore adopted the proposal in the final rule.

The changes to this section also separate and clarify the submittal requirements to FRA to obtain approval for the qualifying cant deficiency of a vehicle type (paragraph (e)), and to notify FRA prior to the implementation of the approved higher curving speeds (paragraph (f)). As discussed above, FRA is clarifying paragraph (e) so that the load condition under which the testing was performed is included in the description of the test procedure. Additional clarification in paragraph (e) has been included for submitting suspension system maintenance information. This requirement for submitting suspension system maintenance information applies to vehicle types not subject to parts 238 or 229 of this chapter, such as a freight car operated in a freight train, and then only to safety-critical components. Paragraph (f) also clarifies that in approving the request made pursuant to paragraph (e), FRA may impose conditions necessary for safely operating at the higher curving speeds.

FRA notes that former footnote 6 is being redesignated as footnote 9 and modified in conformance with the changes in this final rule. The former footnote offered an example test procedure providing measurements for up to 6 inches of cant deficiency and 7 inches of cant excess. This footnote has been modified to reference testing at "the proposed cant deficiency," rather than a specific condition, consistent with the requirements of this section.

The cant-excess requirement has also been addressed, as explained above. In addition, FRA notes that it has removed the statement in the former footnote that the "test procedure may be conducted in a test facility." Testing may of course be conducted in a test facility, but the statement could cause confusion that testing may be conducted only in a test facility. No such limitation is intended.

Former paragraph (f) is being moved to new paragraph (g), which was proposed as paragraph (h) in the NPRM. As noted, paragraph (g) is identical to two other provisions in this final rule: § 213.57(g)—the counterpart to this section for lower-speed track classes—and § 213.345(i). The Task Force agreed that the purpose of these paragraphs is the same and recommended that the same text be included. FRA agreed and has modified the rule accordingly. Please see the discussion of § 213.345(i), below.

As discussed in § 213.57(h), paragraph (h) was proposed to be added as paragraph (i) to clarify that vehicle types that have been permitted by FRA to operate at cant deficiencies,  $E_u$ , greater than 3 inches prior to the publication of this final rule in the **Federal Register** would be considered qualified under this section to operate at those permitted cant deficiencies over the previously-operated track segments(s). Consequently, before the vehicle type could operate over another track segment at such cant deficiencies, FRA proposed that the vehicle type be qualified as provided in this section.

In commenting on the NPRM, Amtrak stated that this proposal implicated issues associated with vehicle qualification, and Amtrak referenced its comments concerning proposed § 213.345(b) and (d). Moreover, Amtrak stated that the tests proposed in this section, as in § 213.57 for lower-speed track classes, would be even more wasteful because, unlike the tests proposed for § 213.345, the tests proposed here would not have been conducted under "local" conditions but rather in a static testing facility having no connection to the location of the proposed service. Amtrak therefore wondered what types of conditions FRA believed would be uncovered during this testing process before permitting the vehicle types to operate at the same cant deficiencies on other track segments. Amtrak believed that it would be simply repeating the exact same test on the exact same car at the exact same test facility, and therefore found it difficult to find any justification for the proposed limitation.

As noted, FRA discussed the proposal and the comments received with the

Task Force. The Task Force recommended that vehicle types that have been permitted by FRA to operate at cant deficiencies,  $E_u$ , greater than 3 inches but not exceeding 5 inches be considered qualified under this section to operate at those permitted cant deficiencies over all track segments—not only over previously operated segments. As adopted in paragraph (h)(1), FRA agrees that extending the nature of the qualification in this way is appropriate for operations on Class 6 track given that the requirements of this paragraph are static or steady-state and do not directly reflect the “local” interaction of the vehicle and the track. Further, FRA makes clear that the provision applies not only to previous permission by FRA to operate at these cant deficiencies, but also prospectively to vehicle types when they are approved by FRA to operate at these cant deficiencies. Nonetheless, a requirement has been included in paragraph (h)(1) that written notice be provided to FRA no less than 30 calendar days prior to the proposed implementation of such curving speeds on another track segment in accordance with paragraph (f) of this section. This notice is intended to identify the new track segment(s) so that FRA is aware of the proposed operation, can ensure that appropriate permission has been provided for it, and otherwise administer the requirements of this rule.

However, FRA does note that pursuant to § 213.345, Vehicle/track system qualification, dynamic testing is required when moving a vehicle type to a new track segment for operation at cant deficiencies greater than 5 inches on Class 6 track, or greater than 3 inches on Class 7 through 9 track, to reflect the “local” interaction of the vehicle and the track over which it operates as a system. Accordingly, paragraph (h)(2) makes clear that vehicle types that have been permitted by FRA to operate at cant deficiencies,  $E_u$ , greater than 5 inches on Class 6 track, or greater than 3 inches on Class 7 through 9 track, shall be considered qualified under this section to operate at those permitted cant deficiencies only for the previously operated or identified track segments(s). Operation of these vehicle types at such cant deficiencies and track class on any other track segment is permitted only in accordance with the qualification requirements in this subpart.

Paragraph (i), proposed as paragraph (j), is a new paragraph for defining the terms “vehicle” and “vehicle type,” as used in this section and in §§ 213.333 and 213.345. As the term “vehicle” is used elsewhere in this subpart and has a different meaning than the term

“vehicle type,” both terms are defined here for the purposes of these sections so that these sections’ requirements may be properly understood and applied. These terms have the same meaning as in § 213.57(j).

#### Section 213.331 Track Surface

This section is the subpart G counterpart to § 213.63 and is intended for higher-speed track classes.

As proposed in the NPRM, FRA is making three changes to the single-deviation, track surface limits in paragraph (a). Specifically, the 124-foot MCO limit for Class 9 track has been reduced to 1 inch, based on a review of simulation results of Acela equipment performance. Further, the limit for the difference in crosslevel between any two points less than 62 feet apart has been reduced to  $1\frac{1}{4}$  inches for Class 8 track, and 1 inch for Class 9 track. These two changes are intended to provide more consistent safety limits and are based on simulation studies conducted for short warp conditions.

In addition, three new limits are being added to the single-deviation, track surface limits in paragraph (a). Two of these limits (deviation from zero crosslevel on tangent track, and reverse elevation for curved track), although not explicitly stated in the table in former paragraph (a), have effectively been applicable to track Classes 6 through 9 because these higher-speed track classes must at least meet the minimum geometry requirements for the lower-speed track classes. Specifically, the 1-inch limit for deviation from zero crosslevel on tangent Class 5 track, as specified in § 213.63, is being added as a limit for track Classes 6 through 9. Second, the  $\frac{1}{2}$ -inch reverse elevation limit for curved track, as formerly specified in § 213.329(a), is being moved to this paragraph (a). The third limit, a new limit for the difference in crosslevel between any two points less than 10 feet apart (short warp), is being added to paragraph (a) as well. FRA noted in the NPRM that the Task Force proposed that the existing 1-inch runoff limit for Class 5 track, as specified in § 213.63, be added for higher track classes. However, FRA believes that appropriate surface requirements have already been established in § 213.331 that address this runoff condition, and thus FRA believes it would be duplicative to include this 1-inch runoff limit separately in the text of this paragraph.

In its comments on this section, the AAR raised concern with the proposed addition in paragraph (a) of a new restriction on the deviation from zero crosslevel on tangent track. The AAR noted that the proposed requirement

parallels an existing entry in the corresponding table in § 213.63 for the lower-speed track classes but that there is a proviso contained in § 213.59(b) that makes allowances for elevation runoff in curves. Specifically, the proviso in § 213.59(b) states: “If physical conditions do not permit a spiral long enough to accommodate the minimum length of runoff, part of the runoff may be on tangent track.” The AAR believed that the proposed restriction on the deviation from zero crosslevel on tangent track needed a similar proviso, and recommended including the same text in this paragraph. Amtrak likewise raised this concern and made the same suggestion. The Task Force concurred with these commenters, recognizing that the additional text applies to the comparable provision for the lower-speed classes of track. FRA agrees and has included the text as footnote 2 to this section. Footnote numbering has been modified appropriately to reflect the addition of this new footnote 2.

As proposed, FRA is also adding tighter geometry limits for operations above 5 inches of cant deficiency in revised paragraph (b). These include 124-foot MCO limits and a new limit for the difference in crosslevel between any two points less than 10 feet apart (short warp). The text of former paragraph (b) is being moved to new paragraph (c). FRA believes that adding these track geometry limits is necessary to provide an equivalent margin of safety for operations at higher cant deficiency. These limits are based on the results of simulation studies to determine the safe amplitudes of track geometry surface variations. See *Technical Background*, Section IV.B, above.

As noted in § 213.313, FRA received comment on the inclusion of proposed footnote 3, specifying that curved track surface limits apply only when track curvature is greater than 0.25 degree. In response to this comment and as a result of Task Force discussions following publication of the NPRM, FRA is adding § 213.313 to make clear that limits specified for curved track apply only to track having a curvature greater than 0.25 degree. By defining curved track as track having a curvature greater than 0.25 degree, the rule clarifies when the requirements for curved track apply and makes the adoption of proposed footnote 3 unnecessary.

The remaining comment on this section was raised by Bombardier concerning the propriety of retaining Class 9 track standards. FRA has addressed Bombardier’s comment in the general discussion of Class 9 track standards in § 213.307.

### Section 213.332 Combined Track Alinement and Surface Deviations

As proposed in the NPRM, FRA is adding a new section containing limits addressing combined track alinement and surface deviations. These limits apply to high-speed operations on curved track above 5 inches of cant deficiency, as well as to any operation at Class 9 speeds. (In preparing the final rule, FRA added “track” to the section heading to be consistent with the section headings for § 213.327, Track alinement, and § 213.331, Track surface.) An equation-based safety limit is provided for track alinement and surface deviations occurring in combination within a single chord length of each other. The limits in this section are intended to be used only with a TGMS. These limits are applicable on the outside rail in curves, as well as to any of the two rails of a tangent section in Class 9 track. Please see the discussion of § 213.65, which is the companion provision to this section for lower-speed classes of track. Please also note that in accordance with § 213.313, the limits specified for curved track apply only to track having a curvature greater than 0.25 degree.

The only comment on this section was raised by Bombardier concerning the inclusion of standards for Class 9 track. Specifically, Bombardier stated that the inclusion of combined alinement and surface deviations on all Class 9 track, both on curves and on tangent track, was not reviewed by the Task Force. FRA believes that the standards are appropriate for Class 9 track; please see the general discussion of Class 9 track standards in § 213.307. Consequently, this section is being adopted as proposed without substantive change.

### Section 213.333 Automated Vehicle-Based Inspection Systems

FRA is making a number of significant changes to this section, which contains requirements for automated vehicle-based measurement systems—i.e., track geometry measurement systems, gage restraint measurement systems, and the systems necessary to monitor vehicle/track interaction (acceleration and wheel/rail forces). For clarity, FRA is revising the original section heading “Automated vehicle inspection systems” to reflect more clearly that the inspection systems are vehicle-based—not necessarily vehicles themselves—and are for inspecting track conditions and monitoring vehicle/track interactions.

In paragraph (a)(1), FRA is adding TGMS inspection requirements for low-

speed, high cant deficiency operations, which apply as required by § 213.57(i). FRA believes that these requirements are appropriate and necessary for operations at high cant deficiency on lower-speed track classes.

In paragraph (a)(2), FRA is also adding TGMS inspection requirements for Class 6 track, with two different inspection frequencies depending on the amount of cant deficiency. For operations at a qualified cant deficiency,  $E_c$ , not exceeding 5 inches, at least one inspection must be conducted each calendar year with not less than 170 days between inspections. If the qualified cant deficiency is more than 5 inches, then at least two inspections must be conducted each calendar year, with not less than 120 days between inspections.

In its comments on the NPRM, however, the AAR stated that the focus of the proposal was on operations with cant deficiency greater than 5 inches, and that there was no support in the record for TGMS inspection requirements on Class 6 track having less cant deficiency. Consequently, the AAR maintained that FRA should not adopt TGMS inspection requirements for Class 6 track where the cant deficiency is not greater than 5 inches.

FRA believes that TGMS inspection of Class 6 track is required for safety regardless of the operating cant deficiency. Nonetheless, the rule does take into account that for track with lower amounts of cant deficiency, the inspection need not be as frequent—only once per calendar year. Further, discussion within the Task Force in response to this comment revealed that, with the exception of a limited amount of Class 6 track in the state of New York owned by CSXT over which Amtrak operated, all other Class 6 track was inspected by Amtrak with a qualifying TGMS meeting the requirements of this final rule. FRA makes clear that an operating railroad may fulfill the requirements of this paragraph, even where it is not the track owner. In this regard, given that Amtrak currently operates over all Class 6 track, it may conduct TGMS inspections as the operating railroad on behalf of any owner of Class 6 track, and FRA does not foresee any change that would impact such an arrangement between a track owner and Amtrak or another high-speed passenger railroad operation. Moreover, as discussed below, FRA is modifying the requirements in the final rule to address issues raised by the AAR concerning a host freight railroad performing TGMS inspections of its track in its own right as the track owner.

Paragraph (a)(3) concerns TGMS inspections for Class 7 track. The former Class 7 track inspection frequency of twice within 120 calendar days with not less than 30 days between inspections is being reduced to not less than 25 days between inspections in this 120-day period. This change is intended to provide additional operational flexibility to fulfill the requirements and allow for more frequent inspections to be performed regularly, for example, on a monthly basis, with additional days in which to complete inspections that may be interrupted or not started as planned.

For Class 8 and 9 track in paragraph (a)(4), the former TGMS inspection frequency of twice within 60 calendar days with not less than 15 days between inspections is also being reduced to not less than 12 days between inspections in this 120-day period. This change is also intended to provide additional operational flexibility to fulfill the requirements and allow for more frequent inspections to be performed regularly, for example, on a bi-weekly basis, with additional days in which to complete inspections that may be interrupted or not started as planned.

In paragraph (b)(1), FRA proposed to retain the requirement that track geometry measurements be taken no more than 3 feet away from the contact point of wheels carrying a vertical load of no less than 10,000 pounds per wheel. In response, the AAR commented that this provision would exclude the use of current test platforms (including hi-rail geometry equipment) that do not meet this axle load, as well as the development and exploration of test platforms that do not meet this axle load. The AAR believed that, lacking justification for this requirement, it should be deleted. FRA also notes that Amtrak commented on proposed paragraphs (b) and (h) as together creating an internal inconsistency that would make compliance difficult. According to Amtrak, it uses a GRMS as its TGMS to take geometry measurements of record for its Class 8 track. Amtrak stated that proposed paragraph (b)(1) would require that the measurement be made within 3 feet of the 10,000-pound loaded axle and that this distance requirement is not attainable on vehicles using a contact geometry system such as a GRMS. Further, Amtrak stated that while it would be possible for an entity to comply with the requirements of both proposed paragraphs (b) and (h), Amtrak could not without incurring the time and expense of running two type of TGMS tests, where it now runs only one. Amtrak therefore suggested that a railroad be deemed in compliance with

paragraph (b)(1) when the railroad performs otherwise qualifying TGMS tests with a GRMS. Amtrak did add that while CSXT was the only freight railroad with track affected by paragraph (b), if high-speed operations do proliferate, freight railroads may find themselves unable to comply with the regulations, as proposed, because they would no longer be able to rely on their hi-rail-mounted TGMS equipment.

FRA notes that the actual text of paragraph (b)(1) as proposed in the NPRM was unchanged from the 1998 Track Safety Standards final rule. What was different was the proposal to expand the application of TGMS inspection requirements to more than track Classes 7 through 9, discussed above. As explained by the AAR in Task Force meetings, this change would make the TGMS requirements applicable to equipment used by CSXT for the inspection of Class 6 track. To address this concern, the text is being revised to allow for FRA approval to measure track geometry other than as specified in this paragraph. Further, the text is being revised to express the 10,000-pound wheel load in kips, for consistency with related provisions, as suggested by Bombardier in its comments on the NPRM. Consequently, as revised, paragraph (b)(1) states that track geometry measurements shall be taken no more than 3 feet away from the contact point of wheels carrying a vertical load of no less than 10 kips per wheel, unless otherwise approved by FRA. FRA believes that this modification also addresses Amtrak's concern by providing added flexibility for the use of different equipment that measures track geometry. FRA did not intend for a railroad to duplicate measurements to comply with both paragraphs (b) and (h). A railroad may use GRMS equipment to perform otherwise qualifying TGMS tests. In the circumstance raised by Amtrak in its comments on the NPRM, Amtrak does not need to repeat the testing performed using GRMS equipment with one of its TGMS vehicles as well.

In paragraph (b)(2), FRA proposed to amend the TGMS sampling interval so that the interval would not exceed 1 foot. FRA believed this proposal to be in line with current practice for providing sufficient data to identify track geometry perturbations. In commenting on the NPRM, however, the AAR stated that there is equipment in use that takes measurements at a 2-foot sampling rate, and that there is no showing that this equipment should be prohibited from taking measurements in this way. The AAR stated that in developing the NPRM the Task Force made no

recommendation to prohibit the use of a 2-foot sampling rate, and that FRA should not adopt this change. In addition, Amtrak stated that the 1-foot interval in proposed paragraphs (b)(2) and (c), as discussed below, would conflict with the requirement in paragraph (h)(1)(i) for GRMS equipment to take measurements within a 16-inch interval. Consequently, Amtrak stated that it could not meet the requirements of proposed paragraph (b) with its current GRMS equipment and operating practices.

FRA discussed this comment with the Task Force, and the Task Force concurred with modifying the provision to state that track geometry measurements shall be taken and recorded on a distance-based sampling interval at a nominal distance of 1 foot, not exceeding 2 feet. FRA agrees with the Task Force's recommendation, and in the final rule has expressed the 1-foot sampling interval as the preferable distance, all else being equal. Nonetheless, FRA recognizes that an allowance can be made for sampling at up to a 2-foot interval depending on the circumstances involved, and therefore railroads may continue to use equipment that samples within such a 2-foot interval. FRA has modified a related provision in paragraph (c), as discussed below. Further, the AAR requested that in this final rule, FRA make clear that the use of existing equipment that takes measurement samples on a time-based interval is permitted as long as the equipment produces a measurement within the specified distance-based sampling interval. Accordingly, FRA makes clear that equipment that takes measurement samples on a time-based interval at a rate that corresponds to the distance-based interval specified in this section indeed complies with this provision.

In paragraph (c), as proposed, FRA is specifying the application of the added TGMS inspection requirements for high cant deficiency operations on lower-speed track classes. These requirements in subpart G apply to vehicle types intended to operate at any curving speed producing more than 5 inches of cant deficiency, as provided in § 213.57(i). Requirements for track Classes 6 through 9 have been amended to reference § 213.332, the new section for combined track alignment and surface deviations. In addition, consistent with the modification of paragraph (b)(2), as discussed above, FRA is removing the proposed reference in paragraph (c) to measuring and processing track geometry parameters at an interval of no more than every 1 foot. While former paragraph (c) referenced a

2-foot interval, FRA is removing the distance reference altogether in paragraph (c), as it is adequately addressed in paragraph (b).

Paragraphs (d) through (f) remain unchanged.

During Task Force consideration of the draft final rule, it was noted that former paragraph (g) required the track owner to maintain for a period of one year following an inspection performed by a qualifying TGMS, a copy of the plot and the exception "printout" for the track segment involved. Given the proliferation of electronic information since the 1998 Track Safety Standards were issued, FRA's support for appropriate usage of electronic information to comply with FRA's requirements, and FRA's recognition that reports of exceptions do not necessarily need to be printed out, FRA has clarified the paragraph by replacing "exception printout" with "exception report." FRA has also modified the paragraph to apply the requirements expressly to railroads, as well as to track owners, consistent with the others changes in this rule to provide clearly for railroads to carry out the regulatory requirements, and not only track owners. The Task Force concurred with these revisions, which clarify FRA's intent.

As noted in the discussion of § 213.110, above, FRA is making changes to the GRMS testing requirements in paragraphs (h) and (i), to reflect recommendations made in the FRA report titled "Development of Gage Widening Projection Parameter for the Deployable Gage Restraint Measurement System." These changes include replacing the GWR equation (and all references to GWR) with a GWP equation, which is intended to compensate for the weight of the testing vehicle. This correction is also intended to result in more uniform strength measurements across the variety of testing vehicles that are in operation. FRA has also modified the Class 8 and 9 track inspection frequency of once per year with not less than 180 days between inspections to require at least one inspection per calendar year with not less than 170 days between inspections. This change is intended to provide additional operational flexibility in scheduling inspections.

In Bombardier's comments on the NPRM, in addition to its general concerns on the inclusion of track Class 9 standards, Bombardier raised specific concern that there was no justification for requiring GRMS to be operated over Class 9 track. Bombardier stated that if the track standards for Class 9 track were contained in an RPA, it would be

expected that the requirements specific to the operation, such as for ballast and the maximum number of allowable defective crossties, would result in a superior track structure than currently required. A GRMS requirement on this structure would result in a significant cost with no safety benefit, according to Bombardier.

FRA notes that the requirement to conduct GRMS testing on Class 9 track was established in the 1998 Track Safety Standards final rule and is not a new requirement. Nonetheless, FRA recognizes that the underlying issue raised by Bombardier relates to track inspection and maintenance standards for a high-speed operation on a dedicated right-of-way. This concern has been addressed in the revision to § 213.307, as discussed above. FRA's regulatory approval may allow for the use of inspection and maintenance criteria and procedures in the alternative to those contained in this subpart, including the GRMS inspection requirements in this paragraph, based upon a showing that at least an equivalent level of safety is provided.

FRA is making one change to paragraph (i) from that proposed in the NPRM by stating the GWP load in kips and not pounds, as suggested by Bombardier in its comments on the NPRM. The Task Force concurred that the units should be stated in kips for consistency among measurement units.

As proposed, FRA is revising the wording and requirements in paragraphs (j) and (k), which concern the monitoring of carbody and truck accelerations. Changes include adding the option to use a portable device when performing the acceleration monitoring, and clarifying the requirements for locating the carbody and truck accelerometers. In paragraph (j)(1), monitoring requirements have been added for operations above 5 inches of cant deficiency on track Classes 1 through 6. These requirements for monitoring high cant deficiency operations apply to vehicle types qualified to operate at any curving speed producing more than 5 inches of cant deficiency, as provided in § 213.57(i) and § 213.345(a), as appropriate. Indeed, these monitoring and qualification requirements for carbody accelerations are intended to be complementary, in the same way as the monitoring requirements for track Classes 7 through 9 are likewise intended to continue to apply to vehicles that have been qualified to operate under § 213.345.

Paragraph (j)(2) applies to operations at track Class 7 speeds, and requires that carbody and truck accelerations be

monitored at least twice within any 60-day period with not less than 12 days between inspections on at least one passenger car of each type that is assigned to the service. This paragraph essentially restates requirements applicable to operations on Class 7 track in former paragraph (k), reducing the minimum period between inspections in the 60-day period to not less than 12 days—from not less than 15 days in the former paragraph.

As discussed in Section IV.A, above, FRA is revising the requirement in former paragraph (j) to monitor carbody and truck accelerations each day on at least one vehicle in one train operating at track Class 8 and 9 speeds. Based on data collected to date and to reduce unnecessary burden on the track owner or railroad operating the vehicle type, this monitoring frequency has been reduced from a minimum of once per day to four times within any 7-day period for carbody accelerations, and twice within 60 days for truck accelerations. These requirements are now found in paragraph (j)(3).

In its comments on proposed paragraph (j), the AAR stated that it opposed the monitoring of carbody acceleration for any track class. The AAR stated that these accelerations are often caused by train handling and other normal events unrelated to the condition of the track. Requiring railroads to monitor carbody acceleration and address accelerometer measurements would divert resources from more productive safety endeavors, according to the AAR. Further, the AAR believed that, leaving aside the issue of whether there should be any monitoring of carbody accelerations, proposed paragraph (j) contained contradictory statements regarding the vehicle to be used for monitoring: the first sentence proposed the use of a vehicle having dynamic response characteristics that are representative of other vehicles assigned to the service, while paragraph (j)(1) proposed to require the use of at least one passenger car of each type that is assigned to the service. The AAR added that freight railroads do not possess passenger cars.

As a result of the AAR's comments and discussions within the Task Force, the text of paragraph (j) is being revised to make clear that the requirements apply as specified for the combination of track class, cant deficiencies, and vehicles subject to paragraphs (j)(1) through (3). Consequently, the acceleration monitoring requirements in paragraphs (j)(1) and (2) for speeds up to 125 m.p.h. do not apply to equipment operated in a freight train. In fact, the requirements of this section apply to

equipment operating in a freight train only at speeds above 125 m.p.h., per paragraph (j)(3), and only as appropriate; specifically, if no passenger carrying vehicles are assigned to the service, there are no passenger carrying vehicles to monitor. FRA also makes clear that, in the case of Amtrak's Acela service at track Class 8 speeds, the carbody acceleration monitoring requirements of paragraph (j)(3) require only one power car (locomotive), i.e., non-passenger carrying vehicle, and one trailer car (passenger coach) to be monitored. FRA recognizes that only one type of passenger carrying vehicle is currently assigned to this Acela service—the café cars, first class cars, and business class cars are all passenger carrying vehicles of the same dynamic response type.

In commenting on the NPRM, Amtrak stated that the proposal to revise paragraph (k)(1) to require accelerometers on the floor of a vehicle, as near to the center of a truck as practicable, would be a substantive change from the requirement to place them near the end of the vehicle at the floor level. Amtrak noted that accelerometers have been mounted under the floors of its vehicles in the machine bay on the centerline next to the trucks. Amtrak believed that placing the units on the floor would not be an option and would result in the creation of a tripping hazard in the center of the passenger aisle. Nor did Amtrak believe that there was a readily-available space to locate the accelerometers near the centerline within coach cars. Moreover, Amtrak was concerned with locating accelerometers where they could be subject to being kicked and influenced by dropped luggage, which could falsely indicate unsafe readings when there are none. Amtrak therefore requested that FRA retain the original language in paragraph (k) relating to placement of accelerometers.

FRA is revising this final rule in response to Amtrak's comment so that paragraph (k)(1) requires the accelerometers to be attached to the carbody on or under the floor of the vehicle, as near the center of a truck as practicable. FRA did not intend for the proposed text to create the concerns raised by Amtrak. FRA's intent in revising the text has been focused on placing the accelerometers near the center of a truck—not simply near the end of a vehicle. FRA did not intend in any way to remove the needed flexibility for a railroad to locate the accelerators on or under the floor. FRA has revised the rule text accordingly, and the Task Force concurred with this revision.

Paragraph (k)(2) is based on former paragraph (k) and provides that a device for measuring lateral accelerations shall be mounted on a truck frame at a longitudinal location as close as practicable to an axle's centerline (either outside axle for trucks containing more than 2 axles), or, if approved by FRA, at an alternate location. As proposed, a provision has been added to allow the track owner or operating railroad to petition FRA for an exemption from the periodic monitoring requirements in paragraph (j) for truck acceleration, after 2 years, or 1 million miles, whichever occurs first. FRA does note that, pursuant to § 238.427, truck acceleration is continuously monitored on each Tier II passenger vehicle in order to determine if hunting oscillations of the vehicle are occurring during revenue operation.

Paragraph (k)(3) is based on provisions in former paragraphs (j) and (k). Paragraph (j) formerly provided that each track owner have in effect written procedures for the notification of track personnel when on-board accelerometers on trains in Classes 8 and 9 indicate a possible track-related problem, and paragraph (k) formerly provided that for the periodic testing of equipment in track Classes 7 through 9, speeds would be reduced if the vehicle/track interaction safety limits were exceeded. In the NPRM, FRA sought to combine the two provisions, proposing that if any of the carbody lateral, carbody vertical, or truck frame lateral acceleration safety limits in this section's table of vehicle/track interaction safety limits is exceeded, appropriate speed restrictions be applied until corrective action is taken.

In its comments on the NPRM, Amtrak stated that the proposal in paragraph (k)(3) would have required Amtrak to issue a mandatory slow order when an accelerometer recorded an anomaly. Amtrak believed that the proposal was completely impractical and did not take into account the reality of accelerometer testing or railroad operations. Amtrak related the example of an Acela coach with a bad lateral damper that had recorded 57 separate "hits," asserting that under the proposal Amtrak would have been required to have placed slow orders on a large portion of the NEC, impacting all intercity and commuter rail operations. Amtrak stated that the original provision required Amtrak only to have a plan in place to handle accelerometer data issues, that the requirement had served Amtrak well, and that there was no evidence that mandatory slow orders would do anything but result in slower trains.

FRA is revising paragraph (k)(3) in consultation with the Task Force. Paragraph (k)(3) provides that if any of the carbody lateral, carbody vertical, or truck frame lateral acceleration safety limits in this section's table of vehicle/track interaction safety limits is exceeded, corrective action shall be taken as necessary. Paragraph (k)(3) also provides that track personnel shall be notified when the accelerometers indicate a possible track-related problem. FRA did not intend that a railroad issue a slow order merely because an accelerometer registers a "hit." FRA intended that corrective action be taken only as necessary for safety, and has modified the paragraph to make that clearer. Likewise, the requirement to provide notification to track personnel does not, in itself, require that a slow order must be issued. Overall, FRA believes that this paragraph reflects the intent of the former paragraphs and provides the necessary direction and flexibility to the track owner or railroad, or both, to respond appropriately when the accelerometers record that the safety limits in the VTI table have been exceeded.

FRA is modifying the requirement in paragraph (l) for conducting instrumented wheelset (IWS) testing on Class 8 and 9 track. IWS testing is no longer a general requirement applicable for all Class 8 and 9 track. Instead, the specific need to perform IWS testing shall be determined by FRA on a case-by-case basis, after reviewing a report submitted annually by the track owner or railroad detailing the accelerometer monitoring data collected in accordance with paragraphs (j) and (k) of this section. A thorough review of the Acela trainset IWS data, as well as consideration of the economics associated with the testing, revealed that there were significant cost and little apparent safety benefit to justify IWS testing as a general requirement on an annual basis. FRA believes that the testing and monitoring requirements in this section, as a whole, together with FRA's oversight and ability to impose IWS testing requirements as needed, are sufficient to maintain safety at a lower cost.

FRA is making conforming changes to paragraph (m), which, because of the revisions to this section, now requires that the track owner or railroad maintain a copy of the most recent exception records for the inspections required under paragraphs (j) and (k) of this section, and, as appropriate, paragraph (l) should IWS testing be required. FRA noted in publishing the NPRM that the Task Force did not

specifically propose to retain paragraph (m), seemingly because of the proposed addition in paragraph (l) of an annual requirement to provide an analysis of the monitoring data gathered for operations on track Classes 8 and 9. However, while the reporting requirement in paragraph (l) is new, it is intended to support the change to the IWS testing requirements so that IWS testing is no longer generally required for Class 8 and 9 operations, as discussed above. Moreover, the reporting requirement is only an annual one and, by virtue of applying only to Class 8 and 9 operations, does not address lower-speed operations.

At the recommendation of the Task Force, paragraph (m) is also being modified to make clear that exception data shall be maintained as a record, but not necessarily a printed record. Each railroad or track owner is in the best position to determine the most efficient and effective method for keeping this information, and FRA makes clear that the information may be maintained electronically. In this regard, § 213.369(f) requires that each vehicle/track interaction safety record required under § 213.333(g) and (m) be made available for inspection and copying by FRA, and § 213.369(e) sets forth conditions for maintaining records in an electronic system.

As proposed, substantial changes are being made to the content of the VTI safety limits table. In general, most of the limits have been clarified or updated. Specifically, the single wheel vertical load ratio limit has been tightened from 0.10 to 0.15 to ensure an adequate safety margin for wheel unloading.

The net axle lateral L/V ratio limit is being modified from 0.5, to  $0.4 + 5.0/V_a$ , so as to take into account the effect of axle load and more appropriately reflect the cumulative, detrimental effect of track panel shift from heavier vehicles. This net axle lateral load limit is intended to control excessive lateral track shift and is sensitive to a number of track parameters. The well-established, European Prud'homme limit is a function of the axle load and this sensitivity is desired to differentiate between coach car and heavier locomotive loads. The Volpe Center's TREDA (Track Residual Deflection Analysis) simulation work, testing at the Transportation Technology Center, Inc. (TTCI), and comparison to the Prud'homme limit all have indicated the dependence on axle load and the importance of initial, small lateral deflections. Representatives of the Task Force independently reviewed the Volpe Center analysis and concurred



with this change. The limiting condition allows for a small initial deformation and assumes a stable configuration with the accumulation of additional traffic.

Due to variations in vehicle design requirements and passenger ride safety, the carbody acceleration limits have been divided into separate limits for "Passenger Cars" and those for "Other Vehicles" (such as conventional locomotives). In addition, the carbody transient acceleration limits have been modified from 0.5g lateral and 0.6g vertical to the following: in the lateral direction, 0.65g for passenger cars and 0.75g for other vehicles; and, in the vertical direction, 1.0g for both passenger cars and other vehicles. These changes were developed after considerable research into the performance of existing vehicles during qualification testing and revenue operations. Overall, it was found that the carbody transient acceleration limits need not be as stringent to protect against events leading to vehicle or passenger safety issues.

Based on the small energy content associated with high-frequency acceleration events of the carbody, FRA is adding text to exclude any transient acceleration peaks lasting less than 50 milliseconds. Other changes include the addition of new limits for sustained carbody lateral and vertical oscillatory accelerations, as well as the addition of minimum requirements for sampling and filtering of the acceleration data. The sustained carbody oscillatory acceleration limits have been developed in response to a review of data that was obtained during qualification testing for the MARC-III multi-level passenger car, as discussed in Section IV.A. of the preamble. The sustained carbody oscillatory acceleration limits are 0.10g RMS<sub>r</sub> (root mean squared with linear trend removed) for passenger cars and 0.12g RMS<sub>r</sub> for other vehicles in the lateral direction, and 0.25g RMS<sub>r</sub> for both passenger cars and other vehicles in the vertical direction. These new limits require that the RMS<sub>r</sub> value be used in order to attenuate the effects of the linear variation in oscillatory accelerations resulting from negotiation of track segments with changes in curvature or grade by design, such as spirals. Root mean squared values shall be determined over a sliding 4-second window with linear trend removed and be sustained for more than 4 seconds. Acceleration measurements shall be processed through a low pass filter with a minimum cut-off frequency of 10 Hz, and the sample rate for oscillatory acceleration data need be at least 100 samples per second.

FRA is modifying the proposed requirement that peak-to-peak carbody vertical (transient) accelerations, measured as the algebraic difference between the two extreme values of measured acceleration in any 1-second time period, excluding any peak lasting less than 50 milliseconds, not exceed 1.0g for both "Passenger Cars" and "Other Vehicles." While the final rule retains the limit for "Passenger Cars" of 1.0g, the limit for "Other Vehicles" is changed to 1.25g.

In commenting on the NPRM, Bombardier stated that this limit had been an open issue with the Task Force prior to publication of the NPRM and that it should be discussed by the Task Force prior to promulgating this final rule. Further, in commenting on the proposed VTI safety limits, SNCF noted that it did not consider vertical car body acceleration as a safety limit. This issue was discussed with the Task Force, and FRA reevaluated relevant test data, including wheel/rail loads at the time of peak-to-peak acceleration. FRA does not believe that safety will be compromised by changing this limit to 1.25g.

The last set of changes to the VTI table concerns the truck lateral acceleration limit used for the detection of truck hunting. This limit is being tightened from 0.4g to 0.3g and specifies that the value must exceed that limit for more than 2 seconds. Analyses conducted by FRA have shown that this change will help to better identify the occurrences of excessive truck hunting, while excluding high-frequency, low-amplitude oscillations that do not require immediate attention. In addition, this revised limit requires that the RMS<sub>r</sub> value be used rather than the RMS<sub>m</sub> (root mean squared with mean removed) value. FRA believes that this revision will improve the process for analyzing data while the vehicle is negotiating spiral track segments. Separately, FRA notes that it has retained the entry in the "Parameter" column as "Truck Lateral"—rather than change it to "Truck Lateral Acceleration" as proposed in the NPRM. The original entry is stated appropriately and needs no modification.

#### Section 213.345 Vehicle/Track System Qualification

As part of the 1998 Track Safety Standards final rule, all (passenger and freight) rolling stock was required to be qualified for operation for its intended track class. Qualification testing was intended to demonstrate that the equipment not exceed the VTI limits specified in § 213.333 at any speed less than 10 m.p.h. above the proposed

maximum operating speed. An exception was provided for equipment that had already operated in specified track classes. Rolling stock operating in Class 6 track within one year prior to the promulgation of the 1998 final rule was considered qualified. Further, vehicles operating at Class 7 track speeds under conditional waivers prior to the promulgation of the 1998 final rule were qualified for Class 7 track, including equipment that was then operating on the Northeast Corridor at Class 7 track speeds.

FRA is making a number of significant changes to this section, whose heading is modified from "Vehicle qualification testing" to "Vehicle/track system qualification," to reflect more appropriately the interaction of the vehicle and the track over which it operates as a system. These changes include modifying and clarifying this section's substantive requirements, reorganizing the structure and layout of the rule text, and revising the qualification procedures. Among the specific changes, high cant deficiency operations on lower-speed track classes are subject to the requirements of this section in accordance with § 213.57(i).

FRA proposed that paragraph (a) require all vehicle types intended to operate at Class 6 speeds or above, or at any curving speed producing more than 5 inches of cant deficiency, to be qualified for operation for their intended track classes in accordance with this subpart. FRA also proposed that, for qualification purposes, the former over-speed testing requirement be reduced from 10 m.p.h. to 5 m.p.h. above the maximum proposed operating speed. FRA noted in the NPRM that it agreed with the Task Force's view that the former 10 m.p.h. over-speed testing requirement, which was established as part of the 1998 final rule, had become overly conservative based on improved speed control and display technology deployed in current operations.

In commenting on the proposal, the AAR stated that FRA insert language providing that where the maximum operating speed is 150 m.p.h., qualification testing may take place at speeds up to 155 m.p.h. without requiring an RPA for operating at speeds in excess of 150 m.p.h., per former footnote 2 to § 213.307(a). Specifically, the AAR suggested that FRA add a sentence to paragraph (a)(2), stating that speeds up to 155 m.p.h. are permitted for the purpose of qualification testing without an RPA, where the maximum allowable operating speed is 150 m.p.h.

As explained in the discussion of § 213.307, above, FRA is modifying the rule to make clear that an RPA is not

specifically needed to authorize high-speed rail operations. Paragraph (a) concerns qualification testing to operate rail service at such high speeds. No process or procedure as formal as an RPA is necessary to allow such qualification testing above the maximum speeds proposed for the operation. Rather, FRA's very approval of the qualification test plan will provide the necessary oversight to allow for the safe conduct of testing at such speeds, and testing conducted in accordance with this FRA approval shall be deemed in compliance with this part 213. Accordingly, paragraph (a)(2) clarifies that for purposes of qualification testing, speeds may exceed the maximum allowable operating speeds for the class of track in accordance with the test plan approved by FRA.

In its comments on the NPRM, Bombardier stated that paragraph (a) did not contain a Task Force proposal that qualification testing take place not only at any speed up to and including 5 m.p.h. above the proposed maximum operating speed, but also at a speed that produces a cant deficiency greater than 3 inches above the proposed maximum cant deficiency, whichever is less. Bombardier stated that not including this proposal seems appropriate on the higher track classes, since a 5 m.p.h. increase in speed through any curve will not result in cant deficiency greater than 3 inches over the proposed cant deficiency. However, Bombardier believed that this may not be the case when conducting such tests on lower-speed track classes at cant deficiencies exceeding 5 inches. Therefore, Bombardier suggested retaining the proposed language developed by the Task Force, and stated that this comment affected proposed paragraph (f)(2)(ii) in this section as well.

The final rule does not include an alternative requirement that qualification testing take place at a speed that produces a cant deficiency greater than 3 inches above the proposed maximum cant deficiency, if this speed is less than 5 m.p.h. above the proposed maximum operating speed. FRA believes that the 5 m.p.h. over-speed testing requirement is appropriate, especially for the lower-speed track classes, because the requirements of this section apply only to those operations on Class 1 through 5 track at curving speeds producing more than 5 inches of cant deficiency. For example, a speed that produces a cant deficiency greater than 3 inches above this already high level of cant deficiency on Class 2 or 3 track would be unrealistic for testing. Moreover,

since that speed would surely exceed 5 m.p.h. above the proposed maximum operating speed, the lesser speed of 5 m.p.h. over the proposed maximum operating speed would apply. FRA has therefore not adopted the suggestion of the commenter.

Paragraph (b) addresses the qualification of existing vehicle types and provides that such vehicle types previously qualified or permitted to operate at track Class 6 speeds or above or at any curving speeds producing more than 5 inches of cant deficiency are considered as being successfully qualified under the requirements of this section for operation at the previously operated speeds and cant deficiencies over the previously operated track segment(s). FRA makes clear that this qualification applies for operation over the previously-operated track segment(s) only. To qualify such vehicle types to operate over new routes (even at the same track speeds), the qualification requirements contained in other paragraphs of this section must be met.

Paragraph (c) contains the requirements for qualifying new vehicle types. The additional (and tighter) carbody acceleration limits in former paragraph (b) for new vehicle qualification have been removed. In their place, this section now references § 213.333 for the applicable VTI limits for accelerations and wheel/rail forces. This change resulted from considerable research into the performance of existing vehicles during qualification testing and revenue operations. Overall, it was found that the acceleration limits in former paragraph (b) need not be as stringent to protect against events leading to vehicle or passenger safety issues. As further specified in this paragraph, vehicle types intended to operate at track Class 6 speeds or above, or at any curving speed producing more than 5 inches of cant deficiency, may be subject to a combination of computer simulations, carbody acceleration testing, truck acceleration testing, and wheel/rail force measurements.

In commenting on proposed paragraph (c), Bombardier stated that for new vehicles intended to operate at track Class 6 speeds, the rule should allow an option for vehicles to be qualified either through simulations or wheel/rail force measurements, to be consistent with what has been allowed for vehicle qualification testing. In addition, NCDOT raised concern that the proposal would have eliminated the use of instrumented wheelsets for the measurement of wheel/rail forces during vehicle qualification testing on track Class 6, noting that computer simulations over a representative

segment of the actual route using MCAT were proposed in lieu of IWS tests for speeds up to 110 m.p.h. and up to 6 inches of cant deficiency. NCDOT stated that, while this may be a safe and less expensive method, NCDOT believed it not entirely clear whether the vehicle/track model validation requirements in the NPRM could be achieved and approved by FRA in a reasonable timeframe and at a lower cost than conducting IWS tests. NCDOT stated that, since the concept of using simulations as a qualification tool is relatively new, it suggested an option be allowed to use simulations or instrumented wheelsets for qualification on track Class 6. NCDOT cited that this concept was proposed in the NPRM for qualifying equipment for use on another corridor at the same speed and cant deficiency, and believed it logical to allow this option for new vehicle qualification in this lower speed range. NCDOT suggested that FRA employ this option as an interim measure until the implications of the simulation requirements have been fully verified and justified using a detailed cost-benefit analysis. In addition, NCDOT noted that this option would allow the use of existing instrumentation if it is compatible with the new vehicle type seeking qualification.

FRA agrees with the commenters that instrumented wheelsets are currently used for qualifying vehicle types intended to operate at track Class 6 speeds and that their use for such qualification purposes should be permitted to continue. As recommended by the Task Force, paragraph (c) is being revised by adding a new paragraph (c)(1) to allow for vehicle types intended to operate at track Class 6 speeds to be qualified either through simulations or the use of instrumented wheelsets to demonstrate compliance with the wheel/rail force limits specified in § 213.333.

Consequently, what was proposed as paragraph (c)(1) for computer simulations is being designated as paragraph (c)(2) and modified to state that it applies to new vehicle types intended to operate at track Class 7 speeds or above—not Class 6 speeds or above—as well at any curving speed producing more than 6 inches of cant deficiency, as proposed in the NPRM. FRA notes that, although in accordance with § 213.57(i), vehicle types intended to operate at cant deficiencies greater than 5 inches on the lower-speed track classes are subject to the requirements of this section, the requirements of paragraph (c)(2) apply to the lower-speed track classes only for operations at cant deficiencies greater than 6

inches. This paragraph requires computer simulations to be conducted on both an analytically defined track segment representative of minimally compliant track conditions (MCAT) for the respective track classes as specified in appendix D to this part and on a track segment representative of the full route on which the vehicle type is intended to operate. (See the discussion of MCAT in appendix D, below.)

No comment was specifically raised on the remaining provisions of proposed paragraph (c), and they have been adopted as proposed, newly designated as paragraphs (c)(3) through (c)(5).

Paragraph (c)(3) requires carbody acceleration testing for all operations at track Class 6 speeds or above, or for any operation above 5 inches of cant deficiency. FRA notes that, in accordance with § 213.57(i), vehicle types intended to operate at cant deficiencies greater than 5 inches on the lower-speed track classes are subject to the requirements of this section.

Paragraph (c)(4) requires truck acceleration testing for all operations at track Class 6 speeds or above.

Paragraph (c)(5) provides that measurement of wheel/rail forces, through the use of instrumented wheelsets (or equivalent devices), are required for all operations at track Class 7 speeds or above, or for any operation above 6 inches of cant deficiency. Again, FRA notes that, although in accordance with § 213.57(i), vehicle types intended to operate at cant deficiencies greater than 5 inches on the lower-speed track classes are subject to the requirements of this section, the requirements of paragraph (c)(5) apply to the lower-speed track classes only for operations at cant deficiencies greater than 6 inches.

In paragraph (d), FRA proposed to separate and explicitly define the qualification requirements for previously qualified vehicle types intended to operate on new track segments. Former paragraph (d) provided for test runs to be made over the entire route intended for revenue service, and for previously qualified equipment, the paragraph applied if a new route were proposed at a later date.

In commenting on the NPRM, Bombardier suggested that for vehicles previously qualified under this subpart for a track class and cant deficiency using both wheel/rail force measurements and simulations, the vehicles should be qualified at the same class and cant deficiency on another route without requiring additional simulations or track testing. Bombardier stated that as the vehicle model would have been fully validated with the

extensive process required by the rule, including the worst-case MCAT conditions, there would be high cost with no safety benefit to conducting simulations and testing on other routes.

In addition, Amtrak commented extensively on proposed changes to this section concerning the “portability” of a vehicle type’s qualification. Amtrak commented that it could see no increased safety benefit from the regulatory scheme proposed by FRA. According to Amtrak, the proposed changes would not be an efficient use of railroad resources in that there would be a potentially never-ending series of qualifications and re-qualifications required. Amtrak cited as an example the safe use of Amfleet equipment for decades on the Northeast Corridor. Amtrak believed that if it sought to use that same Amfleet equipment in the Midwest at the same speeds on track maintained to the same track class standards as the Northeast Corridor, then under the proposed regulation Amtrak would have been required to qualify the equipment to the new standards. Moreover, Amtrak raised concern that FRA would have required qualification every time it sought to operate a type of equipment over a new portion of the same route. Amtrak stated that track maintained to a particular FRA class standard in one part of the country is, by definition, identical to any other piece of track maintained to that same standard. Amtrak commented that once equipment is qualified to operate at a particular speed on a class of track, that qualification should suffice to “certify” that that equipment can operate at the speed in question over that class of track anywhere in the country. At the same time, Amtrak noted that it did not question the need for local testing of operational and safety issues; all new and expanded service must be thoroughly vetted to make sure that all safety issues are discovered and addressed.

Amtrak added that FRA’s proposal was counter to the Task Force recommendation that once a vehicle is qualified for a particular speed and cant deficiency, it would not have to be retested and qualified each time it moved to operate at that same cant deficiency on a new track segment. Amtrak offered another example to illustrate its concern: Amtrak performs testing on a particular piece of equipment to demonstrate that it can operate safely at a particular cant deficiency. This new service is to be run over the territory of a freight railroad host. The equipment is placed in service by Amtrak and operates safely. One year later, a State decides to increase service

and builds a new station 5 miles away from the existing terminus of Amtrak service, on the same host railroad’s line. Amtrak believed that, under FRA’s proposal, Amtrak would have to re-qualify this equipment to operate safely over this “new” stretch of railroad, even though the equipment is operated by the same railroad, and the rail line itself is maintained by the same railroad to the same standards as the existing line. Amtrak stated that FRA cannot justify the need for this new qualification as responsive to “local” conditions. There are no “local” variations to track class standards, according to Amtrak; the track is either maintained to the FRA standards, or it is not. Amtrak also pointed out that portability of equipment qualification could simplify the design and procurement process for future high-speed and commuter equipment. Knowing a particular design already meets FRA safety standards for known track conditions makes it easier to procure equipment, Amtrak stated.

Based on the comments received, the Task Force re-addressed the portability requirements in paragraph (d) for previously qualified vehicle types. The Task Force considered that, although the vehicle type would be unchanged, the vehicle/track system should be appropriately examined for deficiencies prior to its service operation on a new route where performance-based standards are relied upon at track Class 7 speeds or above and at cant deficiencies exceeding 5 inches. Past experience was cited with the high-speed and high cant deficiency qualification of the Acela trainset where testing at a well-maintained track Class 8 test facility did not uncover performance issues that were later identified during the local vehicle/track system testing on the Northeast Corridor, where it was intended to operate. In this regard, the Task Force considered the adequacy to which the new vehicle/track system need be examined during qualification testing to demonstrate system safety.

At the same time, the Task Force took into account that all of the requirements of revised paragraph (c) in this final rule—i.e., wheel/rail force, carbody acceleration and truck lateral acceleration testing, as well as simulations using MCAT and a representative track segment—apply to new vehicle qualification for track Class 7 speeds or above, or at any curving speed producing more than 6 inches of cant deficiency. The MCAT simulations are independent of the route, and once conducted, will have examined the vehicle/track system performance under the majority of worst-case conditions

that might be found on any route. However, MCAT cannot account for all wavelengths and combinations of track deviations that may locally exist on a given route.

For consistency within this final rule, the Task Force agreed that the static lean requirements of § 213.57(d) and § 213.329(d), once met, are independent of the route and noted that no further analysis or testing with respect to these requirements is necessary for previously qualified vehicle types. In addition, vehicle types that have been permitted to operate at cant deficiencies greater than 3 inches but not exceeding 5 inches are considered to be qualified under the new rule for all operations at track Class 6 speeds and below. In the final rule, no testing or simulations are required for previously qualified vehicle types intending to operate on new routes at track Class 1 through Class 6 speeds and at cant deficiencies not exceeding 5 inches.

As provided in paragraph (d)(1), for all operations at track Class 7 speeds or above and cant deficiencies exceeding 5 inches, or for any operation above 6 inches of cant deficiency, simulations or measurement of wheel/rail forces is required to demonstrate safe, local vehicle/track system performance on a new route. For performance-based standards that address the vehicle/track system, simulations are especially useful for demonstrating that when qualified vehicles are intended to operate on a new route, the new vehicle/track system is adequately examined for deficiencies prior to revenue service operation. The Task Force did recognize that, once run for the MCAT deviations, a fully-validated vehicle model required for qualifying new vehicle types under this final rule need not be repeated. Only a simulation for a representative track segment from the new route is required, as the results of the MCAT simulations will be kept on file and be available for reference.

As noted, for previously qualified vehicle types intended to operate on new routes at track Class 1 through Class 6 speeds and at cant deficiencies not exceeding 5 inches, the requirements of this paragraph (d) do not apply. Should the proposed cant deficiency exceed 5 inches but not exceed 6 inches for operations at track Class 1 through 6 speeds, carbody acceleration testing under paragraph (d)(2) is required to demonstrate safe, local vehicle/track system performance on a new route; however, no other qualification testing is required by this paragraph (d).

As provided in paragraphs (d)(2) and (3), for previously qualified vehicle

types intended to operate on new routes at track Class 7 speeds or above, carbody and truck acceleration testing is required to demonstrate safe, local vehicle/track system performance. The carbody acceleration testing requirements in paragraph (d)(2) also apply to previously qualified vehicle types intended to operate on new routes at cant deficiencies exceeding 5 inches.

Paragraph (e) clarifies the requirements in former paragraph (c) for the content of the qualification testing plan and adds a requirement for the plan to be submitted to FRA at least 60 days prior to conducting the testing.

In response to a comment from Bombardier, FRA is consolidating proposed paragraph (e)(1), for including in the testing plan the results of required vehicle/track performance simulations, with proposed paragraph (e)(7), for including in the testing plan an analysis of simulation results, when simulations are required as part of vehicle qualification. Together, both paragraphs were potentially duplicative and are now addressed in paragraph (e)(6), which provides that the testing plan shall include the results of vehicle/track performance simulations that are required by this section. As a consequence, the remaining paragraphs, proposed as paragraphs (e)(2) through (6), are designated as paragraphs (e)(1) through (5) in this final rule.

FRA notes that paragraph (e)(3) is being modified from the proposal in paragraph (e)(4) to provide that the test plan identify the maximum angle found on the gage face of the designed (newly profiled) wheel flange referenced with respect to the axis of the wheelset that will be used for the determination of the Single Wheel L/V Ratio safety limit specified in § 213.333. This modification is consistent with the proposal in the NPRM and clarifies that the designed wheel flange is of a wheel newly profiled to that which is intended for service.

In addition, paragraph (e)(4) is being modified from the proposal in paragraph (e)(5), to provide that the test plan identify the target maximum testing speed in accordance with paragraph (a) of this section and the maximum testing cant deficiency. During Task Force consideration of the draft final rule, Interfleet noted that the reference to paragraph (a) concerns the maximum testing speed but that, as proposed, the reference appeared after the mention of the target maximum cant deficiency. Specifically, paragraph (a)(2) provides that for purposes of qualification testing, speeds may exceed the maximum allowable operating speed for the class of track in accordance with

the test plan approved by FRA. Therefore, this reordering from the NPRM more clearly associates together the provisions that concern testing speed. At the same time, FRA has clarified what was meant by the "target" maximum cant deficiency in proposed paragraph (e)(5). The final rule makes clear that this cant deficiency is the "maximum testing cant deficiency," i.e., the maximum cant deficiency intended (targeted) during qualification testing. In addition, FRA recognizes that not every curve tested in a track segment need or will require the same level of cant deficiency, and therefore, FRA does not expect all test operations to be conducted at the maximum cant deficiency specified in a track segment for each curve within that segment. FRA intends that issues specific to individual qualification tests, such as the targeted cant deficiency for each curve, be addressed in the qualification testing plan, program, and approval process.

Paragraph (f) contains the requirements for conducting qualification testing upon FRA approval of the test plan, expanding on the original requirements in this section. For instance, this paragraph expressly requires that TGMS equipment be operated over the intended test route within 30 days prior to the start of the testing, to help ensure the integrity of the test results. This paragraph also makes clear that exceptions to the safety limits that occur on track or at speeds that are not part of the test do not need to be reported. Specifically, any exception to the safety limits that occurs at speeds below track Class 6 speeds when the cant deficiency is at or below 5 inches does not need to be reported.

During Task Force consideration of the draft final rule, Interfleet recommended that FRA set a timeframe for FRA approval of testing plans so that the track owner or railroad can schedule testing and plan related activities that are resource- or time-critical, or both. FRA notes that for this reason, and as proposed, paragraph (e) specifies that a qualification testing plan be submitted to FRA at least 60 days prior to conducting the testing. This 60-day period is for the benefit of FRA primarily to allow sufficient time to review and approve the plan, and to seek clarification from the submitter as necessary. In some cases, the review and approval may be able to be accomplished in less than 60 days; in other cases, the process may take longer, especially if the plan is incomplete or if questions are raised. FRA is mindful of the concern that FRA not unduly delay testing, and at the same time recognizes that safety is better and more efficiently

served by identifying potential safety issues early in the qualification process. FRA therefore encourages those planning to conduct qualification testing to approach FRA prior to the submission of their test plans should they have any questions or concerns about the testing and approval process.

Paragraph (g) contains the requirements for reporting to FRA the results of the qualification testing program. Bombardier commented that the Task Force did not discuss the proposal that when simulations are required as part of vehicle qualification this report include a comparison of simulation predictions to the actual wheel/rail force or acceleration data, or both, recorded during full-scale testing. Bombardier stated that it understands the intent of the requirement but expressed concern that if not applied in a practical manner, it could significantly delay equipment approvals. Bombardier suggested that this issue be further reviewed and discussed by the Task Force prior to promulgation of the final rule. Bombardier believed that one way of addressing this issue would be to include a section in the Track Safety Standards Compliance Manual that would provide guidance on the means and expectations for correlating simulations with vehicle qualification test results. A good example would be the correlation that was conducted by the Volpe Center on the vehicle models used to develop the regulation, according to Bombardier.

FRA appreciates Bombardier's comment on this proposal. Indeed, FRA has sponsored research at TTCI to establish a set of procedures for validating models used in simulating vehicle/track dynamic interaction. FRA intends to publish this research before the final rule takes effect and appropriately incorporate it into FRA's formal guidance on compliance with the Track Safety Standards. FRA also encourages parties to approach FRA early in the vehicle/track system qualification process should they have any questions or concerns about correlating simulation predictions with actual wheel/rail force or acceleration test data.

Pursuant to paragraph (h), FRA approves a maximum train speed and value of cant deficiency for revenue service, based on the test results and all other required submissions. FRA intends to provide an approval decision normally within 45 days of receipt of all the required information, and has expressed its intent here at the suggestion of the Task Force. A decision may be made earlier or later, depending on the circumstance of each request.

Paragraph (h) also makes clear that FRA may impose conditions necessary for safely operating at the maximum train speed and value of cant deficiency approved for revenue service.

Paragraph (i) is being added to this section. In commenting on the NPRM, Amtrak stated that a significant paragraph approved by the Task Force has been omitted. The paragraph proposed that documents required by this section must be submitted to FRA by either the tracker owner or an operating entity that provides service with the vehicle type over trackage of one or more track owners with the written consent of all affected track owners. According to Amtrak, the second clause is an important tenet in the operating world when an entity like Amtrak wants to operate a high-speed train over trackage owned by one or more freight railroads. Without this paragraph, Amtrak believed that each of the host railroads would be required to submit the paperwork and perform the tests required.

The AAR likewise noted the Task Force's concurrence that this section would contain a requirement that all documents be submitted to FRA by either the track owner or by the operating entity with the written consents of all affected track owners. The AAR stated that FRA removed this provision without any explanation. According to the AAR, FRA should not approve any application for permission to operate vehicles at Class 6 speeds or at cant deficiencies without the concurrence of the track owner(s), which the AAR believed was the underlying intent behind the proposal that the necessary documents should be submitted either by a track owner or with the approval of the track owner(s).

FRA did not intend such a result. Paragraph (i) is therefore being added to this section to make clear that the documents required by this section must be provided to FRA by either (1) the track owner, or (2) a railroad that provides service with the same vehicle type over trackage of one or more track owner(s), with the written consent of each affected track owner. The Task Force concurred with this addition, making clearer and more concise what was earlier discussed prior to the publication of the NPRM. In this regard, FRA makes clear that a "railroad" includes what was previously identified as an "operator of a passenger or commuter service" in former § 213.57(e) and § 213.329(f). For example, Amtrak is a railroad that provides passenger service over trackage often owned by other entities, usually freight railroads. Amtrak is also a track owner over whose

trackage numerous passenger railroads operate, such as SEPTA and NJ Transit, which commented on the NPRM.

#### Section 213.355 Frog Guard Rails and Guard Faces; Gage

This section currently sets limits for guard check gage and guard face gage for track Classes 6 through 9. As proposed, FRA is making minor changes to the way in which the requirements of this section are formatted. However, no substantive change is intended.

#### Appendix A to Part 213—Maximum Allowable Curving Speeds

This appendix formerly contained only two charts showing maximum allowable operating speeds in curves, by degree of curvature and inches of unbalance (cant deficiency): table 1, which applies to curves with 3 inches of unbalance; and table 2, which applies to curves with 4 inches of unbalance. Because this final rule facilitates the use of higher cant deficiencies, this appendix has been expanded to include two additional tables: tables 3 and 4, which apply, respectively, to curves with 5 and 6 inches of unbalance. While this rule does provide for operations at higher levels of unbalance, for convenience, FRA has set out only those tables that it believes are more likely to be commonly used.

FRA notes that in response to comments by Bombardier on the NPRM, FRA is revising the formatting of the tables from that proposed in the NPRM. Bombardier suggested lowering the "Degree of curvature" text by one row and inscribing a box around "Elevation of outer rail (inches)" for placement over columns 0 through 6, as well as inscribing a box around the "Maximum allowable operating speed (m.p.h.)" text for placement over columns 0 through 6. For clarify, each of the tables has been formatted accordingly.

#### Appendix B to Part 213—Schedule of Civil Penalties

Appendix B to part 213 contains a schedule of civil penalties for use in connection with this part. Because such penalty schedules are statements of agency policy, notice and comment are not required prior to their issuance. See 5 U.S.C. 553(b)(3)(A). Nevertheless, FRA invited commenters to submit suggestions to FRA describing the types of actions or omissions for each proposed regulatory section, either added or revised, that would subject a person to the assessment of a civil penalty. Commenters were also invited to recommend what penalties may be appropriate, based upon the relative

seriousness of each type of violation. No comment was received.

FRA is amending the penalty schedule to reflect the changes made to part 213. Specifically, FRA is adding entries for new sections §§ 213.65 and 213.332, Combined track alinement and surface deviations. FRA is also adding an entry for § 213.110, Gage restraint measurement systems, which is being revised. Although § 213.110 is not a new section, no entry for this section had previously been included. For each of these entries, FRA has specified guideline penalty amounts that are consistent with those for similar entries in this appendix. FRA is also revising the entries for §§ 213.55, 213.307, 213.327, 213.329, 213.333, and 213.345 so that the entries conform to their respective sections that are being revised in this final rule; however, no change to the guideline penalty amounts is being made.

In addition, in preparing the final rule, FRA identified other items in this appendix in need of revision. First, FRA is revising the headings for subparts D and G so that they conform to the subpart headings in the rule itself. Second, FRA is modifying this appendix so that it conforms to the changes made by the Concrete Crossties final rule, which was published without revisions to the appendix. *See* 76 FR 18073, April 1, 2011; 76 FR 55819, Sept. 9, 2011. Specifically, FRA is adding an entry for § 213.234, Automated inspection of track constructed with concrete crossties. In addition, FRA is revising the entry for § 213.109, Crossties, to conform to the changes made to that section and is also revising the entry for § 213.127, Rail fastening systems, so that it conforms to the section heading, as revised by that rule.

#### Appendix D to Part 213—Minimally Compliant Analytical Track (MCAT) Simulations Used for Qualifying Vehicles To Operate at High Speeds and at High Cant Deficiencies

Appendix D is a new appendix containing the requirements for the use of computer simulations to demonstrate compliance with the vehicle/track system qualification testing requirements specified in subpart G of this part. Computational models have become practical and reliable tools for understanding the dynamic interaction of vehicles and track, as a result of advancements made over the last few decades. Such models are capable of assessing the response of vehicle designs to a wide range of track conditions corresponding to the limiting conditions allowed for each class of track. Consequently, portions of the

qualification requirements in subpart G can be met by simulating vehicle testing using a suitably-validated vehicle model instead of testing an actual vehicle over a representative track segment.

As explained in paragraph 1, the simulations described in this appendix are required to be performed using a track model containing defined geometry perturbations for different track segments at the limits that are permitted for a specific class of track and level of cant deficiency. This track model is referred to as MCAT. These simulations shall be used to identify vehicle dynamic performance issues prior to service or, as appropriate, a change in service, and demonstrate that a vehicle type is suitable for operation on the track over which it is intended to operate. FRA notes that the lengths of the MCAT segments identified in this appendix are the same as the segment lengths that were used in the modeling of several representative high-speed vehicles. See the discussion of research and computer modeling in the Technical Background section of this final rule, Section IV.B, for additional background.

In order to validate a computer model using MCAT, the predicted results must be compared to actual data from on-track, instrumented vehicle performance testing using accelerometers, or other instrumentation, or both. Validation must also demonstrate that the model is sufficiently robust to capture fundamental responses observed during field testing. Disagreements between predictions and test data may be indicative of inaccurate vehicle parameters, such as for stiffness and damping, or track input. Once validated, the computer model can be used for assessing a range of operating conditions or even to examine modifications to current designs.

In addition, FRA notes that computer modeling using MCAT has the potential to be applied by railroads and by car manufacturers for safety planning purposes beyond the scope of what is required by this rule. The Engineering Task Force of RSAC's Passenger Safety Working Group is considering the use of MCAT in evaluating the operation of high-speed vehicles over lower-speed classes of track, regardless of the cant deficiency. Current FRA standards for Class 1 through 5 track may be unsuitable for suspensions designed for operations at the highest speeds. Consequently, by developing a set of MCAT parameters that reflect the safety standards for Class 1 through 5 track, and conducting simulations using existing high-speed vehicle dynamics models on this lower-speed track, track

conditions could be identified that would cause the VTI safety criteria to be exceeded and potentially lead to a derailment. Such MCAT modeling for lower-speed track could also be a useful development tool for foreign car rail manufacturers considering the introduction of vehicles that would be equipped with suspension systems having wheel profiles designed for U.S. standard gage track.

FRA received a number of comments relating to this appendix and is addressing them in the order in which they arise.

Paragraph 2 is being modified from that proposed in the NPRM. Paragraph 2 concerns the application of MCAT for vehicle/track system qualification in § 213.345 and is consequently being modified in accordance with the changes made to § 213.345. Please see the discussion of § 213.345.

FRA is removing proposed paragraph 3 from this appendix. Paragraph 3 proposed that, for a comprehensive safety evaluation, the track owner or railroad identify any non-redundant suspension system element or component that may present a single point of failure. The paragraph further proposed that additional MCAT simulations be included that reflect the fully-degraded mode of the vehicle type's performance due to such a failure. Bombardier objected to proposed paragraph 3, stating that the proposal was not taken into consideration by the Task Force in any of the simulations conducted to develop the proposed track geometry limits. According to Bombardier, should such a requirement be contemplated, it would be necessary to reassess completely the allowable track geometry limits proposed, and neither simulations nor testing had been performed on any existing vehicles that reflect these conditions. Bombardier added that the purpose of MCAT is to evaluate vehicle response to fully-degraded track conditions that represent single-point failures, or near-failures, of the track and in some cases combined track anomalies. If the intent of this paragraph is for the vehicle to meet the vehicle/track interaction safety limits, with the track containing failure(s) and the vehicle suspension containing a single-point failure, Bombardier stated that this would amount to a combined failure which, while theoretically possible, has not been identified as a real issue. Bombardier further stated that most suspension system components, by nature, cannot have redundant elements and that this is true on all ground-based transportation systems. Bombardier believed that other

provisions, both then-existing and proposed, relating to suspension system maintenance adequately address the concerns raised by the proposal with respect to the vehicle. Bombardier maintained that to require further tightening of track geometry standards to address combined track and vehicle suspension failures is unnecessary and impractical. Bombardier also stated that many vehicles have been qualified in accordance with § 213.345 since its promulgation in 1998, and FRA had not indicated why this provision was added as related to past experience or unsafe conditions. Bombardier therefore requested that the provision be removed and that FRA clarify that it was not FRA's intent to include such a requirement.

FRA is not including proposed paragraph 3 as a requirement of this final rule's appendix. FRA intends that for purposes of vehicle/track system safety planning, a comprehensive safety evaluation include the identification of non-redundant suspension system elements or components that may present a single point of failure. Conducting MCAT simulations reflecting the vehicle type's performance in such a fully-degraded mode can then be used to inform safety decisions more fully. However, FRA did not intend to impose a requirement that the MCAT safety performance criteria be met under such circumstances. Nonetheless, should the simulations identify potential safety concerns, the information could be considered for equipment inspection, testing, and maintenance purposes, for example, to help develop appropriate inspection, testing, and maintenance criteria and procedures for the equipment.

Paragraph (a) addresses the validation of the vehicle model used for simulations. Bombardier sought clarification of FRA's proposal, in particular raising concern with the possible misapplication of the proposal for fully validating the vehicle model. Bombardier stated that discrepancies or a lack of correlation between vehicle simulations and actual qualification test data can often be due to errors in the track model or track geometry measurements, wheel and rail profiles, or friction levels, or other causes. Bombardier therefore recommended that validation requirements be reviewed and discussed prior to promulgation of the final rule, and cited related comments on proposed § 213.345(g).

As discussed in § 213.345(g), FRA has sponsored research at TTCI to establish a set of procedures for validating models used in simulating vehicle/track dynamic interaction. FRA intends to

publish this research, when complete, and make it part of FRA's formal guidance on compliance with the Track Safety Standards. Again, in the interim, FRA encourages parties to approach FRA early in the qualification process should they have any questions or concerns about correlating simulation predictions with measured track geometry data.

FRA is making one change to paragraph (a) from that proposed in the NPRM. Paragraph (a) now references § 213.345(c)(2)(ii), consistent with the changes to § 213.345(c), discussed above.

Paragraph (b) specifies the layout of the MCAT segments. Bombardier submitted a number of comments on proposed paragraph (b), first taking issue with the last sentence in proposed (b)(1)(i) that the hunting perturbation segment would be used only on tangent track simulations. Bombardier noted that the proposal was inconsistent with paragraphs (c)(3) and (4) of this appendix, which would require that the hunting segment be used on curves less than 1 degree, and that, as a result, a revision to paragraph (b)(1)(i) or a footnote to figure 1 would be needed to address this inconsistency.

In response to this comment, paragraph (b)(1)(i) is being revised to make clear that the hunting perturbation segment applies both to tangent track and to track that is curved less than 1 degree. Figure 1 is also being modified accordingly to show that the hunting perturbation section must be included for curves less than 1 degree. The modifications to figure 1 and the text in paragraph (b)(1)(i) reference under what curvature conditions the hunting segment is to be used. Since the curvature value is calculated using a combination of speed and cant deficiency, there is no need to specify which track classes need to include this section in curving simulations.

Further, the amplitude value  $a_1$  for the hunting perturbation segment is being lowered from 0.5 inch, as proposed in the NPRM, to 0.25 inch in this final rule. The intent of the hunting perturbation segment is to test vehicle stability on tangent track. A perturbation of 0.5 inch could result in wheel flange contact with the rail and thereby cause one of the VTI safety limits to be exceeded. Consequently, use of a 0.5-inch perturbation could lead to exceedances that would not appropriately reflect the vehicle/track performance concern at issue, or be useful for proper evaluation of the intended feature of the vehicle design. By reducing the amplitude to 0.25 inch, wheel contact should stay on the tread,

and the ability of the vehicle to remain stable and resist hunting can more appropriately be examined. This change is intended to advance the purpose of including the hunting perturbation segment and not compromise safety.

In addition, Bombardier commented that the text in proposed paragraph (b)(1)(ix) concerning the combined perturbation segment was inconsistent with § 213.332, Combined track alinement and surface deviations, which has been adopted in this final rule. The text of proposed paragraph (b)(1)(ix) limited its application to curved track segments, while § 213.332 addresses combined track alinement and surface deviation limits for Class 9 track, either curved or tangent. Bombardier noted that a revision to paragraph (b)(1)(ix) or a footnote to figure 1 was needed to address this inconsistency. In response to this comment, paragraph (b)(1)(ix) has been modified to make clear that the segment is to be used for all simulations on Class 9 track. In addition, figure 1 has been modified so that it reflects application of the combined perturbations segment to tangent cases on Class 9 track. These changes make this appendix consistent with § 213.332.

As noted, the MCAT layout in figure 1 has been modified to clarify which segments are required depending on the speed and the degree of curvature involved. In particular, the hunting perturbation segment is not required for simulations of curves greater than or equal to 1 degree; the short warp segment is not required for tangent track simulations; and the combined perturbation segment is required on tangent track only for Class 9 track, and is not required for simulations of no more than 5 inches of cant deficiency other than for Class 9 track, where it is required for all cant deficiency values.

As proposed in the NPRM, table 1 identifies the minimum lengths of the MCAT segments. In response to a request for clarification from Interfleet during the development of the final rule, FRA makes clear that longer segment lengths can be used at higher speeds to allow for transient response to dissipate and to ensure that the filtering window does not cover more than one MCAT segment.

Table 2 is being added to this appendix D to identify the degree of curvature for use in MCAT simulations of both passenger and freight equipment performance on Class 2 through 9 track by speed and cant deficiency, based on the equation in paragraph (b)(3)(i) of this appendix. For track Classes 2 through 5, degrees of curvature are identified only where the cant deficiencies are more than 6 inches,

since those are the only cant deficiencies that require simulations for such track classes. In this regard, degrees of curvature for use in MCAT simulations of equipment performance on Class 1 track are not specified given the extraordinarily high values that would be reached for such cant deficiencies; nonetheless, FRA intends that degrees of curvature for Class 1 track be based on the same equation in paragraph (b)(3)(i) using an appropriate superelevation. FRA also notes that the degrees of curvature for use in MCAT simulations of freight equipment performance on Class 6 (freight) track for speeds of 85 and 90 m.p.h. is shown in italics for cant deficiencies not exceeding 6 inches, to emphasize that these values apply to freight equipment only. MCAT simulations are required for both passenger and freight equipment performance where track Class 6 speeds coincide, i.e., speeds exceeding 90 m.p.h.

Paragraph (c) identifies and describes the simulations that are required using MCAT. To aid the reader, table 3 was originally proposed as table 2 in the NPRM to summarize by vehicle type, cant deficiency, and class of track when assessments of vehicle performance using MCAT are required. Following the NPRM's publication, Bombardier commented that the proposed table needed to be revised to include Class 9 track, and during Task Force discussions it was suggested that this table be made clearer in other ways. Accordingly, FRA has revised the table not only to correct the inadvertent omission noted by Bombardier, but also to make more explicit when simulations are required and when they are not, including identifying when simulations are an option for demonstrating compliance with the rule.

Paragraph (c)(1)(ii) addresses the use of worn wheel profiles in simulations. Bombardier commented that the Task Force agreed that simulations using worn wheels be conducted only for tangent track segments. Bombardier did not believe that this agreement was reflected in the NPRM text that implied that all simulations must be conducted with worn wheel profiles on tangent track and in curves. Bombardier stated that such a requirement was not taken into consideration by the Task Force in any of the simulations conducted to develop the proposed track geometry limits. In discussing this issue with the Task Force following publication of the NPRM, FRA noted that it had believed that the proposed requirement was part of the Task Force's consensus on the NPRM and that worn wheel profiles can both present a problem for stability on

tangent track and affect response during curving. Nonetheless, FRA acknowledges that the effect of wheel wear on stability on tangent track is of paramount concern and that, for all other vehicle and rail parameters that might equally or more significantly affect response during curving, only nominal values for such parameters are required to be used in MCAT simulations. Thus, FRA has agreed to limit the requirement to conduct simulations using worn wheel profiles to tangent track segments. However, FRA expects that railroads and car manufacturers will utilize MCAT for broader safety planning purposes and for performance optimization studies while conducting these simulations. As an additional point, Bombardier commented that the words "running profile" should be replaced with "wheel profile" in this paragraph. The Task Force concurred with this change, and FRA has modified the paragraph accordingly to make the text clearer and more precise.

Paragraph (c)(2) addresses vehicle performance on tangent track Classes 6 through 9. As a general comment on the proposal, Bombardier believed that some effort should be applied to simplifying proposed paragraph (c)(2) by including more information in table 4 (proposed table 3) with less descriptive text in paragraphs (c)(2)(ii) and (iii). Bombardier suggested a proposed revision to the table, and the Task Force recommended that new table 4 be reformatted according to the example shown in Bombardier's comments. Table 4 provides the amplitude values for the MCAT segments described in paragraphs (b)(1)(i) through (vii) and, for track Class 9, (b)(1)(ix), for each speed of the required parametric MCAT simulations. In preparing the table for the final rule, an additional header table has been added, as recommended by Bombardier, containing the maximum operating and simulation speeds for each track class, along with a list of all of the amplitude parameters identifying each MCAT segment to which they correspond, where each segment description can be found, and to which class(es) of track they are applicable. The inclusion of the additional information in new Table 4 does help add clarity; however, even with this additional information, the descriptive text in paragraphs (c)(2)(ii) and (iii) is still required. For example, without the text in paragraph (c)(2)(ii), it would not be clear that running simulations using all three 31-foot-based wavelengths is a requirement, and paragraph (c)(2)(iii) states the

requirement to run the final simulations at 5 m.p.h. over the maximum proposed operating speed. Moreover, even though the new information in the table lists a maximum speed for simulations for each track class, only the rule text in paragraphs (c)(2)(iii)(A) through (C) specifies that this 5 m.p.h. overspeed is required when transitioning into track classes, e.g., 115 m.p.h. for Class 6 track when qualifying a vehicle for Class 7 track.

Bombardier raised a number of additional comments with table 4 (proposed table 3). Specifically, Bombardier commented that the combined deviation parameters  $a_7$ ,  $a_8$  and  $a_{13}$  should be specified in the table for track Class 9, and that the repeated surface parameter  $a_9$  for the 124-foot wavelength on track Class 9 be specified as 0.625 inch. Bombardier is correct that there were no values specifically identified for combined deviation parameters  $a_7$ ,  $a_8$  and  $a_{13}$  for track Class 9, and that the repeated surface parameter  $a_9$  for the 124-foot wavelength on track Class 9 was inadvertently proposed as 0.875 inch.

As was the consensus of the Task Force, new table 4 is being restated to include the combined deviation parameters  $a_7$ ,  $a_8$  and  $a_{13}$  for track Class 9; 31-foot wavelength:  $a_7=0.333$  inch,  $a_8=0.000$  inch, and  $a_{13}=0.333$  inch; 62-foot wavelength:  $a_7=0.333$  inch,  $a_8=0.000$  inch, and  $a_{13}=0.500$  inch; and 124-foot wavelength:  $a_7=0.500$  inch,  $a_8=0.000$  inch, and  $a_{13}=0.667$  inch. Moreover, the repeated surface parameter  $a_9$  for the 124-foot wavelength on track Class 9 has been restated as 0.625 inch. These changes make the table consistent with § 213.332, which provides that combined deviation limits apply to all Class 9 track, including tangent sections. These changes also make the table consistent with the repeated surface limit of 0.625 inch for the 124-foot wavelength on Class 9 track in § 213.331(c).

In addition, FRA notes that on closer examination of the proposed MCAT tables FRA found and corrected some inadvertent errors in the proposed track Class 6 amplitude parameters for  $a_3$  (gauge widening) and  $a_6$  (single alignment). The corrected values now reflect both the maximum permissible gage and the maximum permissible alignment variations. Specifically, for Class 6 track in table 4 of the final rule, for the 31-foot perturbation wavelength, the  $a_3$  parameter is 0.75 inch; and for the 62-foot perturbation wavelength, the  $a_3$  parameter is 0.75 inch, and the  $a_6$  parameter is 0.

FRA is also formatting tables 4 through 7 in this final rule so that the  $a_1$



(hunting) and  $a_{12}$  (short warp) amplitude parameters are in their own designated rows, rather than grouped with the 31-, 62-, and 124-foot wavelengths. These hunting and short warp perturbation segments have fixed wavelengths, 10 feet and 20 feet, respectively, which are now explicitly stated in the tables to identify clearly the wavelength to be used for simulating these perturbations.

Paragraph (c)(3) addresses vehicle performance on curved track Classes 6 through 9. As for paragraph (c)(2), Bombardier stated that some effort should be applied to simplifying the paragraph by including more information in tables 5 and 6 (proposed tables 4 and 5) with less descriptive text in paragraphs (c)(3)(ii) and (iv). Table 5 applies to Class 6 through 9 curved track with cant deficiency greater than 3 inches but not greater than 5 inches; table 6 applies to Class 6 through 9 curved track with cant deficiency greater than 5 inches. The Task Force concurred that new tables 5 and 6 be reformatted to match the examples shown in Bombardier's comments with an additional header table containing the maximum operating and simulation speeds for each track class, along with a list of all of the amplitude parameters identifying each MCAT segment to which they correspond, where each segment description can be found, and to which class(es) of track they are applicable. Tables 5 and 6 also include the parameter  $a_1$ . This hunting perturbation parameter applies to track that is curved less than 1 degree, and has been included accordingly. Please note that the amplitude of this perturbation parameter has been reduced, as discussed above.

The inclusion of the additional information in tables 5 and 6 does help add clarity; however, even with this additional information, the descriptive text in paragraphs (c)(3)(ii) and (iv) is still required. For example, without the text in paragraph (c)(3)(ii), it would not be clear that running simulations using all three 31-foot-based wavelengths is a requirement, and the text in paragraph (c)(3)(iv) specifies the need to run the final simulations at 5 m.p.h. over the maximum proposed operating speed and cant deficiency. Moreover, even though the new information in the tables lists a maximum speed for simulations for each track class, only the rule text in paragraphs (c)(3)(iv)(A) through (C) specifies that this 5 m.p.h. overspeed is required when transitioning between classes, e.g., 115 m.p.h. for Class 6 track when qualifying a vehicle for Class 7 track. In addition, the text in paragraphs (c)(3)(iv)(A)

through (C) describes how the 5 m.p.h. overspeed cases at the end of a track class will be conducted at the maximum proposed cant deficiency, using the curvature value,  $D$ , calculated using the maximum track class speed and maximum proposed cant deficiency.

Bombardier raised additional comments on tables 5 and 6 (proposed tables 4 and 5). Bombardier noted that the repeated surface parameter  $a_9$  for the 124-foot wavelength on track Class 9 should be 0.625 inch. In the NPRM, in proposed tables 4 and 5, the repeated surface parameter  $a_9$  for the 124-foot wavelength on track Class 9 was identified as 0.875 inch. By consensus of the Task Force, in new tables 5 and 6 the repeated surface parameter  $a_9$  for the 124-foot wavelength on track Class 9 has been corrected to state 0.625 inch. These changes conform the tables with the repeated surface limit of 0.625 inch for the 124-foot wavelength on track Class 9 track provided in § 213.331(c).

Bombardier also commented that the warp parameter  $a_{12}$  for track Class 9 should be corrected in tables 5 and 6 (proposed tables 4 and 5). As proposed, the warp parameter  $a_{12}$  on track Class 9 was identified as 0.500 inch. The Task Force concurred that the tables be corrected so that the warp parameter  $a_{12}$  for track Class 9 be 0.750 inch. These changes also conform the tables with the warp limit of 0.75 inch for Class 9 track provided in § 213.331(a) and (b).

Bombardier additionally commented that the combined deviation surface parameter  $a_{13}$  for track Class 9 should be 0.667 inch in table 5 (proposed table 4). In the NPRM, the combined deviation surface parameter  $a_{13}$  for track Class 9 was proposed as 0.833 inch. The Task Force concurred that new table 5 reflect that the combined deviation surface parameter  $a_{13}$  for track Class 9 be 0.667 inch. This change conforms the surface value in the table with the combined deviation equation stated in § 213.332, when evaluated using the corresponding combined deviation alignment parameter  $a_7$  found in the table.

FRA also notes that, on closer examination of the MCAT tables, FRA found and corrected some inadvertent errors in the proposed track Class 6 amplitude parameters for  $a_3$  (gauge widening) and  $a_6$  (single alignment). The corrected values now reflect both the maximum permissible gauge and the maximum permissible alignment variations. Specifically, for Class 6 track in tables 5 and 6 of the final rule, for the 31-foot perturbation wavelength, the  $a_3$  parameter is 0.75 inch; and for the 62-foot perturbation wavelength, the  $a_3$  parameter is 0.75 inch, and the  $a_6$  parameter is 0.

Paragraph (c)(4) addresses vehicle performance on curved track Classes 1 through 5 at high cant deficiency. As for paragraphs (c)(2) and (3) Bombardier raised the same general comment that this section be simplified by including more information in table 7 (proposed table 6) with less descriptive text in paragraphs (c)(4)(ii) and (iv). (FRA notes that Bombardier's comment references paragraph (c)(3) under a discussion of paragraph (c)(4) and has treated the comment as relating to paragraph (c)(4).) As for the other tables, the Task Force concurred that table 7 (proposed table 6) be reformatted. Table 7 also includes the parameter  $a_1$ , which has been added for curves less than 1 degree, as noted above.

The inclusion of the additional information in table 7 helps add clarity; however, even with this additional information, the descriptive text in paragraphs (c)(4)(ii) and (iv) is still required. For example, without the text in paragraph (c)(4)(ii), it would not be clear that running simulations using both the 31-foot and 62-foot wavelengths is required for assessing vehicle performance on curved track Classes 1 through 5 at high cant deficiency.

#### *Proposed Amendments to 49 CFR Part 238, Passenger Equipment Safety Standards*

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

##### Section 238.227 Suspension System

FRA is modifying this section so that it conforms with the changes being made to part 213 of this chapter and also to provide cross-references to relevant sections of part 213. Overall, these revisions help to reconcile the requirements of the 1998 Track Safety Standards final rule and the 1999 Passenger Equipment Safety Standards final rule for Tier I passenger equipment, i.e., passenger equipment operated at speeds not exceeding 125 mph.

For consistency throughout this part and part 213 of this chapter, the term “hunting oscillations” in paragraph (a) is being replaced with the term “truck hunting,” which has the same meaning as that for “truck hunting” in 49 CFR 213.333. Truck hunting is defined in the table of vehicle/track interaction safety limits in § 213.333 as “a sustained cyclic oscillation of the truck evidenced by lateral accelerations exceeding 0.3g root mean squared for more than 2 seconds.” The Task Force believed that the term “hunting oscillations,” which was formerly defined in paragraph (b) of this section as “lateral oscillations of

trucks that could lead to a dangerous instability,” has a less definite meaning and could be applied unevenly as a result. The Task Force therefore preferred using the definition of “truck hunting” in part 213 with its more specific criteria, and FRA agrees that more specific criteria provide more certainty. Unlike § 213.333, however, paragraph (a) of this section applies to all Tier I passenger equipment, regardless of track class or level of cant deficiency.

The pre-revenue service qualification requirements in paragraph (b) are being revised consistent with the revisions to part 213 of this chapter. Paragraph (b) is also being broadened to address revenue service operation requirements. Paragraph (b), as revised, generally summarizes the qualification and revenue service operation requirements of part 213 for Tier I passenger equipment. This paragraph is not intended to impose any requirement itself not otherwise contained in part 213.

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

##### Section 238.427 Suspension System

Similar to the revisions to § 238.227, FRA is modifying this section to conform to the changes made in part 213 of this chapter. Overall, these revisions help to reconcile the requirements of the 1998 Track Safety Standards final rule and the 1999 Passenger Equipment Safety Standards final rule.

While paragraph (a)(1) remains unchanged, paragraph (a)(2) is being revised in an effort to summarize the qualification and revenue service operation requirements of part 213 for Tier II passenger equipment. The reference to the suspension system safety standards in appendix C has been removed, as discussed below. The carbody acceleration requirements in paragraph (b) have been revised consistent with the changes to part 213. The steady-state lateral carbody acceleration limits of 0.1g for pre-revenue service qualification and 0.12g for service operation have been revised to a single limit of 0.15g, to conform to the changes in § 213.329. Please see the discussion of § 213.329. The remaining carbody acceleration requirements have been consolidated by referencing the requirements of § 213.333.

Paragraph (c) continues to require that each truck be equipped with a permanently installed lateral accelerometer mounted on the truck frame. However, for consistency throughout this part and part 213 of this

chapter, this paragraph is being revised to make clear that the purpose of the accelerometer is to detect “truck hunting,” as defined in 49 CFR 213.333. This change helps not only to reconcile the requirements governing truck hunting but to streamline the requirements of this paragraph by removing the term “hunting oscillations” and its defining text. If truck hunting is detected, the train monitoring system shall provide an alarm to the engineer, and the train shall be slowed to a speed at least 5 m.p.h. less than the speed at which the truck hunting stopped. This paragraph formerly stated that the notification alarm be provided to the “train operator,” and FRA has revised the text to make clear that this notification be provided to the “locomotive engineer,” i.e., the crewmember operating the train.

The Task Force believed that the overheat sensor requirements in paragraph (d) were not directly related to suspension system safety and should be specified elsewhere. FRA agreed that the requirements of this paragraph could be stated separately for clarity, and therefore proposed to move them to a new section, § 238.428.

##### Section 238.428 Overheat Sensors

As proposed, FRA is adding a new section containing the requirements that were previously found in § 238.427(d). However, there has been no change to the substantive rule text. FRA agreed with the Task Force that the requirements for overheat sensors are more appropriately contained in their own section rather than with the requirements for suspension systems in § 238.427. FRA has amended the rule accordingly.

#### Appendix A to Part 238—Schedule of Civil Penalties

This appendix contains a schedule of civil penalties to be used in connection with this part. Because such penalty schedules are statements of agency policy, notice and comment are not required prior to their issuance. *See* 5 U.S.C. 553(b)(3)(A). Nevertheless, FRA invited comment on the penalty schedule; no comment was received, however.

Accordingly, FRA is amending the penalty schedule to reflect the addition of a new section to part 238, § 238.428, Overheat sensors. The requirements of this section were previously included in § 238.427, Suspension system, and have been set apart for clarity.

#### Appendix C to Part 238—Suspension System Safety Performance Standards

As proposed, FRA is removing and reserving appendix C, which contained the minimum suspension system safety performance standards for Tier II passenger equipment. FRA believes that removing appendix C is appropriate in light of the changes to § 238.427(a)(2). Section 238.427(a)(2) formerly required that Tier II passenger equipment meet the safety performance standards for suspension systems contained in appendix C, or alternative standards providing at least equivalent safety if approved by FRA under § 238.21. As discussed above, FRA is revising § 238.427(a)(2) to require compliance with the safety standards contained in § 213.333, in lieu of those in appendix C. Given the cross-reference to the requirements in § 213.333, which are more extensive than the ones contained in appendix C, appendix C is no longer necessary and has therefore been removed and reserved.

## VII. Regulatory Impact and Notices

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

This final rule is a significant regulatory action within the meaning of Executive Orders 12866 and 13563, and DOT regulatory policies and procedures (*see* 44 FR 11034; Feb. 26, 1979). FRA has prepared and placed in the docket a regulatory impact analysis (RIA) addressing the economic impact of this final rule.

In analyzing the impacts of this rule and the NPRM that preceded it, FRA considered the extent of affected operations based on preliminary plans and policies, many of which are still in development, or subject to change. For example, when the NPRM was published there were plans for high speed operations in Florida, but now those plans have been suspended. In this analysis FRA does not attempt to quantify benefits in the same manner as the NPRM. FRA acknowledges significant uncertainty with the development of certain high speed systems. FRA also acknowledges significant uncertainty with respect to the estimates of time savings and equipment procurement savings. As a result of this uncertainty, and the difficulty in finding reliable evidence for point estimates from which to base a sensitivity analysis, FRA describes its expectations for the benefits and uses its expert technical experience to conclude that the costs will be justified by the benefits.

The changes to geometric standards and performance standards for high-speed operations will not adversely affect any existing operations, which are now limited to Amtrak on the Northeast Corridor, but rather will promote their safe operation. In order to meet the vehicle acceleration limits of the Track Safety Standards' subpart G before the changes made in this final rule, Amtrak had, in effect, adhered to the tighter geometric standards in this rule, even though those standards were not expressly identified. If Amtrak were to have attempted to operate Acela at the maximum allowable speeds and cant deficiencies for which it was qualified, but were to have allowed track deviations to reach the previous maximum limits, the Acela trainset, because of its dynamic characteristics, would have been subject to accelerations in excess of the limits permitted. FRA's modeling has shown that Acela, as it is currently qualified to operate, will meet the safety standards in this final rule.

There will be a relatively small one-time cost (\$292,000) to program the new limits into existing geometry measuring systems discussed in the cost section below. Further, those railroads that voluntarily operate at high cant deficiencies will have to maintain their tracks to tighter limits. This cost will be offset by the reduced cost of maintaining curves where entering trains would have to brake to reduce their speeds to meet the prior cant deficiency standard, as discussed below.

FRA believes that significant benefits will arise from this rulemaking. Time savings will result from permitting trains that operate at maximum speeds up to 90 m.p.h. to travel around curves with higher cant deficiencies and thereby more rapidly and efficiently. Previously, the rule did not permit such high cant deficiency operations for these trains, which meant that they had to operate more slowly through curves, adding to trip time. Railroads will also experience cost savings when they purchase new trains for operations at speeds over 90 m.p.h. This will result from increased competition as a greater variety of equipment will be able to meet the revised vehicle/track interaction qualification requirements for speeds over 90 m.p.h. Cost savings will also result from more streamlined testing requirements for new and existing passenger trainsets, regardless of operating speed. Revised testing requirements will also make it much easier to qualify a trainset on additional track once it has been qualified on any track, and provide more flexibility for

monitoring trainset performance in service.

#### Benefits: Equipment Procurement

Future high-speed operations will be made simpler, because the railroad, if it requires equipment manufacturers to provide equipment that will meet performance requirements on minimally compliant track, will find several suppliers of off-the-shelf equipment, likely lowering bid prices, and gaining multiple bidders. Further, some high cant deficiency passenger train operations at speeds in excess of 90 m.p.h. may be able to use equipment without tilting mechanisms under the final rule, saving procurement costs.

Absent this rulemaking, FRA believes railroads would seek to have new equipment used in high-speed train operations built to performance standards at the maximum deviations permitted under the previous geometric standards, or with tilting mechanisms, or both.

FRA believes that future high-speed operations will in comparison save on bids because of the increased number of trainsets and carbuilders that will meet the final rule's standards with little or no modification compared to the number that would have met the prior rule's standards with little or no modification. Because high cant deficiency operations at passenger train speeds in excess of 90 m.p.h. would have been permitted under the prior rule, FRA generally does not believe that there is a benefit from travel time saved at these speeds, only a benefit for equipment procurement.

FRA notes that, in commenting on the economic analysis for the NPRM, which attempted to quantify the benefits of the rule changes, Amtrak stated:

The assumption that the standards simplify the design process of the equipment and would save \$2,000,000 per train set is false. The Acela example indicates the exact opposite to be true. The FRA rules, as existing and proposed, eliminate the possibility of purchasing off-the-shelf equipment. The engineering work required to design new compliant equipment alone would far outstrip any possible savings from the rules if there were any to be had.

FRA believes that the former rule would not have permitted many, and perhaps might not have permitted any, carbuilders to offer off-the-shelf equipment with little or no modification that would have met the acceleration requirements on track with geometry having the maximum allowable deviations. Under the final rule it is likely that several carbuilders could provide off-the-shelf equipment that will meet acceleration requirements on

minimally compliant track. This will lower costs through increased competition, and use of existing designs. Further, railroads may now be able to order equipment without tilting mechanisms and operate that equipment at high cant deficiencies, thus saving the costs of tilting mechanisms and making the number of available trainsets even greater. Based on the above, FRA does not agree with Amtrak's comment for the purposes of this final rule. It is not unreasonable to estimate that the equipment procurement benefits alone will justify the costs of the rule. However, even if FRA eliminates from consideration equipment procurement benefits, as a result of Amtrak's comment, FRA believes the high cant deficiency and streamlined testing requirements would justify the costs of the rule.

#### Benefits: High Cant Deficiency

The provisions for high cant deficiency operations on all track classes are permissive in nature and create no additional net costs. A railroad could either adhere to these provisions in expectation that any additional expenditure would trigger savings and result in an overall net benefit, or simply avoid triggering the provisions. High cant deficiency offers significant opportunities to reduce trip time, as it will reduce the amount of time travelled at the slowest speeds. For example, to travel a mile, a train could take three minutes at 20 m.p.h. or two minutes at 30 m.p.h. Traveling at 30 m.p.h. would reduce trip time by a minute. By contrast a train traveling 120 m.p.h. would take 5 minutes to travel ten miles, while a train traveling 150 m.p.h. would take four minutes to travel the same distance, reducing trip time by one minute relative to the train traveling 120 m.p.h. The net time savings from traveling one mile at 30 m.p.h. instead of 20 m.p.h. is the same as the time savings from traveling ten miles at 150 m.p.h. instead of 120 m.p.h. High cant deficiency can allow that kind of time savings at lower speeds, and therefore offers a relatively low-cost way of improving trip time. The United States is investing more in passenger rail transportation, and this is a very good way to make the high-speed rail system more efficient.

FRA believes that use of higher cant deficiencies will become much more common over the coming years, although, nearer term, relatively few opportunities for new operations at cant deficiencies in excess of 5 inches will present themselves. In any event, there could be a benefit to some operations from the potential enhanced speeds.

For illustrative purposes, Amtrak has placed values of \$2 million or more annually for a reduction of 1 minute in total travel time on the south end of the Northeast Corridor, and in excess of \$1 million for such a reduction on the north end of the Northeast Corridor, for its high-speed operations. FRA expects significant travel time savings on the Northeast Corridor, and eventually other routes, from the high cant deficiency provisions. These benefits are partially offset by the additional costs of maintaining track for high cant deficiency operation, but this offset is roughly two orders of magnitude less than the benefits. Moreover, the additional maintenance costs are at least partially offset by reduced track maintenance from passenger trains that would otherwise have subjected rail to braking forces at entries to curves, and by efficiency savings because the passenger trains can clear the track segments more rapidly so that other trains can use the tracks.

FRA also notes that there is no procurement benefit considered for passenger train operations at speeds no greater than 90 m.p.h, principally because these operations were not permitted to operate at high cant deficiency under the prior rule. Similarly, the time savings from high cant deficiency for passenger operations at speeds in excess of 90 m.p.h. already existed and is not included in the high cant deficiency benefit. The equipment benefit and the high cant deficiency benefit therefore apply to different classes of operations and are exclusive of each other.

#### Benefits: Streamlined Testing Requirements

Improvements in the use of monitoring equipment and streamlined qualification procedures have the potential to reduce costs, without any offsetting increases. New procedures will not require as much labor, or as expensive capital, as was required before the final rule, all else being equal. The reduced need for instrumented wheelsets, instrumented cars, and related tests could save roughly \$2 million per year on current high-speed operations (based in part on Task Force discussions), and have the potential for similar savings on planned high-speed operations. Furthermore, the current policy of the DOT is to promote balance in the Nation's transportation system in the long-term by growing the market-share of passenger rail service in intercity travel. FRA believes that this policy will result in the implementation of more high-speed rail projects that

align with the estimates used in this analysis.

In addition, FRA believes that using MCAT to extend the range of qualified equipment will result in savings greater than \$1 million per year. MCAT can work to enhance safety, because a train that is shown to be safe on minimally compliant track will likely be safe under foreseeable operating conditions. In the absence of MCAT, the train could be qualified on very good track, which might later deteriorate over time. Although accelerometers should provide indications of such deterioration, using MCAT to ensure that the train will be safe on track meeting the geometric limits adds to the life-cycle safety of a trainset, most notably because the geometry standards help limit unsafe accelerations that could cause a derailment.

FRA believes that modifications to the vehicle/track system qualification requirements themselves, as opposed to the process, will have no net impact as the changes codify current practice.

#### Benefits: Other

Certain refinements to the testing requirements will yield greater confidence in the test results and thus enhanced safety levels. Such benefits are not readily quantifiable and FRA has not attempted to quantify them.

#### Costs: Track Maintenance

When a railroad voluntarily operates passenger trains at high cant deficiencies, the track in curves must have smaller deviations, which in turn means that deviations that would not have to be adjusted in the absence of high cant deficiency operations would have to be adjusted to conform to the standards. On the other hand, if a railroad does not allow high cant deficiency operations, it requires passenger trains to slow down just before they enter curves. The braking imparts a longitudinal force in the rail, making it more likely that the rail will displace from its original alignment. When the rail displaces from its original alignment, it may now have deviations that even exceed the less restrictive standards that would have been applicable in the absence of high cant deficiency operations, and the rail must be adjusted. The process of adjusting rail is roughly the same whether the adjustment occurs because the rail moved longitudinally under braking or the rail needed to be adjusted to meet tighter geometric standards, and thus the cost is roughly equal for either adjustment. FRA believes the probability of needing to adjust the rail is roughly equivalent in either case.

FRA believes that it costs roughly \$400 to adjust a rail to restore alignment per occurrence. On good track, the kind most likely to be found in high cant deficiency passenger operations, this occurs about twice a year per mile of curve, at a cost of about \$800 per mile per year. FRA believes the difference, if any, between the frequency of such occurrences, and consequently, the maintenance costs for the track with and without high cant deficiency operations, is less than 10%, or \$80 per mile per year. FRA is not certain whether maintenance costs will be higher or lower with high cant deficiency operations. FRA expects a difference of plus or minus \$80 per mile per year in maintenance costs. Given the uncertainty as to whether the change would be a benefit or a cost, and because FRA anticipates any maintenance costs to be significantly less than the benefits of high cant deficiency operations, FRA does not find any potential maintenance costs would change its core conclusion about this rule.

#### Costs: Programming

Railroads use automated track geometry measuring systems to determine whether track geometry complies with track safety standards. The final rule adds new standards and dimensions that must be programmed into automated track geometry measuring software before the railroads can operate under the final rule. FRA is contracting to modify the software on FRA's inspection cars to record instances where deviations exceed the maximum allowed under the final rule. Although the contractor has estimated that providing and system testing the software modifications will require roughly \$73,000, the amount FRA is going to pay will fall on the government, not on regulated entities, and is not accounted for any further.

Four other entities provide automated track inspection services to railroads, and may need to update their inspection vehicles' software to accommodate the new requirements of the final rule. FRA believes that the \$73,000 figure provided by FRA's contractor may be higher than the cost to an entity providing services over a more limited set of tracks, or for other reasons, but that the higher number is a ceiling on likely costs, and is conservative. Thus FRA estimates that it will cost 4 times \$73,000, or \$292,000 for a one-time expense of updating track inspection software. The programming modifications must occur before the railroads operate under the final rule, so the costs are not discounted.

Offsetting any additional programming costs, but not accounted for in the benefits, the new geometry limits should avoid instances where an excessive acceleration is recorded but the track is within geometry limits, as happens with some frequency under the prior rule. The cost for a railroad to inspect the track in the area of an exceedance of an acceleration limit is more than \$100 per instance, and FRA believes the new limits will reduce such instances by at least two per day, more than offsetting any programming costs. As the extent of high cant deficiency operations or high speed operations increases, the number of such exceedances would have increased in the absence of the final rule.

#### Total Costs

Total costs are \$292,000, whether using a 3 percent or 7 percent discount rate, as they are one-time costs. Annualized total costs over twenty years are \$27,563 per year, using a 7 percent discount rate, or \$19,627 using a 3 percent discount rate.

#### Net Benefits

FRA expects the equipment procurement, time savings, and streamlined testing benefits to vastly exceed the programming costs of the rule. It is not unreasonable to estimate that the equipment procurement benefits alone will justify the costs of the rule. However, even if FRA eliminates from consideration equipment procurement benefits, as a result of Amtrak's comment, FRA believes the high cant deficiency and streamlined testing requirements would justify the costs of the rule. FRA concludes the rule will have net benefits.

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

To ensure that the potential impact of this rule on small entities was properly considered, FRA developed this rule in accordance with Executive Order 13272 ("Proper Consideration of Small Entities in Agency Rulemaking") and DOT's policies and procedures to promote compliance with the Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*). The Regulatory Flexibility Act requires an agency to review regulations to assess their impact on small entities. An agency must conduct a regulatory flexibility analysis unless it determines and certifies that a rule is not expected to have a significant economic impact

on a substantial number of small entities.

The U.S. Small Business Administration (SBA) stipulates in its "Size Standards" that the largest a railroad business firm that is "for-profit" may be, and still be classified as a "small entity," is 1,500 employees for "Line-Haul Operating Railroads," and 500 employees for "Switching and Terminal Establishments." "Small entity" is defined in the Regulatory Flexibility Act as a small business that is not independently owned and operated, and is not dominant in its field of operation. Federal agencies may adopt their own size standards for small entities in consultation with SBA and in conjunction with public comment. Pursuant to that authority, FRA has published a final statement of agency policy that formally establishes "small entities" or "small businesses" as being railroads, contractors, and hazardous materials shippers that meet the revenue requirements of a Class III railroad as set forth in 49 CFR 1201.1-1, which is \$20 million or less in inflation-adjusted annual revenues; and commuter railroads or small governmental jurisdictions that serve populations of 50,000 or less. See 68 FR 24891, May 9, 2003, codified at Appendix C to 49 CFR, part 209. The \$20 million-limit is based on the Surface Transportation Board's revenue threshold for a Class III railroad. Railroad revenue is adjusted for inflation by applying a revenue deflator formula in accordance with 49 CFR 1201.1-1. FRA has applied this definition for this rulemaking.

There are currently two intercity passenger railroads, Amtrak and the Alaska Railroad Corporation. Neither is considered to be a small entity. Amtrak is a Class I railroad and the Alaska Railroad is a Class II railroad. The Alaska Railroad is owned by the State of Alaska, which has a population well in excess of 50,000.

There are currently 28 commuter railroad operations in the U.S. Most commuter railroads are part of larger transportation organizations that receive Federal funds and serve major metropolitan areas with populations greater than 50,000. However, two commuter rail operations do not fall in this category and are considered small entities. One provides service to and from a sporting venue in Iowa City, Iowa; the second provides service between North Creek and Saratoga Springs, New York. Both operations are conducted at low speeds—with only

one reaching a maximum speed as high as 30 m.p.h. Consequently, neither entity will be impacted by the requirements of this rule affecting high-speed operations. Moreover, it is extremely unlikely that either entity would engage in high cant deficiency operations because such operations require relatively expensive rolling equipment capable of tilting to provide a safe and comfortable ride to passengers.

At present, no small entities will be affected by either the high-speed provisions or the high cant deficiency provisions. Small railroads hosting passenger operations can recoup any costs of maintaining infrastructure, through trackage agreements which enable host railroads to recover marginal costs of permitting passenger operations over their tracks, to accommodate high cant deficiency operations, or they can refuse to host such operations, as appropriate. To the extent that new passenger railroads are small entities, and want to take advantage of high cant deficiency and have the means to do so, they will benefit. Nonetheless, FRA does not foresee any situation under which a small entity might be affected by the high-speed provisions in this final rule.

In the NPRM, FRA requested comments on both the analysis and the certification that there will be no significant economic impact on a substantial number of small entities. No comment was received.

Based on these determinations, I certify that this action will not have a significant economic impact on a substantial number of small entities.

#### C. Paperwork Reduction Act

The information collection requirements in this final rule have been submitted for approval to the Office of Management and Budget (OMB) under the Paperwork Reduction Act of 1995, 44 U.S.C. 3501 *et seq.* The sections that contain both new and current information collection requirements, and the estimated time to fulfill each requirement, are summarized in the following table. Please note that the table does not include those information collection requirements added by the Concrete Crossties rulemaking, see 76 FR 18073 (April 1, 2011), 76 FR 55819 (Sept. 9, 2011), as they are covered under a separate approval, OMB No. 2130-0592, which is current until October 31, 2014.

CFR Section	Respondent universe	Total annual responses	Average time per response	Total annual burden hours
213.4—Excepted Track:				
—Designation of track as excepted.	200 railroads .....	20 orders .....	15 minutes .....	5
—Notification to FRA about removal of excepted track.	200 railroads .....	15 notifications .....	10 minutes .....	3
213.5—Responsibility for Compliance.	728 railroads .....	10 notifications .....	8 hours .....	80
213.7—Designation of Qualified Persons to Supervise Certain Renewals and Inspect Track:				
—Designations .....	728 railroads .....	1,500 names .....	10 minutes .....	250
—Employees trained in CWR procedures.	31 railroads .....	80,000 employees .....	24 hours .....	1,920,000
—Written authorizations and recorded Exams.	31 railroads .....	80,000 authorizations + 80,000 exams.	10 minutes + 60 minutes .....	93,333
—Designations (partially qualified) under paragraph (c) of this section.	31 railroads .....	250 names .....	30 minutes .....	125
213.17—Waivers .....	728 railroads .....	6 petitions .....	112 hours .....	672
213.57—Curves; Elevation and Speed Limitations:				
—Requests to FRA for vehicle type approval.	728 railroads .....	2 requests/documents .....	80 hours .....	160
—Written notification to FRA prior to implementation of higher curving speeds.	728 railroads .....	2 notifications .....	8 hours .....	16
—Written consent of track owner(s) by railroad providing service over the track.	728 railroads .....	2 consents .....	8 hours .....	16
213.110—Gage Restraint Measurement Systems (GRMS):				
—Implementing GRMS; notices and reports.	728 railroads .....	2 notifications + 1 technical report.	24 hours .....	72
—GRMS vehicle output reports.	728 railroads .....	50 reports .....	60 minutes .....	50
—GRMS vehicle exception reports.	728 railroads .....	50 reports .....	60 minutes .....	50
—GRMS/PTLF procedures for data integrity.	728 railroads .....	4 procedure documents .....	2 hours .....	8
—GRMS training programs/sessions.	728 railroads .....	2 programs + 5 sessions .....	24 hours .....	168
—GRMS inspection records.	728 railroads .....	50 records .....	2 hours .....	100
213.118—Continuous Welded Rail (CWR); Plan Review and Approval:				
—Plans .....	728 railroads .....	728 reviewed plans .....	4 hours .....	2,912
—Notification to FRA and employees of plan effective date.	728 railroads .....	728 notifications + 80,000 notifications.	15 minutes + 2 minutes .....	2,849
—Written submissions in support of plan.	728 railroads .....	20 submissions .....	2 hours .....	40
—FRA-required revisions to CWR plan.	728 railroads .....	20 reviewed plans .....	1 hour .....	20
213.119—Continuous Welded Rail (CWR); Plan Contents:				
—Fracture report for each broken CWR joint bar.	239 railroads/1 association .....	12,000 reports .....	10 minutes .....	2,000
—Petition for technical conference on fracture reports.	1 association .....	1 petition .....	15 minutes .....	0.25
—Training programs on CWR procedures.	239 railroads/ 1 association .....	240 amended programs .....	1 hour .....	240

CFR Section	Respondent universe	Total annual responses	Average time per response	Total annual burden hours
—Annual CWR training of employees.	31 railroads .....	80,000 employees .....	30 minutes .....	40,000
—Recordkeeping (track with CWR).	239 railroads .....	2,000 records .....	10 minutes .....	333
—Recordkeeping for CWR rail joints.	239 railroads .....	360,000 records .....	2 minutes .....	12,000
—Periodic records for CWR rail joints.	239 railroads .....	480,000 records .....	1 minute .....	8,000
—Copy of track owner's CWR procedures.	728 railroads .....	239 manuals .....	10 minutes .....	40
213.233—Track Inspections:				
—Notations .....	728 railroads .....	12,500 notations .....	1 minute .....	208
213.241—Inspection Records.	728 railroads .....	1,542,089 records .....	varies .....	1,672,941
213.303—Responsibility for Compliance.	2 railroads .....	1 petition .....	8 hours .....	8
213.305—Designation of Qualified Individuals; General Qualifications:				
—Designations .....	2 railroads .....	150 designations .....	60 minutes .....	150
—Designations (partially qualified) under paragraph (d) of this section.	2 railroads .....	20 designations .....	60 minutes .....	20
213.317—Waivers .....	2 railroads .....	1 petition .....	80 hours .....	80
213.329—Curves; Elevation and Speed Limitations:				
—FRA approval of qualified vehicle types based on results of testing.	728 railroads .....	2 documents .....	80 hours .....	160
—Written notification to FRA prior to implementation of higher curving speeds.	728 railroads .....	2 notifications .....	8 hours .....	16
—Written consent of track owner(s) by railroad providing service over the track.	728 railroads .....	2 written consents .....	8 hours .....	16
213.333 Automated Vehicle-Based Inspection Systems:				
—Request for alternative measurement distance (new requirement).	10 railroads .....	1 request .....	8 hours .....	8
—Track Geometry Measurement System (TGMS) output/exception reports.	10 railroads .....	3 reports .....	40 hours .....	120
—Track/vehicle performance measurement system; copies of most recent exception records.	10 railroads .....	20 records .....	40 hours .....	800
—Notification to track personnel when on-board accelerometers indicate track related problem (new requirement).	10 railroads .....	10 notifications .....	40 hours .....	400
—Requests for an alternate location for device measuring lateral accelerations (new requirement).	10 railroads .....	10 requests .....	40 hours .....	400
—Report to FRA providing analysis of collected monitoring data (new requirement).	10 railroads .....	4 reports .....	8 hours .....	32
213.341—Initial Inspection of New Rail and Welds:				

CFR Section	Respondent universe	Total annual responses	Average time per response	Total annual burden hours
—Mill inspection; copy of manufacturer's report.	2 railroads .....	2 reports .....	16 hours .....	32
—Welding plan inspection report.	2 railroads .....	2 reports .....	16 hours .....	32
—Inspection of field welds.	2 railroads .....	125 records .....	20 minutes .....	42
213.343—Continuous welded rail (CWR):				
—Recordkeeping .....	2 railroads .....	150 records .....	10 minutes .....	25
213.345—Vehicle/Track System Qualification:				
—Qualification program for all vehicle types operating at track Class 6 speeds or above or at curving speeds above 5 inches of cant deficiency (new requirement).	10 railroads .....	10 programs .....	120 hours .....	1,200
—Qualification program for previously qualified vehicle types (new requirement).	10 railroads .....	10 programs .....	80 hours .....	800
—Written consent of track owner(s) by railroad providing service over the track (new requirement).	10 railroads .....	1 written consent .....	8 hours .....	8
213.347—Automotive or Railroad Crossings at Grade:				
—Protection plans .....	1 railroad .....	2 plans .....	8 hours .....	16
213.369—Inspection Records:				
—Record of inspection of track.	2 railroads .....	500 records .....	1 minute .....	8
—Internal defect inspections and remedial action taken.	2 railroads .....	50 records .....	5 minutes .....	4

All estimates include the time for reviewing instructions, searching existing data sources, gathering or maintaining the needed data, and reviewing the information. Pursuant to 44 U.S.C. 3506(c)(2)(B), FRA solicits comments concerning the following: whether these information collection requirements are necessary for the proper performance of the functions of FRA, including whether the information has practical utility; the accuracy of FRA's estimates of the burden of the information collection requirements; the quality, utility, and clarity of the information to be collected; and whether the burden of collection of information on those who are to respond, including through the use of automated collection techniques or other forms of information technology, may be minimized. For information or a copy of the paperwork package submitted to OMB, contact Mr. Robert Brogan, Information Clearance Officer, Federal Railroad Administration, at

202-493-6292, or Ms. Kimberly Toone, Federal Railroad Administration, at 202-493-6132.

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

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

FRA is not authorized to impose a penalty on persons for violating

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

*D. Federalism Implications*

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



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

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

However, this final rule could have preemptive effect by operation of law under certain provisions of the Federal railroad safety statutes, specifically the former Federal Railroad Safety Act of 1970, repealed and recodified at 49 U.S.C. 20106. Section 20106 provides that States may not adopt or continue in effect any law, regulation, or order related to railroad safety or security that covers the subject matter of a regulation prescribed or order issued by the Secretary of Transportation (with respect to railroad safety matters) or the Secretary of Homeland Security (with respect to railroad security matters), except when the State law, regulation, or order qualifies under the “essentially local safety or security hazard” exception to section 20106.

In sum, FRA has analyzed this final rule in accordance with the principles and criteria contained in Executive Order 13132. As explained above, FRA has determined that this final rule has no federalism implications, other than the possible preemption of State laws under Federal railroad safety statutes, specifically 49 U.S.C. 20106. Accordingly, FRA has determined that

preparation of a federalism summary impact statement for this final rule is not required.

#### *E. Environmental Impact*

FRA has evaluated this final rule in accordance with its “Procedures for Considering Environmental Impacts” (FRA’s Procedures) (*see* 64 FR 28545, May 26, 1999) as required by the National Environmental Policy Act (*see* 42 U.S.C. 4321 *et seq.*), other environmental statutes, Executive Orders, and related regulatory requirements. FRA has determined that this action is not a major FRA action (requiring the preparation of an environmental impact statement or environmental assessment) because it is categorically excluded from detailed environmental review pursuant to section 4(c)(20) of FRA’s Procedures. *See* 64 FR 28547, May 26, 1999. In accordance with section 4(c) and (e) of FRA’s Procedures, the agency has further concluded that no extraordinary circumstances exist with respect to this final rule that might trigger the need for a more detailed environmental review. As a result, FRA finds that this final rule is not a major Federal action significantly affecting the quality of the human environment.

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

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

#### *G. Energy Impact*

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

FRA has evaluated this final rule in accordance with Executive Order 13211. FRA has determined that this final rule is not likely to have a significant adverse effect on the supply, distribution, or use of energy. Consequently, FRA has determined that this regulatory action is not a “significant energy action” within the meaning of the Executive Order.

#### *H. Trade Impact*

The Trade Agreements Act of 1979 (Pub. L. 96–39, 19 U.S.C. 2501 *et seq.*) prohibits Federal agencies from engaging in any standards or related activities that create unnecessary obstacles to the foreign commerce of the United States. Legitimate domestic objectives, such as safety, are not considered to be unnecessary obstacles. The statute also requires consideration of international standards and, where appropriate, that they be the basis for U.S. standards.

FRA has assessed the potential effect of this rulemaking on foreign commerce and believes that its requirements are consistent with the Trade Agreements Act. The requirements are safety standards, which, as noted, are not considered unnecessary obstacles to trade. Moreover, FRA has sought, to the extent practicable, to state the requirements in terms of the performance desired, rather than in more narrow terms restricted to a particular vehicle design, so as not to limit different, compliant designs by any manufacturer—foreign or domestic. FRA has also taken into consideration international standards for the safe interaction of vehicles and the track over which they operate, such as

standards for steady-state, lateral acceleration of passenger carboodies.

*I. Privacy Act*

Anyone is able to search the electronic form of any comment or petition received into any of FRA's dockets by the name of the individual submitting the comment or petition (or signing the comment or petition, if submitted on behalf of an association, business, labor union, etc.). Please see the privacy notice at <http://www.regulations.gov/#!privacyNotice>. You may review DOT's complete Privacy Act Statement in the **Federal Register** published on April 11, 2000 (65 FR 19477–19478).

**List of Subjects**

*49 CFR Part 213*

Incorporation by reference, Penalties, Railroad safety, Reporting and recordkeeping requirements.

*49 CFR Part 238*

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

**The Rule**

For the reasons discussed in the preamble, FRA amends parts 213 and

238 of chapter II, subtitle B, of title 49, Code of Federal Regulations, as follows:

**PART 213—[AMENDED]**

■ 1. The authority citation for part 213 is revised to read as follows:

**Authority:** 49 U.S.C. 20102–20114 and 20142; Sec. 403, Div. A, Public Law 110–432, 122 Stat. 4885; 28 U.S.C. 2461, note; and 49 CFR 1.89.

**Subpart A—General**

■ 2. Section 213.1 is amended by revising the second sentence of paragraph (a) to read as follows:

**§ 213.1 Scope of part.**

(a) \* \* \* In general, the requirements prescribed in this part apply to specific track conditions existing in isolation.  
\* \* \*

\* \* \* \* \*

■ 3. Section 213.7 is amended by revising paragraphs (a)(2)(i) and (b)(2)(i) to read as follows:

**§ 213.7 Designation of qualified persons to supervise certain renewals and inspect track.**

(a) \* \* \*  
(2) \* \* \*

(i) Knows and understands the requirements of this part that apply to

the restoration and renewal of the track for which he or she is responsible;

\* \* \* \* \*

(b) \* \* \*

(2) \* \* \*

(i) Knows and understands the requirements of this part that apply to the inspection of the track for which he or she is responsible;

\* \* \* \* \*

■ 4. Section 213.14 is added to read as follows:

**§ 213.14 Application of requirements to curved track.**

Unless otherwise provided in this part, requirements specified for curved track apply only to track having a curvature greater than 0.25 degree.

**Subpart C—Track Geometry**

■ 5. Section 213.55 is revised to read as follows:

**§ 213.55 Track alinement.**

(a) Except as provided in paragraph (b) of this section, alinement may not deviate from uniformity more than the amount prescribed in the following table:

Class of track	Tangent track	Curved track	
	The deviation of the mid-offset from a 62-foot line <sup>1</sup> may not be more than— (inches)	The deviation of the mid-ordinate from a 31-foot chord <sup>2</sup> may not be more than— (inches)	The deviation of the mid-ordinate from a 62-foot chord <sup>2</sup> may not be more than— (inches)
Class 1 track .....	5	<sup>3</sup> N/A	5
Class 2 track .....	3	<sup>3</sup> N/A	3
Class 3 track .....	1¾	1¼	1¾
Class 4 track .....	1½	1	1½
Class 5 track .....	¾	½	¾

<sup>1</sup> The ends of the line shall be at points on the gage side of the line rail, five-eighths of an inch below the top of the railhead. Either rail may be used as the line rail; however, the same rail shall be used for the full length of that tangential segment of the track.

<sup>2</sup> The ends of the chord shall be at points on the gage side of the outer rail, five-eighths of an inch below the top of the railhead.

<sup>3</sup> N/A—Not Applicable

(b) For operations at a qualified cant deficiency, E<sub>u</sub>, of more than 5 inches, the alinement of the outside rail of the curve may not deviate from uniformity more than the amount prescribed in the following table:

Class of track	Curved track	
	The deviation of the mid-ordinate from a 31-foot chord <sup>1</sup> may not be more than— (inches)	The deviation of the mid-ordinate from a 62-foot chord <sup>1</sup> may not be more than— (inches)
Class 1 track <sup>2</sup> .....	<sup>3</sup> N/A	1¼
Class 2 track <sup>2</sup> .....	<sup>3</sup> N/A	1¼
Class 3 track .....	¾	1¼
Class 4 track .....	¾	7/8
Class 5 track .....	½	5/8

<sup>1</sup> The ends of the chord shall be at points on the gage side of the outer rail, five-eighths of an inch below the top of the railhead.

<sup>2</sup> Restraining rails or other systems may be required for derailment prevention.

<sup>3</sup> N/A—Not Applicable

■ 6. Section 213.57 is revised to read as follows:

**§ 213.57 Curves; elevation and speed limitations.**

(a) The maximum elevation of the outside rail of a curve may not be more than 8 inches on track Classes 1 and 2, and 7 inches on track Classes 3 through 5. The outside rail of a curve may not be lower than the inside rail by design, except when engineered to address specific track or operating conditions; the limits in § 213.63 apply in all cases.

(b) The maximum allowable posted timetable operating speed for each curve is determined by the following formula—

$$V_{\max} = \sqrt{\frac{E_a + E_u}{0.0007D}}$$

Where—

$V_{\max}$  = Maximum allowable posted timetable operating speed (m.p.h.).

$E_a$  = Actual elevation of the outside rail (inches).<sup>1</sup>

$E_u$  = Qualified cant deficiency<sup>2</sup> (inches) of the vehicle type.

$D$  = Degree of curvature (degrees).<sup>3</sup>

(c) All vehicles are considered qualified for operating on track with a cant deficiency,  $E_u$ , not exceeding 3 inches. Table 1 of appendix A to this part is a table of speeds computed in accordance with the formula in paragraph (b) of this section, when  $E_u$  equals 3 inches, for various elevations and degrees of curvature.

(d) Each vehicle type must be approved by FRA to operate on track with a qualified cant deficiency,  $E_u$ , greater than 3 inches. Each vehicle type must demonstrate, in a ready-for-service load condition, compliance with the requirements of either paragraph (d)(1) or (2) of this section.

(1) When positioned on a track with a uniform superelevation equal to the proposed cant deficiency:

(i) No wheel of the vehicle type unloads to a value less than 60 percent of its static value on perfectly level track; and

(ii) For passenger cars, the roll angle between the floor of the equipment and the horizontal does not exceed 8.6 degrees; or

(2) When operating through a constant radius curve at a constant speed corresponding to the proposed cant deficiency, and a test plan is submitted to and approved by FRA in accordance with § 213.345(e) and (f):

(i) The steady-state (average) load on any wheel, throughout the body of the curve, is not less than 60 percent of its static value on perfectly level track; and

(ii) For passenger cars, the steady-state (average) lateral acceleration measured on the floor of the carbody does not exceed 0.15g.

(e) The track owner or railroad shall transmit the results of the testing specified in paragraph (d) of this section to FRA's Associate Administrator for Railroad Safety/Chief Safety Officer (FRA) requesting approval for the vehicle type to operate at the desired curving speeds allowed under the formula in paragraph (b) of this section. The request shall be made in writing and contain, at a minimum, the following information—

(1) A description of the vehicle type involved, including schematic diagrams of the suspension system(s) and the estimated location of the center of gravity above top of rail;

(2) The test procedure,<sup>4</sup> including the load condition under which the testing was performed, and description of the instrumentation used to qualify the vehicle type, as well as the maximum values for wheel unloading and roll angles or accelerations that were observed during testing; and

(3) For vehicle types not subject to parts 229 or 238 of this chapter, procedures or standards in effect that relate to the maintenance of all safety-critical components of the suspension system(s) for the particular vehicle type. Safety-critical components of the suspension system are those that impact or have significant influence on the roll of the carbody and the distribution of weight on the wheels.

(f) In approving the request made pursuant to paragraph (e) of this section, FRA may impose conditions necessary for safely operating at the higher curving speeds. Upon FRA approval of the request, the track owner or railroad shall notify FRA in writing no less than 30 calendar days prior to the proposed

implementation of the approved higher curving speeds allowed under the formula in paragraph (b) of this section. The notification shall contain, at a minimum, identification of the track segment(s) on which the higher curving speeds are to be implemented.

(g) The documents required by this section must be provided to FRA by:

(1) The track owner; or

(2) A railroad that provides service with the same vehicle type over trackage of one or more track owner(s), with the written consent of each affected track owner.

(h)(1) Vehicle types permitted by FRA to operate at cant deficiencies,  $E_u$ , greater than 3 inches but not more than 5 inches shall be considered qualified under this section to operate at those permitted cant deficiencies for any track segment. The track owner or railroad shall notify FRA in writing no less than 30 calendar days prior to the proposed implementation of such curving speeds in accordance with paragraph (f) of this section.

(2) Vehicle types permitted by FRA to operate at cant deficiencies,  $E_u$ , greater than 5 inches shall be considered qualified under this section to operate at those permitted cant deficiencies only for the previously operated or identified track segment(s).

(i) For vehicle types intended to operate at any curving speed producing more than 5 inches of cant deficiency, the following provisions of subpart G of this part shall apply: §§ 213.333(a) through (g), (j)(1), (k) and (m), 213.345, and 213.369(f).

(j) As used in this section—

(1) *Vehicle* means a locomotive, as defined in § 229.5 of this chapter; a freight car, as defined in § 215.5 of this chapter; a passenger car, as defined in § 238.5 of this chapter; and any rail rolling equipment used in a train with either a freight car or a passenger car.

(2) *Vehicle type* means like vehicles with variations in their physical properties, such as suspension, mass, interior arrangements, and dimensions that do not result in significant changes to their dynamic characteristics.

■ 7. Section 213.59 is amended by revising the second sentence of paragraph (a) to read as follows:

**§ 213.59 Elevation of curved track; runoff.**

(a) \* \* \* If elevation runoff occurs in a curve, the actual minimum elevation shall be used in computing the maximum allowable posted timetable operating speed for that curve under § 213.57(b).

\* \* \* \* \*

■ 8. Section 213.63 is revised to read as follows:

<sup>1</sup> Actual elevation,  $E_a$ , for each 155-foot track segment in the body of the curve is determined by averaging the elevation for 11 points through the segment at 15.5-foot spacing. If the curve length is less than 155 feet, the points are averaged through the full length of the body of the curve.

<sup>2</sup> If the actual elevation,  $E_a$ , and degree of curvature,  $D$ , change as a result of track degradation, then the actual cant deficiency for the maximum allowable posted timetable operating speed,  $V_{\max}$ , may be greater than the qualified cant deficiency,  $E_u$ . This actual cant deficiency for each curve may not exceed the qualified cant deficiency,  $E_u$ , plus 1 inch.

<sup>3</sup> Degree of curvature,  $D$ , is determined by averaging the degree of curvature over the same track segment as the elevation.

<sup>4</sup> The test procedure may be conducted whereby all the wheels on one side (right or left) of the vehicle are raised to the proposed cant deficiency, the vertical wheel loads under each wheel are measured, and a level is used to record the angle through which the floor of the vehicle has been rotated.

**§ 213.63 Track surface.** shall maintain the surface of its track within the limits prescribed in the following table:  
 (a) Except as provided in paragraph (b) of this section, each track owner

Track surface (inches)	Class of track				
	1	2	3	4	5
The runoff in any 31 feet of rail at the end of a raise may not be more than .....	3½	3	2	1½	1
The deviation from uniform profile on either rail at the mid-ordinate of a 62-foot chord may not be more than .....	3	2¾	2¼	2	1¼
The deviation from zero crosslevel at any point on tangent or reverse crosslevel elevation on curves may not be more than .....	3	2	1¾	1¼	1
The difference in crosslevel between any two points less than 62 feet apart may not be more than* <sup>1, 2</sup> .....	3	2¼	2	1¾	1½
*Where determined by engineering decision prior to June 22, 1998, due to physical restrictions on spiral length and operating practices and experience, the variation in crosslevel on spirals per 31 feet may not be more than .....	2	1¾	1¼	1	¾

<sup>1</sup> Except as limited by § 213.57(a), where the elevation at any point in a curve equals or exceeds 6 inches, the difference in crosslevel within 62 feet between that point and a point with greater elevation may not be more than 1½ inches.

<sup>2</sup> However, to control harmonics on Class 2 through 5 jointed track with staggered joints, the crosslevel differences shall not exceed 1¼ inches in all of six consecutive pairs of joints, as created by seven low joints. Track with joints staggered less than 10 feet apart shall not be considered as having staggered joints. Joints within the seven low joints outside of the regular joint spacing shall not be considered as joints for purposes of this footnote.

(b) For operations at a qualified cant surface of the curve within the limits deficiency, E<sub>u</sub>, of more than 5 inches, each track owner shall maintain the prescribed in the following table:

Track surface (inches)	Class of track				
	1	2	3	4	5
The deviation from uniform profile on either rail at the mid-ordinate of a 31-foot chord may not be more than .....	N/A <sup>1</sup>	N/A <sup>1</sup>	1	1	1
The deviation from uniform profile on either rail at the mid-ordinate of a 62-foot chord may not be more than .....	2¼	2¼	1¾	1¼	1
The difference in crosslevel between any two points less than 10 feet apart (short warp) shall not be more than .....	2	2	1¾	1¾	1½

<sup>1</sup> N/A—Not Applicable.

■ 9. Section 213.65 is added to subpart C to read as follows:

**§ 213.65 Combined track alinement and surface deviations.**

On any curved track where operations are conducted at a qualified cant deficiency, E<sub>u</sub>, greater than 5 inches, the combination of alinement and surface deviations for the same chord length on

the outside rail in the curve, as measured by a TGMS, shall comply with the following formula:

$$\frac{3}{4} \times \left| \frac{A_m}{A_L} + \frac{S_m}{S_L} \right| \leq 1$$

Where—

- A<sub>m</sub> = measured alinement deviation from uniformity (outward is positive, inward is negative).
- A<sub>L</sub> = allowable alinement limit as per § 213.55(b) (always positive) for the class of track.
- S<sub>m</sub> = measured profile deviation from uniformity (down is positive, up is negative).
- S<sub>L</sub> = allowable profile limit as per § 213.63(b) (always positive) for the class of track.

$$\left| \frac{A_m}{A_L} + \frac{S_m}{S_L} \right| = \text{the absolute (positive) value of the result of } \frac{A_m}{A_L} + \frac{S_m}{S_L} .$$

**Subpart D—Track Structure**

■ 10. Section 213.110 is amended by revising paragraphs (c) through (f), (l), (p)(2) and (3) to read as follows:

**§ 213.110 Gage restraint measurement systems.**

\* \* \* \* \*

(c)(1) The track owner shall also provide to FRA sufficient technical data to establish compliance with the

following minimum design requirements of a GRMS vehicle:

(2) Gage restraint shall be measured between the heads of rail—

(i) At an interval not exceeding 16 inches;

(ii) Under an applied vertical load of no less than 10 kips per rail; and

(iii) Under an applied lateral load that provides for a lateral/vertical load ratio

of between 0.5 and 1.25<sup>5</sup>, and a load severity greater than 3 kips but less than 8 kips per rail.

(d) Load severity is defined by the formula:

$$S = L - cV$$

Where—

<sup>5</sup> GRMS equipment using load combinations developing L/V ratios that exceed 0.8 shall be operated with caution to protect against the risk of wheel climb by the test wheelset.

S = Load severity, defined as the lateral load applied to the fastener system (kips).  
 L = Actual lateral load applied (kips).  
 c = Coefficient of friction between rail/tie, which is assigned a nominal value of 0.4.  
 V = Actual vertical load applied (kips), or static vertical wheel load if vertical load is not measured.

(e) The measured gage values shall be converted to a Projected Loaded Gage 24 (PLG24) as follows—  
 PLG24 = UTG + A × (LTG – UTG)  
 Where—  
 UTG = Unloaded track gage measured by the GRMS vehicle at a point no less than 10 feet from any lateral or vertical load application.

LTG = Loaded track gage measured by the GRMS vehicle at a point no more than 12 inches from the lateral load application point.  
 A = The extrapolation factor used to convert the measured loaded gage to expected loaded gage under a 24-kip lateral load and a 33-kip vertical load.  
 For all track—

$$A = \frac{13.513}{(L - 0.258 \times V) - .009 \times (L - 0.258 \times V)^2}$$

**Note:** The A factor shall not exceed a value of 3.184 under any valid loading configuration.

L = Actual lateral load applied (kips).  
 V = Actual vertical load applied (kips), or static vertical wheel load if vertical load is not measured.

(f) The measured gage and load values shall be converted to a Gage Widening Projection (GWP) as follows:

$$GWP = (LTG - UTG) \times \frac{8.26}{L - 0.258 \times V}$$

\* \* \* \* \*  
 (l) The GRMS record of lateral restraint shall identify two exception

levels. At a minimum, the track owner shall initiate the required remedial

action at each exception level as defined in the following table—

GRMS parameters <sup>1</sup>	If measurement value exceeds	Remedial action required
<b>First Level Exception</b>		
UTG .....	58 inches .....	(1) Immediately protect the exception location with a 10 m.p.h. speed restriction, then verify location; (2) Restore lateral restraint and maintain in compliance with PTLF criteria as described in paragraph (m) of this section; and (3) Maintain compliance with § 213.53(b) as measured with the PTLF.
LTG .....	58 inches.	
PLG24 .....	59 inches.	
GWP .....	1 inch.	
<b>Second Level Exception</b>		
LTG .....	57 <sup>3</sup> / <sub>4</sub> inches on Class 4 and 5 track <sup>2</sup> .	(1) Limit operating speed to no more than the maximum allowable under § 213.9 for Class 3 track, then verify location; (2) Maintain in compliance with PTLF criteria as described in paragraph (m) of this section; and (3) Maintain compliance with § 213.53(b) as measured with the PTLF.
PLG24 .....	58 inches.	
GWP .....	0.75 inch.	

<sup>1</sup> Definitions for the GRMS parameters referenced in this table are found in paragraph (p) of this section.

<sup>2</sup> This note recognizes that good track will typically increase in total gage by as much as one-quarter of an inch due to outward rail rotation under GRMS loading conditions. For Class 2 and 3 track, the GRMS LTG values are also increased by one-quarter of inch to a maximum of 58 inches. However, for any class of track, GRMS LTG values in excess of 58 inches are considered First Level exceptions and the appropriate remedial action(s) must be taken by the track owner. This 1/4-inch increase in allowable gage applies only to GRMS LTG. For gage measured by traditional methods, or with the use of the PTLF, the table in § 213.53(b) applies.

\* \* \* \* \*  
 (p) \* \* \*  
 (2) *Gage Widening Projection (GWP)* means the measured gage widening, which is the difference between loaded and unloaded gage, at the applied loads, projected to reference loads of 16 kips of lateral force and 33 kips of vertical force.

(3) *L/V ratio* means the numerical ratio of lateral load applied at a point on the rail to the vertical load applied at

that same point. GRMS design requirements specify an L/V ratio of between 0.5 and 1.25.

\* \* \* \* \*

**Subpart G—Train Operations at Track Classes 6 and Higher**

■ 11. Section 213.305 is amended by revising paragraphs (a)(2)(i) and (b)(2)(i) to read as follows:

**§ 213.305 Designation of qualified individuals; general qualifications.**

\* \* \* \* \*

(a) \* \* \*

(2) \* \* \*

(i) Knows and understands the requirements of this subpart that apply to the restoration and renewal of the track for which he or she is responsible;

\* \* \* \* \*

(b) \* \* \*

(2) \* \* \*

(i) Knows and understands the requirements of this subpart that apply to the inspection of the track for which he or she is responsible.

\* \* \* \* \*

■ 12. Section 213.307 is amended by revising the section heading and paragraph (a) to read as follows:

**§ 213.307 Classes of track: operating speed limits.**

(a) Except as provided in paragraph (b) of this section and as otherwise provided in this subpart G, the following maximum allowable speeds apply:

Over track that meets all of the requirements prescribed in this subpart for—	The maximum allowable operating speed for trains is <sup>1</sup>
Class 6 track .....	110 m.p.h.
Class 7 track .....	125 m.p.h.
Class 8 track .....	160 m.p.h. <sup>2</sup>

Over track that meets all of the requirements prescribed in this subpart for—	The maximum allowable operating speed for trains is <sup>1</sup>
Class 9 track .....	220 m.p.h. <sup>2</sup>

<sup>1</sup> Freight may be transported at passenger train speeds if the following conditions are met:

(1) The vehicles utilized to carry such freight are of equal dynamic performance and have been qualified in accordance with § 213.329 and § 213.345.

(2) The load distribution and securement in the freight vehicle will not adversely affect the dynamic performance of the vehicle. The axle loading pattern is uniform and does not exceed the passenger locomotive axle loadings utilized in passenger service, if any, operating at the same maximum speed.

(3) No carrier may accept or transport a hazardous material, as defined at 49 CFR 171.8, except as provided in Column 9A of the Hazardous Materials Table (49 CFR 172.101) for movement in the same train as a passenger-carrying vehicle or in Column 9B of the Table for movement in a train with no passenger-carrying vehicles.

<sup>2</sup> Operating speeds in excess of 125 m.p.h. are authorized by this part only in conjunction with FRA regulatory approval addressing other safety issues presented by the railroad system. For operations on a dedicated right-of-way, FRA's regulatory approval may allow for the use of inspection and maintenance criteria and procedures in the alternative to those contained in this subpart, based upon a showing that at least an equivalent level of safety is provided.

\* \* \* \* \*

■ 13. Section 213.313 is added to read as follows:

**§ 213.313 Application of requirements to curved track.**

Unless otherwise provided in this part, requirements specified for curved track apply only to track having a curvature greater than 0.25 degree.

■ 14. Section 213.323 is amended by revising paragraph (b) to read as follows:

**§ 213.323 Track gage.**

\* \* \* \* \*

(b) Gage shall be within the limits prescribed in the following table:

Class of track	The gage must be at least—	But not more than—	The change of gage within 31 feet must not be greater than—
Class 6 track .....	4'8"	4'9¼"	¾"
Class 7 track .....	4'8"	4'9¼"	½"
Class 8 track .....	4'8"	4'9¼"	½"
Class 9 track .....	4'8¼"	4'9¼"	½"

■ 15. Section 213.327 is revised to read as follows:

**§ 213.327 Track alinement.**

(a) Uniformity at any point along the track is established by averaging the measured mid-chord offset values for nine consecutive points that are

centered around that point and spaced according to the following table:

Chord length	Spacing
31' .....	7'9"
62' .....	15'6"
124' .....	31'0"

(b) Except as provided in paragraph (c) of this section, a single alinement deviation from uniformity may not be more than the amount prescribed in the following table:

Class of track	Tangent/ Curved track	The deviation from uniformity of the mid-chord offset for a 31-foot chord may not be more than—(inches)	The deviation from uniformity of the mid-chord offset for a 62-foot chord may not be more than—(inches)	The deviation from uniformity of the mid-chord offset for a 124-foot chord may not be more than—(inches)
Class 6 track .....	Tangent .....	½	¾	1½
	Curved .....	½	5/8	1½
Class 7 track .....	Tangent .....	½	¾	1¼
	Curved .....	½	½	1¼
Class 8 track .....	Tangent .....	½	¾	1
	Curved .....	½	½	¾
Class 9 track .....	Tangent .....	½	½	¾
	Curved .....	½	½	¾

(c) For operations at a qualified cant deficiency, E<sub>u</sub>, of more than 5 inches, a

single alinement deviation from uniformity of the outside rail of the

curve may not be more than the amount prescribed in the following table:

Class of track	Track type	The deviation from uniformity of the mid-chord offset for a 31-foot chord may not be more than—(inches)	The deviation from uniformity of the mid-chord offset for a 62-foot chord may not be more than—(inches)	The deviation from uniformity of the mid-chord offset for a 124-foot chord may not be more than—(inches)
Class 6 track .....	Curved .....	1/2	5/8	1 1/4
Class 7 track .....	Curved .....	1/2	1/2	1
Class 8 track .....	Curved .....	1/2	1/2	3/4
Class 9 track .....	Curved .....	1/2	1/2	3/4

(d) For three or more non-overlapping deviations from uniformity in track alinement occurring within a distance equal to five times the specified chord length, each of which exceeds the limits in the following table, each track owner shall maintain the alinement of the track within the limits prescribed for each deviation:

Class of track	The deviation from uniformity of the mid-chord offset for a 31-foot chord may not be more than—(inches)	The deviation from uniformity of the mid-chord offset for a 62-foot chord may not be more than—(inches)	The deviation from uniformity of the mid-chord offset for a 124-foot chord may not be more than—(inches)
Class 6 track .....	3/8	1/2	1
Class 7 track .....	3/8	3/8	7/8
Class 8 track .....	3/8	3/8	1/2
Class 9 track .....	3/8	3/8	1/2

(e) For purposes of complying with this section, the ends of the chord shall be at points on the gage side of the rail, five-eighths of an inch below the top of the railhead. On tangent track, either rail may be used as the line rail; however, the same rail shall be used for the full length of that tangential segment of the track. On curved track, the line rail is the outside rail of the curve.

■ 16. Section 213.329 is revised to read as follows:

**§ 213.329 Curves; elevation and speed limitations.**

(a) The maximum elevation of the outside rail of a curve may not be more than 7 inches. The outside rail of a curve may not be lower than the inside rail by design, except when engineered to address specific track or operating conditions; the limits in § 213.331 apply in all cases.

(b) The maximum allowable posted timetable operating speed for each curve is determined by the following formula:

$$V_{max} = \sqrt{\frac{E_a + E_u}{0.0007D}}$$

Where—

$V_{max}$  = Maximum allowable posted timetable operating speed (m.p.h.).

$E_a$  = Actual elevation of the outside rail (inches).<sup>6</sup>

<sup>6</sup> Actual elevation,  $E_a$ , for each 155-foot track segment in the body of the curve is determined by averaging the elevation for 11 points through the segment at 15.5-foot spacing. If the curve length is

$E_u$  = Qualified cant deficiency<sup>7</sup> (inches) of the vehicle type.

$D$  = Degree of curvature (degrees).<sup>8</sup>

(c) All vehicles are considered qualified for operating on track with a cant deficiency,  $E_u$ , not exceeding 3 inches. Table 1 of appendix A to this part is a table of speeds computed in accordance with the formula in paragraph (b) of this section, when  $E_u$  equals 3 inches, for various elevations and degrees of curvature.

(d) Each vehicle type must be approved by FRA to operate on track with a qualified cant deficiency,  $E_u$ , greater than 3 inches. Each vehicle type must demonstrate, in a ready-for-service load condition, compliance with the requirements of either paragraph (d)(1) or (2) of this section.

(1) When positioned on a track with a uniform superelevation equal to the proposed cant deficiency:

(i) No wheel of the vehicle type unloads to a value less than 60 percent of its static value on perfectly level track; and

less than 155 feet, the points are averaged through the full length of the body of the curve.

<sup>7</sup> If the actual elevation,  $E_a$ , and degree of curvature,  $D$ , change as a result of track degradation, then the actual cant deficiency for the maximum allowable posted timetable operating speed,  $V_{max}$ , may be greater than the qualified cant deficiency,  $E_u$ . This actual cant deficiency for each curve may not exceed the qualified cant deficiency,  $E_u$ , plus one-half inch.

<sup>8</sup> Degree of curvature,  $D$ , is determined by averaging the degree of curvature over the same track segment as the elevation.

(ii) For passenger cars, the roll angle between the floor of the equipment and the horizontal does not exceed 8.6 degrees; or

(2) When operating through a constant radius curve at a constant speed corresponding to the proposed cant deficiency, and a test plan is submitted and approved by FRA in accordance with § 213.345(e) and (f):

(i) The steady-state (average) load on any wheel, throughout the body of the curve, is not less than 60 percent of its static value on perfectly level track; and

(ii) For passenger cars, the steady-state (average) lateral acceleration measured on the floor of the carbody does not exceed 0.15g.

(e) The track owner or railroad shall transmit the results of the testing specified in paragraph (d) of this section to FRA's Associate Administrator for Railroad Safety/Chief Safety Officer (FRA) requesting approval for the vehicle type to operate at the desired curving speeds allowed under the formula in paragraph (b) of this section. The request shall be made in writing and contain, at a minimum, the following information—

(1) A description of the vehicle type involved, including schematic diagrams of the suspension system(s) and the estimated location of the center of gravity above top of rail;

(2) The test procedure,<sup>9</sup> including the load condition under which the testing was performed, and description of the instrumentation used to qualify the vehicle type, as well as the maximum values for wheel unloading and roll angles or accelerations that were observed during testing; and

(3) For vehicle types not subject to part 238 or part 229 of this chapter, procedures or standards in effect that relate to the maintenance of all safety-critical components of the suspension system(s) for the particular vehicle type. Safety-critical components of the suspension system are those that impact or have significant influence on the roll of the carbody and the distribution of weight on the wheels.

(f) In approving the request made pursuant to paragraph (e) of this section, FRA may impose conditions necessary for safely operating at the higher curving speeds. Upon FRA approval of the request, the track owner or railroad shall notify FRA in writing no less than 30 calendar days prior to the proposed implementation of the approved higher curving speeds allowed under the formula in paragraph (b) of this section.

The notification shall contain, at a minimum, identification of the track segment(s) on which the higher curving speeds are to be implemented.

(g) The documents required by this section must be provided to FRA by:

- (1) The track owner; or
- (2) A railroad that provides service with the same vehicle type over trackage of one or more track owner(s), with the written consent of each affected track owner.

(h) (1) Vehicle types permitted by FRA to operate at cant deficiencies,  $E_u$ , greater than 3 inches but not more than 5 inches shall be considered qualified under this section to operate at those permitted cant deficiencies for any Class 6 track segment. The track owner or railroad shall notify FRA in writing no less than 30 calendar days prior to the proposed implementation of such curving speeds in accordance with paragraph (f) of this section.

(2) Vehicle types permitted by FRA to operate at cant deficiencies,  $E_u$ , greater than 5 inches on Class 6 track, or greater than 3 inches on Class 7 through 9 track, shall be considered qualified under this section to operate at those permitted

cant deficiencies only for the previously operated or identified track segments(s). Operation of these vehicle types at such cant deficiencies and track class on any other track segment is permitted only in accordance with the qualification requirements in this subpart.

(i) As used in this section and in §§ 213.333 and 213.345—

(1) *Vehicle* means a locomotive, as defined in § 229.5 of this chapter; a freight car, as defined in § 215.5 of this chapter; a passenger car, as defined in § 238.5 of this chapter; and any rail rolling equipment used in a train with either a freight car or a passenger car.

(2) *Vehicle type* means like vehicles with variations in their physical properties, such as suspension, mass, interior arrangements, and dimensions that do not result in significant changes to their dynamic characteristics.

■ 17. Section 213.331 is revised to read as follows:

**§ 213.331 Track surface.**

(a) For a single deviation in track surface, each track owner shall maintain the surface of its track within the limits prescribed in the following table:

Track surface (inches)	Class of track			
	6	7	8	9
The deviation from uniform <sup>1</sup> profile on either rail at the mid-ordinate of a 31-foot chord may not be more than .....	1	1	¾	½
The deviation from uniform profile on either rail at the mid-ordinate of a 62-foot chord may not be more than .....	1	1	1	¾
Except as provided in paragraph (b) of this section, the deviation from uniform profile on either rail at the mid-ordinate of a 124-foot chord may not be more than .....	1¾	1½	1¼	1
The deviation from zero crosslevel at any point on tangent track may not be more than <sup>2</sup> .....	1	1	1	1
Reverse elevation on curves may not be more than .....	½	½	½	½
The difference in crosslevel between any two points less than 62 feet apart may not be more than <sup>3</sup> .....	1½	1½	1¼	1
On curved track, the difference in crosslevel between any two points less than 10 feet apart (short warp) may not be more than .....	1¼	1⅛	1	¾

<sup>1</sup> Uniformity for profile is established by placing the midpoint of the specified chord at the point of maximum measurement.

<sup>2</sup> If physical conditions do not permit a spiral long enough to accommodate the minimum length of runoff, part of the runoff may be on tangent track.

<sup>3</sup> However, to control harmonics on jointed track with staggered joints, the crosslevel differences shall not exceed 1 inch in all of six consecutive pairs of joints, as created by seven low joints. Track with joints staggered less than 10 feet apart shall not be considered as having staggered joints. Joints within the seven low joints outside of the regular joint spacing shall not be considered as joints for purposes of this footnote.

(b) For operations at a qualified cant deficiency,  $E_u$ , of more than 5 inches, a single deviation in track surface shall be within the limits prescribed in the following table:

Track surface (inches)	Class of track			
	6	7	8	9
The difference in crosslevel between any two points less than 10 feet apart (short warp) may not be more than .....	1¼	1	1 <sup>1</sup>	¾
The deviation from uniform profile on either rail at the mid-ordinate of a 124-foot chord may not be more than .....	1½	1¼	1¼	1

<sup>1</sup> For curves with a qualified cant deficiency,  $E_u$ , of more than 7 inches, the difference in crosslevel between any two points less than 10 feet apart (short warp) may not be more than three-quarters of an inch.

<sup>9</sup> The test procedure may be conducted whereby all the wheels on one side (right or left) of the vehicle are raised to the proposed cant deficiency,

the vertical wheel loads under each wheel are measured, and a level is used to record the angle

through which the floor of the vehicle has been rotated.



(c) For three or more non-overlapping deviations in track surface occurring within a distance equal to five times the specified chord length, each of which exceeds the limits in the following table, each track owner shall maintain the surface of the track within the limits prescribed for each deviation:

Track surface (inches)	Class of track			
	6	7	8	9
The deviation from uniform profile on either rail at the mid-ordinate of a 31-foot chord may not be more than .....	3/4	3/4	1/2	3/8
The deviation from uniform profile on either rail at the mid-ordinate of a 62-foot chord may not be more than .....	3/4	3/4	3/4	1/2
The deviation from uniform profile on either rail at the mid-ordinate of a 124-foot chord may not be more than .....	1 1/4	1	7/8	5/8

■ 18. Section 213.332 is added to read as follows:

**§ 213.332 Combined track alinement and surface deviations.**

(a) This section applies to any curved track where operations are conducted at a qualified cant deficiency,  $E_u$ , greater than 5 inches, and to all Class 9 track, either curved or tangent.

(b) For the conditions defined in paragraph (a) of this section, the

combination of alinement and surface deviations for the same chord length on the outside rail in a curve and on any of the two rails of a tangent section, as measured by a TGMS, shall comply with the following formula:

$$\frac{3}{4} \times \left| \frac{A_m}{A_L} + \frac{S_m}{S_L} \right| \leq 1$$

Where—

- $A_m$  = measured alinement deviation from uniformity (outward is positive, inward is negative).
- $A_L$  = allowable alinement limit as per § 213.327(c) (always positive) for the class of track.
- $S_m$  = measured profile deviation from uniformity (down is positive, up is negative).
- $S_L$  = allowable profile limit as per § 213.331(a) and § 213.331(b) (always positive) for the class of track.

$$\left| \frac{A_m}{A_L} + \frac{S_m}{S_L} \right| = \text{the absolute (positive) value of the result of } \frac{A_m}{A_L} + \frac{S_m}{S_L} .$$

■ 19. Section 213.333 is amended by revising the section heading, paragraphs (a), (b)(1) and (2), and (c), paragraph (g) introductory text, paragraphs (h) through (m), and the Vehicle/Track Interaction Safety Limits table to read as follows:

**§ 213.333 Automated vehicle-based inspection systems.**

(a) A qualifying Track Geometry Measurement System (TGMS) shall be operated at the following frequency:

(1) For operations at a qualified cant deficiency,  $E_u$ , of more than 5 inches on track Classes 1 through 5, at least twice per calendar year with not less than 120 days between inspections.

(2) For track Class 6, at least once per calendar year with not less than 170 days between inspections. For operations at a qualified cant deficiency,  $E_u$ , of more than 5 inches on track Class 6, at least twice per calendar year with not less than 120 days between inspections.

(3) For track Class 7, at least twice within any 120-day period with not less than 25 days between inspections.

(4) For track Classes 8 and 9, at least twice within any 60-day period with not less than 12 days between inspections.

(b) \* \* \*

(1) Track geometry measurements shall be taken no more than 3 feet away

from the contact point of wheels carrying a vertical load of no less than 10 kips per wheel, unless otherwise approved by FRA;

(2) Track geometry measurements shall be taken and recorded on a distance-based sampling interval preferably at 1 foot not exceeding 2 feet; and

\* \* \* \* \*

(c) A qualifying TGMS shall be capable of measuring and processing the necessary track geometry parameters to determine compliance with—

(1) For operations at a qualified cant deficiency,  $E_u$ , of more than 5 inches on track Classes 1 through 5: § 213.53, Track gage; § 213.55(b), Track alinement; § 213.57, Curves; elevation and speed limitations; § 213.63, Track surface; and § 213.65, Combined track alinement and surface deviations.

(2) For track Classes 6 through 9: § 213.323, Track gage; § 213.327, Track alinement; § 213.329, Curves; elevation and speed limitations; § 213.331, Track surface; and for operations at a cant deficiency of more than 5 inches § 213.332, Combined track alinement and surface deviations.

\* \* \* \* \*

(g) The track owner or railroad shall maintain for a period of one year following an inspection performed by a qualifying TGMS, a copy of the plot and

the exception report for the track segment involved, and additional records which:

\* \* \* \* \*

(h) For track Classes 8 and 9, a qualifying Gage Restraint Measurement System (GRMS) shall be operated at least once per calendar year with at least 170 days between inspections. The lateral capacity of the track structure shall not permit a Gage Widening Projection (GWP) greater than 0.5 inch.

(i) A GRMS shall meet or exceed minimum design requirements specifying that—

(1) Gage restraint shall be measured between the heads of the rail:

(i) At an interval not exceeding 16 inches;

(ii) Under an applied vertical load of no less than 10 kips per rail; and

(iii) Under an applied lateral load that provides a lateral/vertical load ratio of between 0.5 and 1.25,<sup>10</sup> and a load severity greater than 3 kips but less than 8 kips per rail. Load severity is defined by the formula:

$$S = L - cV$$

Where—

<sup>10</sup> GRMS equipment using load combinations developing L/V ratios that exceed 0.8 shall be operated with caution to protect against the risk of wheel climb by the test wheelset.

S = Load severity, defined as the lateral load applied to the fastener system (kips).  
 L = Actual lateral load applied (kips).  
 c = Coefficient of friction between rail/tie, which is assigned a nominal value of 0.4.

V = Actual vertical load applied (kips), or static vertical wheel load if vertical load is not measured.

(2) The measured gage and load values shall be converted to a GWP as follows:

$$GWP = (LTG - UTG) \times \frac{8.26}{L - 0.258 \times V}$$

Where—

UTG = Unloaded track gage measured by the GRMS vehicle at a point no less than 10 feet from any lateral or vertical load application.

LTG = Loaded track gage measured by the GRMS vehicle at a point no more than 12 inches from the lateral load application.

L = Actual lateral load applied (kips).

V = Actual vertical load applied (kips), or static vertical wheel load if vertical load is not measured.

GWP = Gage Widening Projection, which means the measured gage widening, which is the difference between loaded and unloaded gage, at the applied loads, projected to reference loads of 16 kips of lateral force and 33 kips of vertical force.

(j) As further specified for the combination of track class, cant deficiencies, and vehicles subject to paragraphs (j)(1) through (3) of this section, a vehicle having dynamic response characteristics that are representative of other vehicles assigned to the service shall be operated over the route at the revenue speed profile. The vehicle shall either be instrumented or equipped with a portable device that monitors onboard instrumentation on trains. Track personnel shall be notified when onboard accelerometers indicate a possible track-related problem. Testing shall be conducted at the frequencies specified in paragraphs (j)(1) through (3) of this section, unless otherwise determined by FRA after reviewing the test data required by this subpart.

(1) For operations at a qualified cant deficiency,  $E_u$ , of more than 5 inches on track Classes 1 through 6, carbody acceleration shall be monitored at least

once each calendar quarter with not less than 25 days between inspections on at least one passenger car of each type that is assigned to the service; and

(2) For operations at track Class 7 speeds, carbody and truck accelerations shall be monitored at least twice within any 60-day period with not less than 12 days between inspections on at least one passenger car of each type that is assigned to the service; and

(3) For operations at track Class 8 or 9 speeds, carbody acceleration shall be monitored at least four times within any 7-day period with not more than 3 days between inspections on at least one non-passenger and one passenger carrying vehicle of each type that is assigned to the service, as appropriate. Truck acceleration shall be monitored at least twice within any 60-day period with not less than 12 days between inspections on at least one passenger carrying vehicle of each type that is assigned to the service, as appropriate.

(k)(1) The instrumented vehicle or the portable device, as required in paragraph (j) of this section, shall monitor lateral and vertical accelerations of the carbody. The accelerometers shall be attached to the carbody on or under the floor of the vehicle, as near the center of a truck as practicable.

(2) In addition, a device for measuring lateral accelerations shall be mounted on a truck frame at a longitudinal location as close as practicable to an axle's centerline (either outside axle for trucks containing more than 2 axles), or, if approved by FRA, at an alternate

location. After monitoring this data for 2 years, or 1 million miles, whichever occurs first, the track owner or railroad may petition FRA for exemption from this requirement.

(3) If any of the carbody lateral, carbody vertical, or truck frame lateral acceleration safety limits in this section's table of vehicle/track interaction safety limits is exceeded, corrective action shall be taken as necessary. Track personnel shall be notified when the accelerometers indicate a possible track-related problem.

(l) For track Classes 8 and 9, the track owner or railroad shall submit a report to FRA, once each calendar year, which provides an analysis of the monitoring data collected in accordance with paragraphs (j) and (k) of this section. Based on a review of the report, FRA may require that an instrumented vehicle having dynamic response characteristics that are representative of other vehicles assigned to the service be operated over the track at the revenue speed profile. The instrumented vehicle shall be equipped to measure wheel/rail forces. If any of the wheel/rail force limits in this section's table of vehicle/track interaction safety limits is exceeded, appropriate speed restrictions shall be applied until corrective action is taken.

(m) The track owner or railroad shall maintain a copy of the most recent exception records for the inspections required under paragraphs (j), (k), and (l) of this section, as appropriate.

### Vehicle/Track Interaction Safety Limits

Wheel-Rail Forces <sup>1</sup>			
Parameter	Safety Limit	Filter/ Window	Requirements
Single Wheel Vertical Load Ratio	$\geq 0.15$	5 ft	No wheel of the vehicle shall be permitted to unload to less than 15 percent of the static vertical wheel load for 5 or more continuous feet. The static vertical wheel load is defined as the load that the wheel would carry when stationary on level track.
Single Wheel L/V Ratio	$\leq \frac{\tan(\delta) - 0.5}{1 + 0.5 \tan(\delta)}$	5 ft	The ratio of the lateral force that any wheel exerts on an individual rail to the vertical force exerted by the same wheel on the rail shall not be greater than the safety limit calculated for the wheel's flange angle ( $\delta$ ) for 5 or more continuous feet.
Net Axle Lateral L/V Ratio	$\leq 0.4 + \frac{5.0}{V_a}$	5 ft	The net axle lateral force, in kips, exerted by any axle on the track shall not exceed a total of 5 kips plus 40 percent of the static vertical load that the axle exerts on the track for 5 or more continuous feet. <i>V<sub>a</sub></i> = static vertical axle load (kips)
Truck Side L/V Ratio	$\leq 0.6$	5 ft	The ratio of the lateral forces that the wheels on one side of any truck exert on an individual rail to the vertical forces exerted by the same wheels on that rail shall not be greater than 0.6 for 5 or more continuous feet.
Carbody Accelerations <sup>2</sup>			
Parameter	Passenger Cars	Other Vehicles	Requirements
Carbody Lateral (Transient)	$\leq 0.65g$ peak-to-peak 1 sec window <sup>3</sup> excludes peaks < 50 msec	$\leq 0.75g$ peak-to-peak 1 sec window <sup>3</sup> excludes peaks < 50 msec	The peak-to-peak accelerations, measured as the algebraic difference between the two extreme values of measured acceleration in any 1-second time period, excluding any peak lasting less than 50 milliseconds, shall not

			exceed 0.65g and 0.75g for passenger cars and other vehicles, respectively.
Carbody Lateral (Sustained Oscillatory)	$\leq 0.10g \text{ RMS}_t^4$ 4 sec window <sup>3</sup> 4 sec sustained	$\leq 0.12g \text{ RMS}_t^4$ 4 sec window <sup>3</sup> 4 sec sustained	Sustained oscillatory lateral acceleration of the carbody shall not exceed the prescribed (root mean squared) safety limits of 0.10g and 0.12g for passenger cars and other vehicles, respectively. Root mean squared values shall be determined over a sliding 4-second window with linear trend removed and shall be sustained for more than 4 seconds.
Carbody Vertical (Transient)	$\leq 1.0g$ peak-to-peak 1 sec window <sup>3</sup> excludes peaks < 50 msec	$\leq 1.25g$ peak-to-peak 1 sec window <sup>3</sup> excludes peaks < 50 msec	The peak-to-peak accelerations, measured as the algebraic difference between the two extreme values of measured acceleration in any one second time period, excluding any peak lasting less than 50 milliseconds, shall not exceed 1.0g, or 1.25g, as specified.
Carbody Vertical (Sustained Oscillatory)	$\leq 0.25g \text{ RMS}_t^4$ 4 sec window <sup>3</sup> 4 sec sustained	$\leq 0.25g \text{ RMS}_t^4$ 4 sec window <sup>3</sup> 4 sec sustained	Sustained oscillatory vertical acceleration of the carbody shall not exceed the prescribed (root mean squared) safety limit of 0.25g. Root mean squared values shall be determined over a sliding 4-second window with linear trend removed and shall be sustained for more than 4 seconds.
<b>Truck Lateral Acceleration<sup>5</sup></b>			
<b>Parameter</b>	<b>Safety Limit</b>	<b>Filter/Window</b>	<b>Requirements</b>
Truck Lateral	$\leq 0.30g \text{ RMS}_t^4$	2 sec window <sup>3</sup> 2 sec sustained	Truck hunting shall not develop below the maximum authorized speed. Truck hunting is defined as a sustained cyclic oscillation of the truck evidenced by lateral accelerations exceeding 0.3g root mean squared for more than 2 seconds. Root mean squared values shall be determined over a sliding 2-second window with linear trend removed.

<sup>1</sup> The lateral and vertical wheel forces shall be measured and processed through a low pass filter (LPF) with a minimum cut-off frequency of 25 Hz. The sample rate for wheel force data shall be at least 250 samples per second.

<sup>2</sup> Carbody accelerations in the vertical and lateral directions shall be measured by accelerometers oriented and located in accordance with § 213.333(k).

<sup>3</sup> Acceleration measurements shall be processed through an LPF with a minimum cut-off frequency of 10 Hz. The sample rate for acceleration data shall be at least 100 samples per second.

<sup>4</sup>  $RMS_t = RMS$  with linear trend removed.

<sup>5</sup> Truck lateral acceleration shall be measured on the truck frame by accelerometers oriented and located in accordance with § 213.333(k).

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■ 20. Section 213.345 is revised to read as follows:

**§ 213.345 Vehicle/track system qualification.**

(a) *General.* All vehicle types intended to operate at track Class 6 speeds or above, or at any curving speed producing more than 5 inches of cant deficiency, shall be qualified for operation for their intended track classes in accordance with this subpart. A qualification program shall be used to demonstrate that the vehicle/track system will not exceed the wheel/rail force safety limits and the carbody and truck acceleration criteria specified in § 213.333—

(1) At any speed up to and including 5 m.p.h. above the proposed maximum operating speed; and

(2) On track meeting the requirements for the class of track associated with the proposed maximum operating speed. For purposes of qualification testing, speeds may exceed the maximum allowable operating speed for the class of track in accordance with the test plan approved by FRA.

(b) *Existing vehicle type qualification.* Vehicle types previously qualified or permitted to operate at track Class 6 speeds or above or at any curving speeds producing more than 5 inches of cant deficiency prior to March 13, 2013, shall be considered as being successfully qualified under the requirements of this section for operation at the previously operated speeds and cant deficiencies over the previously operated track segment(s).

(c) *New vehicle type qualification.* Vehicle types not previously qualified under this subpart shall be qualified in accordance with the requirements of this paragraph (c).

(1) *Simulations or measurement of wheel/rail forces.* For vehicle types intended to operate at track Class 6 speeds, simulations or measurement of wheel/rail forces during qualification testing shall demonstrate that the

vehicle type will not exceed the wheel/rail force safety limits specified in § 213.333. Simulations, if conducted, shall be in accordance with paragraph (c)(2) of this section. Measurement of wheel/rail forces, if conducted, shall be performed over a representative segment of the full route on which the vehicle type is intended to operate.

(2) *Simulations.* For vehicle types intended to operate at track Class 7 speeds or above, or at any curving speed producing more than 6 inches of cant deficiency, analysis of vehicle/track performance (computer simulations) shall be conducted using an industry recognized methodology on:

(i) An analytically defined track segment representative of minimally compliant track conditions (MCAT—Minimally Compliant Analytical Track) for the respective track class(es) as specified in appendix D to this part; and

(ii) A track segment representative of the full route on which the vehicle type is intended to operate. Both simulations and physical examinations of the route's track geometry shall be used to determine a track segment representative of the route.

(3) *Carbody acceleration.* For vehicle types intended to operate at track Class 6 speeds or above, or at any curving speed producing more than 5 inches of cant deficiency, qualification testing conducted over a representative segment of the route shall demonstrate that the vehicle type will not exceed the carbody lateral and vertical acceleration safety limits specified in § 213.333.

(4) *Truck lateral acceleration.* For vehicle types intended to operate at track Class 6 speeds or above, qualification testing conducted over a representative segment of the route shall demonstrate that the vehicle type will not exceed the truck lateral acceleration safety limit specified in § 213.333.

(5) *Measurement of wheel/rail forces.* For vehicle types intended to operate at track Class 7 speeds or above, or at any curving speed producing more than 6 inches of cant deficiency, qualification

testing conducted over a representative segment of the route shall demonstrate that the vehicle type will not exceed the wheel/rail force safety limits specified in § 213.333.

(d) *Previously qualified vehicle types.* Vehicle types previously qualified under this subpart for a track class and cant deficiency on one route may be qualified for operation at the same class and cant deficiency on another route through analysis or testing, or both, to demonstrate compliance with paragraph (a) of this section in accordance with the following:

(1) *Simulations or measurement of wheel/rail forces.* For vehicle types intended to operate at any curving speed producing more than 6 inches of cant deficiency, or at curving speeds that both correspond to track Class 7 speeds or above and produce more than 5 inches of cant deficiency, simulations or measurement of wheel/rail forces during qualification testing shall demonstrate that the vehicle type will not exceed the wheel/rail force safety limits specified in § 213.333. Simulations, if conducted, shall be in accordance with paragraph (c)(2) of this section. Measurement of wheel/rail forces, if conducted, shall be performed over a representative segment of the new route.

(2) *Carbody acceleration.* For vehicle types intended to operate at any curving speed producing more than 5 inches of cant deficiency, or at track Class 7 speeds and above, qualification testing conducted over a representative segment of the new route shall demonstrate that the vehicle type will not exceed the carbody lateral and vertical acceleration safety limits specified in § 213.333.

(3) *Truck lateral acceleration.* For vehicle types intended to operate at track Class 7 speeds or above, measurement of truck lateral acceleration during qualification testing shall demonstrate that the vehicle type will not exceed the truck lateral acceleration safety limits specified in

§ 213.333. Measurement of truck lateral acceleration, if conducted, shall be performed over a representative segment of the new route.

(e) *Qualification testing plan.* To obtain the data required to support the qualification program outlined in paragraphs (c) and (d) of this section, the track owner or railroad shall submit a qualification testing plan to FRA's Associate Administrator for Railroad Safety/Chief Safety Officer (FRA) at least 60 days prior to testing, requesting approval to conduct the testing at the desired speeds and cant deficiencies. This test plan shall provide for a test program sufficient to evaluate the operating limits of the track and vehicle type and shall include:

(1) Identification of the representative segment of the route for qualification testing;

(2) Consideration of the operating environment during qualification testing, including operating practices and conditions, the signal system, highway-rail grade crossings, and trains on adjacent tracks;

(3) The maximum angle found on the gage face of the designed (newly-profiled) wheel flange referenced with respect to the axis of the wheelset that will be used for the determination of the Single Wheel L/V Ratio safety limit specified in § 213.333;

(4) A target maximum testing speed in accordance with paragraph (a) of this section and the maximum testing cant deficiency;

(5) An analysis and description of the signal system and operating practices to govern operations in track Classes 7 through 9, which shall include a statement of sufficiency in these areas for the class of operation; and

(6) The results of vehicle/track performance simulations that are required by this section.

(f) *Qualification testing.* Upon FRA approval of the qualification testing

plan, qualification testing shall be conducted in two sequential stages as required in this subpart.

(1) Stage-one testing shall include demonstration of acceptable vehicle dynamic response of the subject vehicle as speeds are incrementally increased—

(i) On a segment of tangent track, from acceptable track Class 5 speeds to the target maximum test speed (when the target speed corresponds to track Class 6 and above operations); and

(ii) On a segment of curved track, from the speeds corresponding to 3 inches of cant deficiency to the maximum testing cant deficiency.

(2) When stage-one testing has successfully demonstrated a maximum safe operating speed and cant deficiency, stage-two testing shall commence with the subject equipment over a representative segment of the route as identified in paragraph (e)(1) of this section.

(i) A test run shall be conducted over the route segment at the speed the railroad will request FRA to approve for such service.

(ii) An additional test run shall be conducted at 5 m.p.h. above this speed.

(3) When conducting stage-one and stage-two testing, if any of the monitored safety limits is exceeded on any segment of track intended for operation at track Class 6 speeds or greater, or on any segment of track intended for operation at more than 5 inches of cant deficiency, testing may continue provided that the track location(s) where any of the limits is exceeded be identified and test speeds be limited at the track location(s) until corrective action is taken. Corrective action may include making an adjustment in the track, in the vehicle, or both of these system components. Measurements taken on track segments intended for operations below track Class 6 speeds and at 5 inches of cant

deficiency, or less, are not required to be reported.

(4) Prior to the start of the qualification testing program, a qualifying TGMS specified in § 213.333 shall be operated over the intended route within 30 calendar days prior to the start of the qualification testing program.

(g) *Qualification testing results.* The track owner or railroad shall submit a report to FRA detailing all the results of the qualification program. When simulations are required as part of vehicle qualification, this report shall include a comparison of simulation predictions to the actual wheel/rail force or acceleration data, or both, recorded during full-scale testing. The report shall be submitted at least 60 days prior to the intended operation of the equipment in revenue service over the route.

(h) Based on the test results and all other required submissions, FRA will approve a maximum train speed and value of cant deficiency for revenue service, normally within 45 days of receipt of all the required information. FRA may impose conditions necessary for safely operating at the maximum approved train speed and cant deficiency.

(i) The documents required by this section must be provided to FRA by:

(1) The track owner; or

(2) A railroad that provides service with the same vehicle type over trackage of one or more track owner(s), with the written consent of each affected track owner.

■ 21. Section 213.355 is revised to read as follows:

**§ 213.355 Frog guard rails and guard faces; gage.**

The guard check and guard face gages in frogs shall be within the limits prescribed in the following table—

Class of track	Guard check gage	Guard face gage
	The distance between the gage line of a frog to the guard line <sup>1</sup> of its guard rail or guarding face, measured across the track at right angles to the gage line, <sup>2</sup> may not be less than—	
Class 6, 7, 8 and 9 track .....	4'6½"	4'5"

<sup>1</sup> A line along that side of the flangeway which is nearer to the center of the track and at the same elevation as the gage line.

<sup>2</sup> A line five-eighths of an inch below the top of the center line of the head of the running rail, or corresponding location of the tread portion of the track structure.

■ 22. Appendix A to part 213 is revised to read as follows:

**Appendix A to Part 213—Maximum Allowable Curving Speeds**

speeds based on 3, 4, 5, and 6 inches of unbalance (cant deficiency), respectively.

This appendix contains four tables identifying maximum allowing curving

**TABLE 1—THREE INCHES UNBALANCE**

Degree of curvature	Elevation of outer rail (inches)												
	0	1/2	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6
	Maximum allowable operating speed (m.p.h.)												
0°30' .....	93	100	107	113	120	125	131	136	141	146	151	156	160
0°40' .....	80	87	93	98	104	109	113	118	122	127	131	135	139
0°50' .....	72	77	83	88	93	97	101	106	110	113	117	121	124
1°00' .....	65	71	76	80	85	89	93	96	100	104	107	110	113
1°15' .....	59	63	68	72	76	79	83	86	89	93	96	99	101
1°30' .....	53	58	62	65	69	72	76	79	82	85	87	90	93
1°45' .....	49	53	57	61	64	67	70	73	76	78	81	83	86
2°00' .....	46	50	53	57	60	63	65	68	71	73	76	78	80
2°15' .....	44	47	50	53	56	59	62	64	67	69	71	73	76
2°30' .....	41	45	48	51	53	56	59	61	63	65	68	70	72
2°45' .....	39	43	46	48	51	53	56	58	60	62	64	66	68
3°00' .....	38	41	44	46	49	51	53	56	58	60	62	64	65
3°15' .....	36	39	42	44	47	49	51	53	55	57	59	61	63
3°30' .....	35	38	40	43	45	47	49	52	53	55	57	59	61
3°45' .....	34	37	39	41	44	46	48	50	52	53	55	57	59
4°00' .....	33	35	38	40	42	44	46	48	50	52	53	55	57
4°30' .....	31	33	36	38	40	42	44	45	47	49	50	52	53
5°00' .....	29	32	34	36	38	40	41	43	45	46	48	49	51
5°30' .....	28	30	32	34	36	38	39	41	43	44	46	47	48
6°00' .....	27	29	31	33	35	36	38	39	41	42	44	45	46
6°30' .....	26	28	30	31	33	35	36	38	39	41	42	43	44
7°00' .....	25	27	29	30	32	34	35	36	38	39	40	42	43
8°00' .....	23	25	27	28	30	31	33	34	35	37	38	39	40
9°00' .....	22	24	25	27	28	30	31	32	33	35	36	37	38
10°00' .....	21	22	24	25	27	28	29	30	32	33	34	35	36
11°00' .....	20	21	23	24	25	27	28	29	30	31	32	33	34
12°00' .....	19	20	22	23	24	26	27	28	29	30	31	32	33

**TABLE 2—FOUR INCHES UNBALANCE**

Degree of curvature	Elevation of outer rail (inches)												
	0	1/2	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6
	Maximum allowable operating speed (m.p.h.)												
0°30' .....	107	113	120	125	131	136	141	146	151	156	160	165	169
0°40' .....	93	98	104	109	113	118	122	127	131	135	139	143	146
0°50' .....	83	88	93	97	101	106	110	113	117	121	124	128	131
1°00' .....	76	80	85	89	93	96	100	104	107	110	113	116	120
1°15' .....	68	72	76	79	83	86	89	93	96	99	101	104	107
1°30' .....	62	65	69	72	76	79	82	85	87	90	93	95	98
1°45' .....	57	61	64	67	70	73	76	78	81	83	86	88	90
2°00' .....	53	57	60	63	65	68	71	73	76	78	80	82	85
2°15' .....	50	53	56	59	62	64	67	69	71	73	76	78	80
2°30' .....	48	51	53	56	59	61	63	65	68	70	72	74	76
2°45' .....	46	48	51	53	56	58	60	62	64	66	68	70	72
3°00' .....	44	46	49	51	53	56	58	60	62	64	65	67	69
3°15' .....	42	44	47	49	51	53	55	57	59	61	63	65	66
3°30' .....	40	43	45	47	49	52	53	55	57	59	61	62	64
3°45' .....	39	41	44	46	48	50	52	53	55	57	59	60	62
4°00' .....	38	40	42	44	46	48	50	52	53	55	57	58	60
4°30' .....	36	38	40	42	44	45	47	49	50	52	53	55	56
5°00' .....	34	36	38	40	41	43	45	46	48	49	51	52	53
5°30' .....	32	34	36	38	39	41	43	44	46	47	48	50	51
6°00' .....	31	33	35	36	38	39	41	42	44	45	46	48	49
6°30' .....	30	31	33	35	36	38	39	41	42	43	44	46	47
7°00' .....	29	30	32	34	35	36	38	39	40	42	43	44	45
8°00' .....	27	28	30	31	33	34	35	37	38	39	40	41	42
9°00' .....	25	27	28	30	31	32	33	35	36	37	38	39	40

TABLE 2—FOUR INCHES UNBALANCE—Continued

Degree of curvature	Elevation of outer rail (inches)												
	0	1/2	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6
	Maximum allowable operating speed (m.p.h.)												
10°00' .....	24	25	27	28	29	30	32	33	34	35	36	37	38
11°00' .....	23	24	25	27	28	29	30	31	32	33	34	35	36
12°00' .....	22	23	24	26	27	28	29	30	31	32	33	34	35

TABLE 3—FIVE INCHES UNBALANCE

Degree of curvature	Elevation of outer rail (inches)												
	0	1/2	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6
	Maximum allowable operating speed (m.p.h.)												
0°30' .....	120	125	131	136	141	146	151	156	160	165	169	173	177
0°40' .....	104	109	113	118	122	127	131	135	139	143	146	150	150
0°50' .....	93	97	101	106	110	113	117	121	124	128	131	134	137
1°00' .....	85	89	93	96	100	104	107	110	113	116	120	122	125
1°15' .....	76	79	83	86	89	93	96	99	101	104	107	110	112
1°30' .....	69	72	76	79	82	85	87	90	93	95	98	100	102
1°45' .....	64	67	70	73	76	78	81	83	86	88	90	93	95
2°00' .....	60	63	65	68	71	73	76	78	80	82	85	87	89
2°15' .....	56	59	62	64	67	69	71	73	76	78	80	82	84
2°30' .....	53	56	59	61	63	65	68	70	72	74	76	77	79
2°45' .....	51	53	56	58	60	62	64	66	68	70	72	74	76
3°00' .....	49	51	53	56	58	60	62	64	65	67	69	71	72
3°15' .....	47	49	51	53	55	57	59	61	63	65	66	68	70
3°30' .....	45	47	49	52	53	55	57	59	61	62	64	65	67
3°45' .....	44	46	48	50	52	53	55	57	59	60	62	63	65
4°00' .....	42	44	46	48	50	52	53	55	57	58	60	61	63
4°30' .....	40	42	44	45	47	49	50	52	53	55	56	58	59
5°00' .....	38	40	41	43	45	46	48	49	51	52	53	55	56
5°30' .....	36	38	39	41	43	44	46	47	48	50	51	52	53
6°00' .....	35	36	38	39	41	42	44	45	46	48	49	50	51
6°30' .....	33	35	36	38	39	41	42	43	44	46	47	48	49
7°00' .....	32	34	35	36	38	39	40	42	43	44	45	46	47
8°00' .....	30	31	33	34	35	37	38	39	40	41	42	43	44
9°00' .....	28	30	31	32	33	35	36	37	38	39	40	41	42
10°00' .....	27	28	29	30	32	33	34	35	36	37	38	39	40
11°00' .....	25	27	28	29	30	31	32	33	34	35	36	37	38
12°00' .....	24	26	27	28	29	30	31	32	33	34	35	35	36

TABLE 4—SIX INCHES UNBALANCE

Degree of curvature	Elevation of outer rail (inches)												
	0	1/2	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6
	Maximum allowable operating speed (m.p.h.)												
0°30' .....	131	136	141	146	151	156	160	165	169	173	177	181	185
0°40' .....	113	118	122	127	131	135	139	143	146	150	154	157	160
0°50' .....	101	106	110	113	117	121	124	128	131	134	137	140	143
1°00' .....	93	96	100	104	107	110	113	116	120	122	125	128	131
1°15' .....	83	86	89	93	96	99	101	104	107	110	112	115	117
1°30' .....	76	79	82	85	87	90	93	95	98	100	102	105	107
1°45' .....	70	73	76	78	81	83	86	88	90	93	95	97	99
2°00' .....	65	68	71	73	76	78	80	82	85	87	89	91	93
2°15' .....	62	64	67	69	71	73	76	78	80	82	84	85	87
2°30' .....	59	61	63	65	68	70	72	74	76	77	79	81	83
2°45' .....	56	58	60	62	64	66	68	70	72	74	76	77	79
3°00' .....	53	56	58	60	62	64	65	67	69	71	72	74	76
3°15' .....	51	53	55	57	59	61	63	65	66	68	70	71	73
3°30' .....	49	52	53	55	57	59	61	62	64	65	67	69	70
3°45' .....	48	50	52	53	55	57	59	60	62	63	65	66	68
4°00' .....	46	48	50	52	53	55	57	58	60	61	63	64	65



TABLE 4—SIX INCHES UNBALANCE—Continued

Degree of curvature	Elevation of outer rail (inches)												
	0	1/2	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6
	Maximum allowable operating speed (m.p.h.)												
4°30' .....	44	45	47	49	50	52	53	55	56	58	59	60	62
5°00' .....	41	43	45	46	48	49	51	52	53	55	56	57	59
5°30' .....	39	41	43	44	46	47	48	50	51	52	53	55	56
6°00' .....	38	39	41	42	44	45	46	48	49	50	51	52	53
6°30' .....	36	38	39	41	42	43	44	46	47	48	49	50	51
7°00' .....	35	36	38	39	40	42	43	44	45	46	47	48	49
8°00' .....	33	34	35	37	38	39	40	41	42	43	44	45	46
9°00' .....	31	32	33	35	36	37	38	39	40	41	42	43	44
10°00' .....	29	30	32	33	34	35	36	37	38	39	40	41	41
11°00' .....	28	29	30	31	32	33	34	35	36	37	38	39	39
12°00' .....	27	28	29	30	31	32	33	34	35	35	36	37	38

- 23. Amend appendix B to part 213:
- a. Under subpart C by removing the entry for § 13.55 and adding entries for §§ 213.55 and 213.65 in numerical order;
- b. By revising the subpart D heading and under it revising the entries for

- §§ 213.109 and 213.127, and adding the entry for § 213.110 in numerical order;
- c. By adding the entry for § 213.234 in numerical order under subpart F;
- d. By revising the subpart G heading and under it revising the entries for §§ 213.307, 213.327, 213.329, 213.333,

and 213.345, and adding the entry for § 213.332 in numerical order.

The revisions and additions read as follows:

**Appendix B to Part 213—Schedule of Civil Penalties**

Section	Violation	Willful violation <sup>1</sup>
<b>SUBPART C—TRACK GEOMETRY:</b>		
* 213.55 Track alinement .....	5,000	7,500
* 213.65 Combined track alinement and surface deviations .....	5,000	7,500
<b>SUBPART D—TRACK STRUCTURE:</b>		
* 213.109 Crossties		
(a) Material used .....	1,000	2,000
(b) Distribution of ties .....	2,500	5,000
(c) and (d) Sufficient number of non-defective ties .....	1,000	2,000
(e) Joint ties .....	2,500	5,000
(f) Track constructed without crossties .....	2,500	5,000
* 213.110 Gage restraint measurement systems .....	5,000	7,500
* 213.127 Rail Fastening Systems .....	2,500	5,000
<b>SUBPART F—INSPECTION:</b>		
* 213.234 Automated inspection of track constructed with concrete crossties .....	5,000	7,500
<b>SUBPART G—TRAIN OPERATIONS AT TRACK CLASSES 6 AND HIGHER:</b>		
* 213.307 Classes of track: operating speed limits .....	2,500	5,000
* 213.327 Track alinement .....	5,000	7,500
* 213.329 Curves; elevation and speed limits .....	2,500	5,000
* 213.332 Combined track alinement and surface deviations .....	5,000	7,500
* 213.333 Automated vehicle-based inspection systems .....	5,000	7,500

		Section	Violation	Willful violation <sup>1</sup>
*	*	*	*	*
213.345	Vehicle/track system qualification:			
	(a) through (d) .....		5,000	7,500
	(e) through (i) .....		2,500	5,000
*	*	*	*	*

<sup>1</sup> A penalty may be assessed against an individual only for a willful violation. The Administrator reserves the right to assess a penalty of up to \$105,000 for any violation where circumstances warrant. See 49 CFR part 209, appendix A.

■ 24. Appendix C to part 213 is added and reserved.

■ 25. Appendix D to part 213 is added to read as follows:

**Appendix D to Part 213—Minimally Compliant Analytical Track (MCAT) Simulations Used for Qualifying Vehicles To Operate at High Speeds and at High Cant Deficiencies**

1. This appendix contains requirements for using computer simulations to comply with the vehicle/track system qualification testing requirements specified in subpart G of this part. These simulations shall be performed using a track model containing defined geometry perturbations at the limits that are permitted for a specific class of track and level of cant deficiency. This track model is known as MCAT, Minimally Compliant Analytical Track. These simulations shall be used to identify vehicle dynamic performance issues prior to service or, as appropriate, a change in service, and demonstrate that a vehicle type is suitable for

operation on the track over which it is intended to operate.

2. As specified in § 213.345(c)(2), MCAT shall be used for the qualification of new vehicle types intended to operate at track Class 7 speeds or above, or at any curving speed producing more than 6 inches of cant deficiency. MCAT may also be used for the qualification of new vehicle types intended to operate at speeds corresponding to Class 6 track, as specified in § 213.345(c)(1). In addition, as specified in § 213.345(d)(1), MCAT may be used to qualify on new routes vehicle types that have previously been qualified on other routes and are intended to operate at any curving speed producing more than 6 inches of cant deficiency, or at curving speeds that both correspond to track Class 7 speeds or above and produce more than 5 inches of cant deficiency.

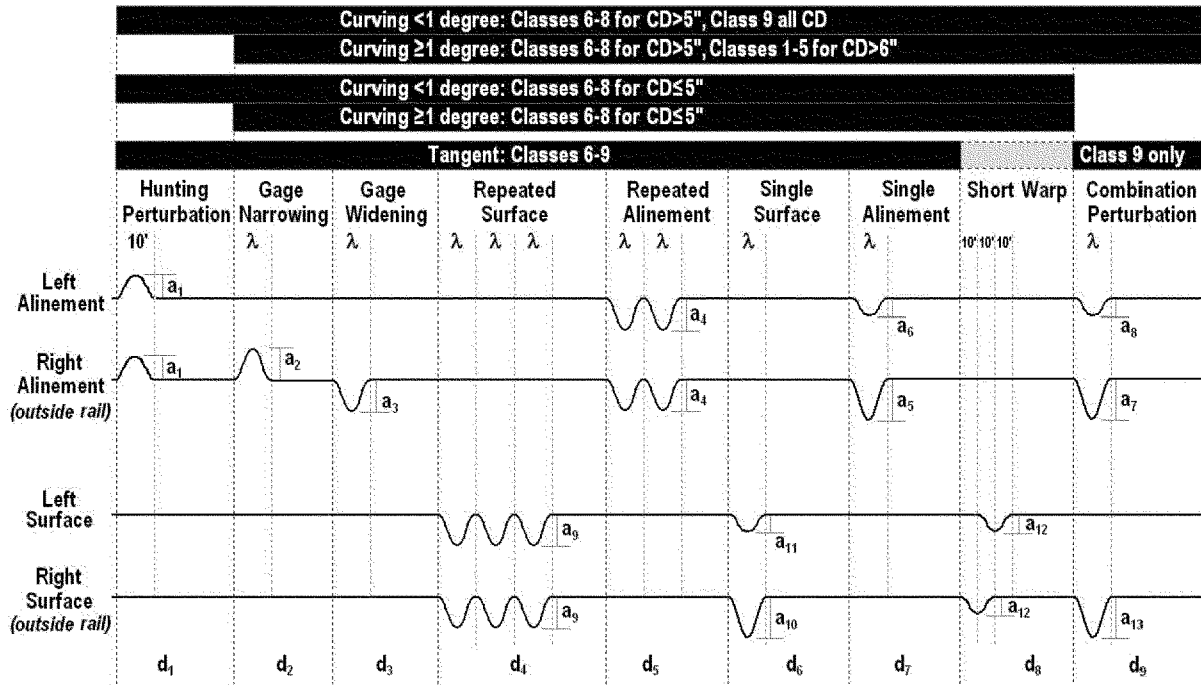
(a) *Validation.* To validate the vehicle model used for simulations under this part, the track owner or railroad shall obtain vehicle simulation predictions using measured track geometry data, chosen from the same track section over which testing

shall be performed as specified in § 213.345(c)(2)(ii). These predictions shall be submitted to FRA in support of the request for approval of the qualification testing plan. Full validation of the vehicle model used for simulations under this part shall be determined when the results of the simulations demonstrate that they replicate all key responses observed during qualification testing.

(b) *MCAT layout.* MCAT consists of nine segments, each designed to test a vehicle's performance in response to a specific type of track perturbation. The basic layout of MCAT is shown in figure 1 of this appendix, by type of track (curving or tangent), class of track, and cant deficiency (CD). The values for wavelength,  $\lambda$ , amplitude of perturbation,  $a$ , and segment length,  $d$ , are specified in this appendix. The bars at the top of figure 1 show which segments are required depending on the speed and degree of curvature. For example, the hunting perturbation section is not required for simulation of curves greater than or equal to 1 degree.

Figure 1 of Appendix D to Part 213

Basic MCAT Layout



(1) *MCAT segments.* MCAT's nine segments contain different types of track deviations in which the shape of each deviation is a versine having wavelength and amplitude varied for each simulation speed as further specified. The nine MCAT segments are defined as follows:

(i) *Hunting perturbation* ( $a_1$ ): This segment contains an alinement deviation having a wavelength,  $\lambda$ , of 10 feet and amplitude of 0.25 inch on both rails to test vehicle stability on tangent track and on track that is curved less than 1 degree.

(ii) *Gage narrowing* ( $a_2$ ): This segment contains an alinement deviation on one rail to reduce the gage from the nominal value to the minimum permissible gage or maximum alinement (whichever comes first).

(iii) *Gage widening* ( $a_3$ ): This segment contains an alinement deviation on one rail to increase the gage from the nominal value to the maximum permissible gage or maximum alinement (whichever comes first).

(iv) *Repeated surface* ( $a_9$ ): This segment contains three consecutive maximum permissible profile variations on each rail.

(v) *Repeated alinement* ( $a_4$ ): This segment contains two consecutive maximum permissible alinement variations on each rail.

(vi) *Single surface* ( $a_{10}, a_{11}$ ): This segment contains a maximum permissible profile variation on one rail. If the maximum permissible profile variation alone produces a condition which exceeds the maximum allowed warp condition, a second profile variation is also placed on the opposite rail to limit the warp to the maximum permissible value.

(vii) *Single alinement* ( $a_5, a_6$ ): This segment contains a maximum permissible alinement variation on one rail. If the maximum permissible alinement variation alone produces a condition which exceeds the maximum allowed gage condition, a second alinement variation is also placed on the opposite rail to limit the gage to the maximum permissible value.

(viii) *Short warp* ( $a_{12}$ ): This segment contains a pair of profile deviations to produce a maximum permissible 10-foot warp perturbation. The first is on the outside rail, and the second follows 10 feet farther on the inside rail. Each deviation has a wavelength,  $\lambda$ , of 20 feet and variable amplitude for each simulation speed as described below. This segment is to be used only on curved track simulations.

(ix) *Combined perturbation* ( $a_7, a_8, a_{13}$ ): This segment contains a maximum permissible down and out combined geometry condition on the outside rail in the body of the curve. If the maximum permissible variations produce a condition which exceeds the maximum allowed gage condition, a second variation is also placed on the opposite rail as for the MCAT segments described in paragraphs (b)(1)(vi) and (vii) of this appendix. This segment is to be used for all simulations on Class 9 track, and only for curved track simulations at speeds producing more than 5 inches of cant deficiency on track Classes 6 through 8, and at speeds producing more than 6 inches of cant deficiency on track Classes 1 through 5.

(2) *Segment lengths:* Each MCAT segment shall be long enough to allow the vehicle's response to the track deviation(s) to damp out. Each segment shall also have a minimum length as specified in table 1 of this appendix, which references the distances in figure 1 of this appendix. For curved track segments, the perturbations shall be placed far enough in the body of the curve to allow for any spiral effects to damp out.

TABLE 1 OF APPENDIX D TO PART 213 MINIMUM LENGTHS OF MCAT SEGMENTS

Distances (ft)								
$d_1$	$d_2$	$d_3$	$d_4$	$d_5$	$d_6$	$d_7$	$d_8$	$d_9$
1000	1000	1000	1500	1000	1000	1000	1000	1000

(3) *Degree of curvature.*

(i) For each simulation involving assessment of curving performance, the degree of curvature, D, which generates a particular level of cant deficiency, E<sub>u</sub>, for a given speed, V, shall be calculated using the following equation, which assumes a curve with 6 inches of superelevation:

$$D = \frac{6 + E_u}{0.0007 \times V^2}$$

Where—

D = Degree of curvature (degrees).

V = Simulation speed (m.p.h.).

E<sub>u</sub> = Cant deficiency (inches).

(ii) Table 2 of this appendix depicts the degree of curvature for use in MCAT simulations of both passenger and freight equipment performance on Class 2 through 9 track, based on the equation in paragraph (b)(3)(i) of this appendix. The degree of curvature for use in MCAT simulations of equipment

performance on Class 1 track is not depicted; it would be based on the same equation using an appropriate superelevation. The degree of curvature for use in MCAT simulations of freight equipment performance on Class 6 (freight) track is shown in italics for cant deficiencies not exceeding 6 inches, to emphasize that the values apply to freight equipment only.

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**Table 2 of Appendix D to Part 213  
Degree of Curvature for Use in MCAT Simulations (Track Classes 2 through 9)**

Passenger	m.p.h.	Tangent	Cant Deficiency (inches)						m.p.h.	Freight	
			3	4	5	6	7	8			9
Class 2	20		Degree of curvature used in simulations						20	Class 2	
	25		46.4	50.0	53.6	29.7	32.0	34.3	25		
	30		20.6	22.2	23.8	20.6	22.2	23.8	30		
Class 3	35		Degree of curvature used in simulations						35	Class 3	
	40		15.2	16.3	17.5	11.6	12.5	13.4	40		
	45		9.17	9.88	10.6	9.17	9.88	10.6	45		
	50		7.43	8.00	8.57	7.43	8.00	8.57	50		
	55		6.14	6.61	7.08	6.14	6.61	7.08	55		
Class 4	60		Degree of curvature used in simulations						60	Class 4	
	65		5.16	5.56	5.95	5.16	5.56	5.95	65		
	70		4.40	4.73	5.07	4.40	4.73	5.07	70		
	75		3.79	4.08	4.37	3.79	4.08	4.37	75		
Class 5	80		Degree of curvature used in simulations						80	Class 5	
	85		2.90	3.13	3.35	2.90	3.13	3.35	85		
Class 6	90	0.00	1.78	1.98	2.18	2.37	2.57	2.77	2.97	85	Class 6
	95		1.59	1.76	1.94	2.12	2.29	2.47	2.65	90	
Class 7	100	0.00	1.42	1.58	1.74	1.90	2.06	2.22	2.37	95	Class 7
	105		1.29	1.43	1.57	1.71	1.86	2.00	2.14	100	
	110		1.17	1.30	1.43	1.55	1.68	1.81	1.94	105	
	115		1.06	1.18	1.30	1.42	1.53	1.65	1.77	110	
Class 8	120	0.00	0.97	1.08	1.19	1.30	1.40	1.51	1.62	115	Class 8
	125		0.89	0.99	1.09	1.19	1.29	1.39	1.49	120	
	130		0.82	0.91	1.01	1.10	1.19	1.28	1.37	125	
	135		0.76	0.85	0.93	1.01	1.10	1.18	1.27	130	
	140		0.71	0.78	0.86	0.94	1.02	1.10	1.18	135	
	145		0.66	0.73	0.80	0.87	0.95	1.02	1.09	140	
Class 9	150	0.00	0.61	0.68	0.75	0.82	0.88	0.95	1.02	145	Class 9
	155		0.57	0.63	0.70	0.76	0.83	0.89	0.95	150	
	160		0.54	0.59	0.65	0.71	0.77	0.83	0.89	155	
	165		0.50	0.56	0.61	0.67	0.73	0.78	0.84	160	
	170		0.47	0.52	0.58	0.63	0.68	0.73	0.79	165	
	175		0.44	0.49	0.54	0.59	0.64	0.69	0.74	170	
	180		0.42	0.47	0.51	0.56	0.61	0.65	0.70	175	
	185		0.40	0.44	0.49	0.53	0.57	0.62	0.66	180	
	190		0.38	0.42	0.46	0.50	0.54	0.58	0.63	185	
	195		0.36	0.40	0.44	0.47	0.51	0.55	0.59	190	
Class 9	200	0.00	0.34	0.38	0.41	0.45	0.49	0.53	0.56	195	Class 9
	205		0.32	0.36	0.39	0.43	0.46	0.50	0.54	200	
	210		0.31	0.34	0.37	0.41	0.44	0.48	0.51	205	
	215		0.29	0.32	0.36	0.39	0.42	0.45	0.49	210	
	220		0.28	0.31	0.34	0.37	0.40	0.43	0.46	215	
	225		0.27	0.30	0.32	0.35	0.38	0.41	0.44	220	

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(c) *Required simulations.*

(1) To develop a comprehensive assessment of vehicle performance,

simulations shall be performed for a variety of scenarios using MCAT. These simulations shall be performed on tangent or curved track, or both,

depending on the level of cant deficiency and speed (track class) as summarized in table 3 of this appendix.

TABLE 3 OF APPENDIX D TO PART 213 SUMMARY OF REQUIRED VEHICLE PERFORMANCE ASSESSMENT USING SIMULATIONS

	New vehicle types	Previously qualified vehicle types
Curved track: cant deficiency ≤ 6 inches.	Curving performance simulation: not required for track Classes 1 through 5; optional for track Class 6; required for track Classes 7 through 9.	Curving performance simulation: not required for track Classes 1 through 6; optional for track Classes 7 through 9 for cant deficiency > 5 inches.
Curved track: cant deficiency > 6 inches.	Curving performance simulation required for all track classes.	Curving performance simulation optional for all track classes.
Tangent track .....	Tangent performance simulation: not required for track Classes 1 through 5; optional for track Class 6; required for track Classes 7 through 9.	Tangent performance simulation not required for any track class.

(i) All simulations shall be performed using the design wheel profile and a nominal track gage of 56.5 inches, using tables 4, 5, 6, or 7 of this appendix, as appropriate. In addition, all simulations involving the assessment of curving performance shall be repeated using a nominal track gage of 57.0 inches, using tables 5, 6, or 7 of this appendix, as appropriate.

(ii) If the wheel profile is different than American Public Transportation Administration (APTA) wheel profiles 320 or 340, then for tangent track segments all simulations shall be repeated using either APTA wheel profile 320 or 340, depending on the established conicity that is common for the operation, as specified in APTA SS-M-015-06, Standard for Wheel Flange Angle of Passenger Equipment (2007). This APTA standard is incorporated by reference into this appendix with the approval of the Director of the Federal Register under 5 U.S.C. 552(a) and 1 CFR part 51. To enforce any edition other than that specified in this appendix, FRA must publish notice of change in the **Federal Register** and the material must be made available to the public. All approved material is available for inspection at the Federal Railroad Administration, Docket Clerk, 1200 New Jersey Avenue SE., Washington, DC 20590 (telephone 202-493-6030), and is available from the American Public Transportation Association, 1666 K Street NW., Suite 1100, Washington, DC 20006 (telephone 202-496-4800; [www.apta.com](http://www.apta.com)). It is also available for inspection at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030 or go to [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html). An

alternative worn wheel profile may be used in lieu of either APTA wheel profile, if approved by FRA.

(iii) All simulations shall be performed using a wheel/rail coefficient of friction of 0.5.

(2) *Vehicle performance on tangent track Classes 6 through 9.* For maximum vehicle speeds corresponding to track Class 6 and higher, the MCAT segments described in paragraphs (b)(1)(i) through (vii) of this appendix shall be used to assess vehicle performance on tangent track. For track Class 9, simulations must also include the combined perturbation segment described in paragraph (b)(1)(ix) of this appendix. A parametric matrix of MCAT simulations shall be performed using the following range of conditions:

(i) *Vehicle speed.* Simulations shall demonstrate that at up to 5 m.p.h. above the proposed maximum operating speed, the vehicle type shall not exceed the wheel/rail force and acceleration criteria defined in the Vehicle/Track Interaction Safety Limits table in § 213.333. Simulations shall also demonstrate acceptable vehicle dynamic response by incrementally increasing speed from 95 m.p.h. (115 m.p.h. if a previously qualified vehicle type on an untested route) to 5 m.p.h. above the proposed maximum operating speed (in 5 m.p.h. increments).

(ii) *Perturbation wavelength.* For each speed, a set of three separate MCAT simulations shall be performed. In each MCAT simulation for the perturbation segments described in paragraphs (b)(1)(ii) through (vii) and (b)(1)(ix) of this appendix, every perturbation shall have the same wavelength. The following three wavelengths, λ, shall be used: 31, 62, and 124 feet. The hunting perturbation segment described in paragraph (b)(1)(i) of this appendix has a fixed wavelength, λ, of 10 feet.

(iii) *Amplitude parameters.* Table 4 of this appendix provides the amplitude values for the MCAT segments described in paragraphs (b)(1)(i) through (vii) and (b)(1)(ix) of this appendix for each speed of the required parametric MCAT simulations. The last set of simulations shall be performed at 5 m.p.h. above the proposed maximum operating speed using the amplitude values in table 4 that correspond to the proposed maximum operating speed. For qualification of vehicle types at speeds greater than track Class 6 speeds, the following additional simulations shall be performed:

(A) For vehicle types being qualified for track Class 7 speeds, one additional set of simulations shall be performed at 115 m.p.h. using the track Class 6 amplitude values in table 4 (i.e., a 5 m.p.h. overspeed on Class 6 track).

(B) For vehicle types being qualified for track Class 8 speeds, two additional sets of simulations shall be performed. The first set at 115 m.p.h. using the track Class 6 amplitude values in table 4 (i.e., a 5 m.p.h. overspeed on Class 6 track), and a second set at 130 m.p.h. using the track Class 7 amplitude values in table 4 (i.e., a 5 m.p.h. overspeed on Class 7 track).

(C) For vehicle types being qualified for track Class 9 speeds, three additional sets of simulations shall be performed. The first set at 115 m.p.h. using the track Class 6 amplitude values in table 4 (i.e., a 5 m.p.h. overspeed on Class 6 track), a second set at 130 m.p.h. using the track Class 7 amplitude values in table 4 (i.e., a 5 m.p.h. overspeed on Class 7 track), and a third set at 165 m.p.h. using the track Class 8 amplitude values in table 4 (i.e., a 5 m.p.h. overspeed on Class 8 track).

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**Table 4 of Appendix D to Part 213  
Track Class 6 through 9 Amplitude Parameters (in inches)  
for MCAT Simulations on Tangent Track**

		Gage 56.5"			
		Class 6	Class 7	Class 8	Class 9
Max. Operating Speed (m.p.h.)		110	125	160	220
Max. Simulation Speed (m.p.h.)		115	130	165	225

MCAT Segments	Parameter	Segment Description			
Hunting	a <sub>1</sub>	(b)(1)(i)			
Gage Narrowing	a <sub>2</sub>	(b)(1)(ii)			
Gage Widening	a <sub>3</sub>	(b)(1)(iii)			
Repeated Surface	a <sub>9</sub>	(b)(1)(iv)			
Repeated Alinement	a <sub>4</sub>	(b)(1)(v)			
Single Surface	a <sub>10</sub> , a <sub>11</sub>	(b)(1)(vi)			
Single Alinement	a <sub>5</sub> , a <sub>6</sub>	(b)(1)(vii)			
Short Warp	a <sub>12</sub>				
Combined Perturbation	a <sub>7</sub> , a <sub>8</sub> , a <sub>13</sub>	(b)(1)(ix)			

		Amplitude Parameters (inches)				
Wavelength λ = 10ft	a <sub>1</sub>	0.250	0.250	0.250	0.250	
	a <sub>12</sub>					
Wavelength λ = 20ft	a <sub>2</sub>	0.500	0.500	0.500	0.250	
	a <sub>3</sub>	0.750	0.500	0.500	0.500	
	a <sub>4</sub>	0.375	0.375	0.375	0.375	
	a <sub>5</sub>	0.500	0.500	0.500	0.500	
	a <sub>6</sub>	0.000	0.000	0.000	0.000	
	a <sub>7</sub>					0.333
	a <sub>8</sub>					0.000
	a <sub>9</sub>	0.750	0.750	0.500	0.375	
	a <sub>10</sub>	1.000	1.000	0.750	0.500	
	a <sub>11</sub>	0.000	0.000	0.000	0.000	
	a <sub>13</sub>					0.333
	Wavelength λ = 62ft	a <sub>2</sub>	0.500	0.500	0.500	0.250
		a <sub>3</sub>	0.750	0.500	0.500	0.500
a <sub>4</sub>		0.500	0.375	0.375	0.375	
a <sub>5</sub>		0.750	0.750	0.750	0.500	
a <sub>6</sub>		0.000	0.250	0.250	0.000	
a <sub>7</sub>						0.333
a <sub>8</sub>						0.000
a <sub>9</sub>		0.750	0.750	0.750	0.500	
a <sub>10</sub>		1.000	1.000	1.000	0.750	
a <sub>11</sub>		0.000	0.000	0.000	0.000	
a <sub>13</sub>						0.500
Wavelength λ = 124ft		a <sub>2</sub>	0.500	0.500	0.500	0.250
		a <sub>3</sub>	0.750	0.750	0.750	0.750
	a <sub>4</sub>	1.000	0.875	0.500	0.500	
	a <sub>5</sub>	1.500	1.250	1.000	0.750	
	a <sub>6</sub>	0.750	0.500	0.250	0.000	
	a <sub>7</sub>					0.500
	a <sub>8</sub>					0.000
	a <sub>9</sub>	1.250	1.000	0.875	0.625	
	a <sub>10</sub>	1.750	1.500	1.250	1.000	
	a <sub>11</sub>	0.250	0.000	0.000	0.000	
	a <sub>13</sub>					0.667

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(3) *Vehicle performance on curved track Classes 6 through 9.* For maximum vehicle speeds corresponding to track Class 6 and higher, the MCAT segments described in paragraphs (b)(1)(ii) through (viii) of this appendix shall be used to assess vehicle performance on curved track. For curves less than 1 degree, simulations must also include the hunting perturbation segment

described in paragraph (b)(1)(i) of this appendix. For track Class 9 and for cant deficiencies greater than 5 inches, simulations must also include the combined perturbation segment described in paragraph (b)(1)(ix) of this appendix. A parametric matrix of MCAT simulations shall be performed using the following range of conditions:

(i) *Vehicle speed.* Simulations shall demonstrate that at up to 5 m.p.h. above the proposed maximum operating speed, the vehicle type shall not exceed the wheel/rail force and acceleration criteria defined in the Vehicle/Track Interaction Safety Limits table in § 213.333. Simulations shall also demonstrate acceptable vehicle dynamic response by incrementally increasing

speed from 95 m.p.h. (115 m.p.h. if a previously qualified vehicle type on an untested route) to 5 m.p.h. above the proposed maximum operating speed (in 5 m.p.h. increments).

(ii) *Perturbation wavelength.* For each speed, a set of three separate MCAT simulations shall be performed. In each MCAT simulation for the perturbation segments described in paragraphs (b)(1)(ii) through (vii) and paragraph (b)(1)(ix) of this appendix, every perturbation shall have the same wavelength. The following three wavelengths,  $\lambda$ , shall be used: 31, 62, and 124 feet. The hunting perturbation segment described in paragraph (b)(1)(i) of this appendix has a fixed wavelength,  $\lambda$ , of 10 feet, and the short warp perturbation segment described in paragraph (b)(1)(viii) of this appendix has a fixed wavelength,  $\lambda$ , of 20 feet.

(iii) *Track curvature.* For each speed, a range of curvatures shall be used to produce cant deficiency conditions ranging from greater than 3 inches up to the maximum intended for qualification (in 1 inch increments). The value of curvature,  $D$ , shall be determined using the equation defined in paragraph (b)(3) of this appendix. Each curve shall include representations of the MCAT segments described in paragraphs (b)(1)(i) through (ix) of this appendix, as appropriate, and have a fixed superelevation of 6 inches.

(iv) *Amplitude parameters.* Table 5 of this appendix provides the amplitude values for each speed of the required

parametric MCAT simulations for cant deficiencies greater than 3 inches and not more than 5 inches. Table 6 of this appendix provides the amplitude values for each speed of the required

parametric MCAT simulations for cant deficiencies greater than 5 inches. The last set of simulations at the maximum cant deficiency shall be performed at 5 m.p.h. above the proposed maximum operating speed using the amplitude values in table 5 or 6 of this appendix, as appropriate, that correspond to the proposed maximum operating speed and cant deficiency. For these simulations, the value of curvature,  $D$ , shall correspond to the proposed maximum operating speed and cant deficiency. For qualification of vehicle types at speeds greater than track Class 6 speeds, the following additional simulations shall be performed:

(A) For vehicle types being qualified for track Class 7 speeds, one additional set of simulations shall be performed at 115 m.p.h. using the track Class 6 amplitude values in table 5 or 6 of this appendix, as appropriate (i.e., a 5 m.p.h. overspeed on Class 6 track) and a value of curvature,  $D$ , that corresponds to 110 m.p.h. and the proposed maximum cant deficiency.

(B) For vehicle types being qualified for track Class 8 speeds, two additional sets of simulations shall be performed. The first set of simulations shall be performed at 115 m.p.h. using the track Class 6 amplitude values in table 5 or 6 of this appendix, as appropriate (i.e.,

a 5 m.p.h. overspeed on Class 6 track) and a value of curvature,  $D$ , that corresponds to 110 m.p.h. and the proposed maximum cant deficiency. The second set of simulations shall be performed at 130 m.p.h. using the track Class 7 amplitude values in table 5 or 6, as appropriate (i.e., a 5 m.p.h. overspeed on Class 7 track) and a value of curvature,  $D$ , that corresponds to 125 m.p.h. and the proposed maximum cant deficiency.

(C) For vehicle types being qualified for track Class 9 speeds, three additional sets of simulations shall be performed. The first set of simulations shall be performed at 115 m.p.h. using the track Class 6 amplitude values in table 5 or 6 of this appendix, as appropriate (i.e., a 5 m.p.h. overspeed on Class 6 track) and a value of curvature,  $D$ , that corresponds to 110 m.p.h. and the proposed maximum cant deficiency. The second set of simulations shall be performed at 130 m.p.h. using the track Class 7 amplitude values in table 5 or 6, as appropriate (i.e., a 5 m.p.h. overspeed on Class 7 track) and a value of curvature,  $D$ , that corresponds to 125 m.p.h. and the proposed maximum cant deficiency. The third set of simulations shall be performed at 165 m.p.h. using the track Class 8 amplitude values in table 5 or 6, as appropriate (i.e., a 5 m.p.h. overspeed on Class 8 track) and a value of curvature,  $D$ , that corresponds to 160 m.p.h. and the proposed maximum cant deficiency.

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Table 5 of Appendix D to Part 213

Track Classes 6 through 9 Amplitude Parameters (in inches)  
for MCAT Simulations on Curved Track with Cant Deficiency > 3 and ≤ 5 Inches

		Gage 56.5"			
		Class 6	Class 7	Class 8	Class 9
Max. Operating Speed (m.p.h.)		110	125	160	220
Max. Simulation Speed (m.p.h.)		115	130	165	225

		Gage 57.0"			
		Class 6	Class 7	Class 8	Class 9
Max. Operating Speed (m.p.h.)		110	125	160	220
Max. Simulation Speed (m.p.h.)		115	130	165	225

MCAT Segments	Parameter	Segment Description			
Hunting	a <sub>1</sub>	(b)(1)(i) <sup>1</sup>			
Gage Narrowing	a <sub>2</sub>	(b)(1)(ii)			
Gage Widening	a <sub>3</sub>	(b)(1)(iii)			
Repeated Surface	a <sub>9</sub>	(b)(1)(iv)			
Repeated Alignment	a <sub>4</sub>	(b)(1)(v)			
Single Surface	a <sub>10</sub> , a <sub>11</sub>	(b)(1)(vi)			
Single Alignment	a <sub>5</sub> , a <sub>6</sub>	(b)(1)(vii)			
Short Warp	a <sub>12</sub>	(b)(1)(viii)			
Combined Perturbation	a <sub>7</sub> , a <sub>8</sub> , a <sub>13</sub>				(b)(1)(ix)

		Amplitude Parameters (inches)			
Wavelength λ = 10ft	a <sub>1</sub>	0.250 <sup>1</sup>	0.250 <sup>1</sup>	0.250 <sup>1</sup>	0.250 <sup>1</sup>
Wavelength λ = 20ft	a <sub>12</sub>	0.625	0.563	0.500	0.375
Wavelength λ = 31ft	a <sub>2</sub>	0.500	0.500	0.500	0.250
	a <sub>3</sub>	0.750	0.500	0.500	0.500
	a <sub>4</sub>	0.375	0.375	0.375	0.375
	a <sub>5</sub>	0.500	0.500	0.500	0.500
	a <sub>6</sub>	0.000	0.000	0.000	0.000
	a <sub>7</sub>				0.333
	a <sub>8</sub>				0.000
	a <sub>9</sub>	0.750	0.750	0.500	0.375
	a <sub>10</sub>	1.000	1.000	0.750	0.500
	a <sub>11</sub>	0.000	0.000	0.000	0.000
a <sub>13</sub>				0.333	
Wavelength λ = 62ft	a <sub>2</sub>	0.500	0.500	0.500	0.250
	a <sub>3</sub>	0.750	0.500	0.500	0.500
	a <sub>4</sub>	0.500	0.375	0.375	0.375
	a <sub>5</sub>	0.625	0.500	0.500	0.500
	a <sub>6</sub>	0.000	0.000	0.000	0.000
	a <sub>7</sub>				0.333
	a <sub>8</sub>				0.000
	a <sub>9</sub>	0.750	0.750	0.750	0.500
	a <sub>10</sub>	1.000	1.000	1.000	0.750
	a <sub>11</sub>	0.000	0.000	0.000	0.000
a <sub>13</sub>				0.500	
Wavelength λ = 124ft	a <sub>2</sub>	0.500	0.500	0.500	0.250
	a <sub>3</sub>	0.750	0.750	0.750	0.750
	a <sub>4</sub>	1.000	0.875	0.500	0.500
	a <sub>5</sub>	1.500	1.250	0.750	0.750
	a <sub>6</sub>	0.750	0.500	0.000	0.000
	a <sub>7</sub>				0.500
	a <sub>8</sub>				0.000
	a <sub>9</sub>	1.250	1.000	0.875	0.625
	a <sub>10</sub>	1.750	1.500	1.250	1.000
	a <sub>11</sub>	0.250	0.000	0.000	0.000
a <sub>13</sub>				0.667	

		Amplitude Parameters (inches)			
Wavelength λ = 10ft	a <sub>1</sub>	0.250 <sup>1</sup>	0.250 <sup>1</sup>	0.250 <sup>1</sup>	0.250 <sup>1</sup>
Wavelength λ = 20ft	a <sub>12</sub>	0.625	0.563	0.500	0.375
Wavelength λ = 31ft	a <sub>2</sub>	0.500	0.500	0.500	0.500
	a <sub>3</sub>	0.250	0.250	0.250	0.500
	a <sub>4</sub>	0.375	0.375	0.375	0.375
	a <sub>5</sub>	0.500	0.500	0.500	0.500
	a <sub>6</sub>	0.250	0.250	0.250	0.250
	a <sub>7</sub>				0.333
	a <sub>8</sub>				0.083
	a <sub>9</sub>	0.750	0.750	0.500	0.375
	a <sub>10</sub>	1.000	1.000	0.750	0.500
	a <sub>11</sub>	0.000	0.000	0.000	0.000
a <sub>13</sub>				0.333	
Wavelength λ = 62ft	a <sub>2</sub>	0.500	0.500	0.500	0.500
	a <sub>3</sub>	0.250	0.250	0.250	0.250
	a <sub>4</sub>	0.500	0.375	0.375	0.375
	a <sub>5</sub>	0.625	0.500	0.500	0.500
	a <sub>6</sub>	0.375	0.250	0.250	0.250
	a <sub>7</sub>				0.333
	a <sub>8</sub>				0.083
	a <sub>9</sub>	0.750	0.750	0.750	0.500
	a <sub>10</sub>	1.000	1.000	1.000	0.750
	a <sub>11</sub>	0.000	0.000	0.000	0.000
a <sub>13</sub>				0.500	
Wavelength λ = 124ft	a <sub>2</sub>	1.000	1.000	1.000	0.750
	a <sub>3</sub>	0.250	0.250	0.250	0.250
	a <sub>4</sub>	1.000	0.875	0.500	0.500
	a <sub>5</sub>	1.500	1.250	0.750	0.750
	a <sub>6</sub>	1.250	1.000	0.500	0.500
	a <sub>7</sub>				0.500
	a <sub>8</sub>				0.250
	a <sub>9</sub>	1.250	1.000	0.875	0.625
	a <sub>10</sub>	1.750	1.500	1.250	1.000
	a <sub>11</sub>	0.250	0.000	0.000	0.000
a <sub>13</sub>				0.667	

<sup>1</sup> For curves <1 degree

**Table 6 of Appendix D to Part 213**

**Track Class 6 through 9 Amplitude Parameters (in inches)**

**for MCAT Simulations on Curved Track with Cant Deficiency > 5 Inches**

		Gage 56.5"				Gage 57.0"			
		Class 6	Class 7	Class 8	Class 9	Class 6	Class 7	Class 8	Class 9
Max. Operating Speed (m.p.h.)		110	125	160	220	110	125	160	220
Max. Simulation Speed (m.p.h.)		115	130	165	225	115	130	165	225

MCAT Segments	Parameter	Segment Description			
Hunting	a <sub>1</sub>	(b)(1)(i) <sup>1</sup>			
Gage Narrowing	a <sub>2</sub>	(b)(1)(ii)			
Gage Widening	a <sub>3</sub>	(b)(1)(iii)			
Repeated Surface	a <sub>9</sub>	(b)(1)(iv)			
Repeated Alinement	a <sub>4</sub>	(b)(1)(v)			
Single Surface	a <sub>10</sub> , a <sub>11</sub>	(b)(1)(vi)			
Single Alinement	a <sub>5</sub> , a <sub>6</sub>	(b)(1)(vii)			
Short Warp	a <sub>12</sub>	(b)(1)(viii)			
Combined Perturbation	a <sub>7</sub> , a <sub>8</sub> , a <sub>13</sub>				(b)(1)(ix)

		Amplitude Parameters (inches)				Amplitude Parameters (inches)			
Wavelength λ = 10ft	a <sub>1</sub>	0.250 <sup>1</sup>	0.250 <sup>1</sup>	0.250 <sup>1</sup>	0.250 <sup>1</sup>	0.250 <sup>1</sup>	0.250 <sup>1</sup>	0.250 <sup>1</sup>	0.250 <sup>1</sup>
Wavelength λ = 20ft	a <sub>12</sub>	0.625	0.500	0.500 <sup>2</sup>	0.375	0.625	0.500	0.500 <sup>2</sup>	0.375
Wavelength λ = 31ft	a <sub>2</sub>	0.500	0.500	0.500	0.250	0.500	0.500	0.500	0.500
	a <sub>3</sub>	0.750	0.500	0.500	0.500	0.250	0.250	0.250	0.500
	a <sub>4</sub>	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375
	a <sub>5</sub>	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
	a <sub>6</sub>	0.000	0.000	0.000	0.000	0.250	0.250	0.250	0.250
	a <sub>7</sub>	0.333	0.333	0.333	0.333	0.333	0.333	0.333	0.333
	a <sub>8</sub>	0.000	0.000	0.000	0.000	0.083	0.083	0.083	0.083
	a <sub>9</sub>	0.750	0.750	0.500	0.375	0.750	0.750	0.500	0.375
	a <sub>10</sub>	1.000	1.000	0.750	0.500	1.000	1.000	0.750	0.500
	a <sub>11</sub>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
a <sub>13</sub>	0.667	0.667	0.500	0.333	0.667	0.667	0.500	0.333	
Wavelength λ = 62ft	a <sub>2</sub>	0.500	0.500	0.500	0.250	0.500	0.500	0.500	0.500
	a <sub>3</sub>	0.750	0.500	0.500	0.500	0.250	0.250	0.250	0.250
	a <sub>4</sub>	0.500	0.375	0.375	0.375	0.500	0.375	0.375	0.375
	a <sub>5</sub>	0.625	0.500	0.500	0.500	0.625	0.500	0.500	0.500
	a <sub>6</sub>	0.000	0.000	0.000	0.000	0.375	0.250	0.250	0.250
	a <sub>7</sub>	0.417	0.333	0.333	0.333	0.417	0.333	0.333	0.333
	a <sub>8</sub>	0.000	0.000	0.000	0.000	0.167	0.083	0.083	0.083
	a <sub>9</sub>	0.750	0.750	0.750	0.500	0.750	0.750	0.750	0.500
	a <sub>10</sub>	1.000	1.000	1.000	0.750	1.000	1.000	1.000	0.750
	a <sub>11</sub>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
a <sub>13</sub>	0.667	0.667	0.667	0.500	0.667	0.667	0.667	0.500	
Wavelength λ = 124ft	a <sub>2</sub>	0.500	0.500	0.500	0.250	1.000	1.000	1.000	0.750
	a <sub>3</sub>	0.750	0.750	0.750	0.750	0.250	0.250	0.250	0.250
	a <sub>4</sub>	1.000	0.875	0.500	0.500	1.000	0.875	0.500	0.500
	a <sub>5</sub>	1.250	1.000	0.750	0.750	1.250	1.000	0.750	0.750
	a <sub>6</sub>	0.500	0.250	0.000	0.000	1.000	0.750	0.500	0.500
	a <sub>7</sub>	0.833	0.667	0.500	0.500	0.833	0.667	0.500	0.500
	a <sub>8</sub>	0.083	0.000	0.000	0.000	0.583	0.417	0.250	0.250
	a <sub>9</sub>	1.250	1.000	0.875	0.625	1.250	1.000	0.875	0.625
	a <sub>10</sub>	1.500	1.250	1.250	1.000	1.500	1.250	1.250	1.000
	a <sub>11</sub>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
a <sub>13</sub>	1.000	0.833	0.833	0.667	1.000	0.833	0.833	0.667	

<sup>1</sup> For curves <1 degree

<sup>2</sup> 0.375 for E<sub>u</sub>>7"

(4) *Vehicle performance on curved track Classes 1 through 5 at high cant deficiency.* For maximum vehicle speeds corresponding to track Classes 1 through 5, the MCAT segments described in paragraphs (b)(1)(ii) through (ix) of this appendix shall be used to assess vehicle performance on

curved track if the proposed maximum cant deficiency is greater than 6 inches. A parametric matrix of MCAT simulations shall be performed using the following range of conditions:

(i) *Vehicle speed.* Simulations shall demonstrate that at up to 5 m.p.h. above the proposed maximum operating

speed, the vehicle shall not exceed the wheel/rail force and acceleration criteria defined in the Vehicle/Track Interaction Safety Limits table in § 213.333. Simulations shall also demonstrate acceptable vehicle dynamic response at 5 m.p.h. above the proposed maximum operating speed.

(ii) *Perturbation wavelength.* For each speed, a set of two separate MCAT simulations shall be performed. In each MCAT simulation for the perturbation segments described in paragraphs (b)(1)(ii) through (vii) and paragraph (b)(1)(ix) of this appendix, every perturbation shall have the same wavelength. The following two wavelengths,  $\lambda$ , shall be used: 31 and 62 feet. The short warp perturbation segment described in paragraph

(b)(1)(viii) of this appendix has a fixed wavelength,  $\lambda$ , of 20 feet.  
 (iii) *Track curvature.* For a speed corresponding to 5 m.p.h. above the proposed maximum operating speed, a range of curvatures shall be used to produce cant deficiency conditions ranging from 6 inches up to the maximum intended for qualification (in 1 inch increments). The value of curvature, D, shall be determined using the equation in paragraph (b)(3) of this

appendix. Each curve shall contain the MCAT segments described in paragraphs (b)(1)(ii) through (ix) of this appendix and have a fixed superelevation of 6 inches.  
 (iv) *Amplitude parameters.* Table 7 of this appendix provides the amplitude values for the MCAT segments described in paragraphs (b)(1)(ii) through (ix) of this appendix for each speed of the required parametric MCAT simulations.

**Table 7 of Appendix D to Part 213  
 Track Class 1 through 5 Amplitude Parameters (in inches)  
 for MCAT Simulations on Curved Track with Cant Deficiency > 6 Inches**

		Gage 56.5"				
		Class 1	Class 2	Class 3	Class 4	Class 5
Max. Operating Speed (m.p.h.)		15	30	60	80	90
Max. Simulation Speed (m.p.h.)		20	35	65	85	95

		Gage 57.0"				
		Class 1	Class 2	Class 3	Class 4	Class 5
Max. Operating Speed (m.p.h.)		15	30	60	80	90
Max. Simulation Speed (m.p.h.)		20	35	65	85	95

MCAT Segments	Parameter	Segment Description				
Hunting	a <sub>1</sub>					
Gage Narrowing	a <sub>2</sub>	(b)(1)(ii)				
Gage Widening	a <sub>3</sub>	(b)(1)(iii)				
Repeated Surface	a <sub>9</sub>	(b)(1)(iv)				
Repeated Alinement	a <sub>4</sub>	(b)(1)(v)				
Single Surface	a <sub>10</sub> , a <sub>11</sub>	(b)(1)(vi)				
Single Alinement	a <sub>5</sub> , a <sub>6</sub>	(b)(1)(vii)				
Short Warp	a <sub>12</sub>	(b)(1)(viii)				
Combined Perturbation	a <sub>7</sub> , a <sub>8</sub> , a <sub>13</sub>	(b)(1)(ix)				

		Amplitude Parameters (inches)				
Wavelength $\lambda = 10ft$	a <sub>1</sub>					
Wavelength $\lambda = 20ft$	a <sub>12</sub>	1.000	1.000	0.875	0.875	0.750
Wavelength $\lambda = 31ft$	a <sub>2</sub>	0.500	0.500	0.500	0.500	0.500
	a <sub>3</sub>	1.250	1.250	1.250	0.500	0.500
	a <sub>4</sub>	0.750	0.750	0.750	0.750	0.500
	a <sub>5</sub>	0.750	0.750	0.750	0.750	0.500
	a <sub>6</sub>	0.000	0.000	0.000	0.250	0.000
	a <sub>7</sub>	0.500	0.500	0.500	0.500	0.333
	a <sub>8</sub>	0.000	0.000	0.000	0.000	0.000
	a <sub>9</sub>	1.000	1.000	1.000	1.000	1.000
	a <sub>10</sub>	1.000	1.000	1.000	1.000	1.000
	a <sub>11</sub>	0.000	0.000	0.000	0.000	0.000
a <sub>13</sub>	0.667	0.667	0.667	0.667	0.667	

		Amplitude Parameters (inches)				
Wavelength $\lambda = 10ft$	a <sub>1</sub>					
Wavelength $\lambda = 20ft$	a <sub>12</sub>	1.000	1.000	0.875	0.875	0.750
Wavelength $\lambda = 31ft$	a <sub>2</sub>	1.250	1.250	1.250	0.500	0.500
	a <sub>3</sub>	0.750	0.750	0.750	0.500	0.500
	a <sub>4</sub>	0.750	0.750	0.750	0.750	0.500
	a <sub>5</sub>	0.750	0.750	0.750	0.750	0.500
	a <sub>6</sub>	0.000	0.000	0.000	0.250	0.000
	a <sub>7</sub>	0.500	0.500	0.500	0.500	0.333
	a <sub>8</sub>	0.000	0.000	0.000	0.000	0.000
	a <sub>9</sub>	1.000	1.000	1.000	1.000	1.000
	a <sub>10</sub>	1.000	1.000	1.000	1.000	1.000
	a <sub>11</sub>	0.000	0.000	0.000	0.000	0.000
a <sub>13</sub>	0.667	0.667	0.667	0.667	0.667	

		Amplitude Parameters (inches)				
Wavelength $\lambda = 10ft$	a <sub>1</sub>					
Wavelength $\lambda = 20ft$	a <sub>12</sub>	1.000	1.000	0.875	0.875	0.750
Wavelength $\lambda = 62ft$	a <sub>2</sub>	0.500	0.500	0.500	0.500	0.500
	a <sub>3</sub>	1.250	1.250	1.250	0.500	0.500
	a <sub>4</sub>	1.250	1.250	1.250	0.875	0.625
	a <sub>5</sub>	1.250	1.250	1.250	0.875	0.625
	a <sub>6</sub>	0.000	0.000	0.000	0.375	0.125
	a <sub>7</sub>	0.833	0.833	0.833	0.583	0.417
	a <sub>8</sub>	0.000	0.000	0.000	0.083	0.000
	a <sub>9</sub>	1.750	1.750	1.750	1.250	1.000
	a <sub>10</sub>	1.750	1.750	1.750	1.250	1.000
	a <sub>11</sub>	0.000	0.000	0.000	0.000	0.000
a <sub>13</sub>	1.167	1.167	1.167	0.833	0.667	

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**PART 238—[AMENDED]**

■ 26. The authority citation for part 238 is revised to read as follows:

**Authority:** 49 U.S.C. 20103, 20107, 20133, 20141, 20302-20303, 20306, 20701-20702,

21301-21302, 21304; 28 U.S.C. 2461, note; and 49 CFR 1.89.

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

■ 27. Section 238.227 is revised to read as follows:

**§ 238.227 Suspension system.**

On or after November 8, 1999—

(a) All passenger equipment shall exhibit freedom from truck hunting at all operating speeds. If truck hunting does occur, a railroad shall immediately take appropriate action to prevent

derailment. Truck hunting is defined in § 213.333 of this chapter.

(b) Nothing in this section shall affect the requirements of the Track Safety Standards in part 213 of this chapter as they apply to passenger equipment as provided in that part. In particular—

(1) *Pre-revenue service qualification.* All passenger equipment intended for service at speeds greater than 90 mph or at any curving speed producing more than 5 inches of cant deficiency shall demonstrate safe operation during pre-revenue service qualification in accordance with § 213.345 of this chapter and is subject to the requirements of either § 213.57 or § 213.329 of this chapter, as appropriate.

(2) *Revenue service operation.* All passenger equipment intended for service at speeds greater than 90 mph or at any curving speed producing more than 5 inches of cant deficiency is subject to the requirements of § 213.333 of this chapter and either § 213.57 or § 213.329 of this chapter, as appropriate.

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

■ 28. Section 238.427 is amended by revising paragraphs (a)(2), (b), and (c),

and by removing paragraph (d) to read as follows:

**§ 238.427 Suspension system.**

(a) \* \* \*

(2) All passenger equipment shall meet the safety performance standards for suspension systems contained in part 213 of this chapter, or alternative standards providing at least equivalent safety if approved by FRA under the provisions of § 238.21. In particular—

(i) *Pre-revenue service qualification.* All passenger equipment shall demonstrate safe operation during pre-revenue service qualification in accordance with § 213.345 of this chapter and is subject to the requirements of § 213.329 of this chapter.

(ii) *Revenue service operation.* All passenger equipment in service is subject to the requirements of §§ 213.329 and 213.333 of this chapter.

(b) *Carbody acceleration.* A passenger car shall not operate under conditions that result in a steady-state lateral acceleration greater than 0.15g, as measured parallel to the car floor inside the passenger compartment. Additional

carbody acceleration limits are specified in § 213.333 of this chapter.

(c) *Truck (hunting) acceleration.* Each truck shall be equipped with a permanently installed lateral accelerometer mounted on the truck frame. If truck hunting is detected, the train monitoring system shall provide an alarm to the locomotive engineer, and the train shall be slowed to a speed at least 5 mph less than the speed at which the truck hunting stopped. Truck hunting is defined in § 213.333 of this chapter.

■ 29. Section 238.428 is added to read as follows:

**§ 238.428 Overheat sensors.**

Overheat sensors for each wheelset journal bearing shall be provided. The sensors may be placed either onboard the equipment or at reasonable intervals along the railroad’s right-of-way.

■ 30. Appendix A to part 238 is amended by adding the entry for new § 238.428 in numerical order to read as follows:

**Appendix A to Part 238—Schedule of Civil Penalties** <sup>1 2</sup>

	Section	Violation	Willful violation
SUBPART E—SPECIFIC REQUIREMENTS FOR TIER II PASSENGER EQUIPMENT:			
	*	*	*
238.428	Overheat sensors .....	2,500	5,000
	*	*	*

**Appendix C to Part 238 [Removed and Reserved]**

■ 31. Appendix C to part 238 is removed and reserved.

Issued in Washington, DC, on February 25, 2013.

**Joseph C. Szabo,**  
*Administrator.*

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<sup>1</sup> A penalty may be assessed against an individual only for a willful violation. Generally when two or more violations of these regulations are discovered with respect to a single unit of passenger equipment that is placed or continued in service by a railroad, the appropriate penalties set forth above are aggregated up to a maximum of \$16,000 per day. However, failure to perform, with respect to a particular unit of passenger equipment, any of the inspections and tests required under subparts D and F of this part will be treated as a violation separate and distinct from, and in addition to, any substantive violative conditions found on that unit of passenger equipment. Moreover, the Administrator reserves the right to assess a penalty of up to \$105,000 for any violation where circumstances warrant. See 49 CFR part 209, appendix A.

Failure to observe any condition for movement of defective equipment set forth in § 238.17 will

deprive the railroad of the benefit of the movement-for-repair provision and make the railroad and any responsible individuals liable for penalty under the particular regulatory section(s) concerning the substantive defect(s) present on the unit of passenger equipment at the time of movement.

Failure to observe any condition for the movement of passenger equipment containing defective safety appliances, other than power brakes, set forth in § 238.17(e) will deprive the railroad of the movement-for-repair provision and make the railroad and any responsible individuals liable for penalty under the particular regulatory section(s) contained in part 231 of this chapter or § 238.429 concerning the substantive defective condition.

The penalties listed for failure to perform the exterior and interior mechanical inspections and tests required under § 238.303 and § 238.305 may be

assessed for each unit of passenger equipment contained in a train that is not properly inspected. Whereas, the penalties listed for failure to perform the brake inspections and tests under § 238.313 through § 238.319 may be assessed for each train that is not properly inspected.

<sup>2</sup> The penalty schedule uses section numbers from 49 CFR part 238. If more than one item is listed as a type of violation of a given section, each item is also designated by a “penalty code,” which is used to facilitate assessment of civil penalties, and which may or may not correspond to any subsection designation(s). For convenience, penalty citations will cite the CFR section and the penalty code, if any. FRA reserves the right, should litigation become necessary, to substitute in its complaint the CFR citation in place of the combined CFR and penalty code citation, should they differ.