Memorandum

U.S. Department
of Transportation

**Federal Railroad
Administration**

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Subject: Technical Bulletin T-13-01, Guidance Regarding the Application of Vehicle/Track Interaction Safety Standards; High-Speed and High Cant Deficiency Operations; Final Rule, Track Classes 1–5

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To: Regional Administrators, Deputy Regional Administrators, Track Specialists, Chief Inspectors, Railroad System Oversight Managers, State Program Managers, and Federal and State Track Inspectors

This technical bulletin is intended to provide guidance to all Federal and State inspectors who perform inspections of Track Classes 1 to 5.

Background: On March 13, 2013, FRA published a final rule in the Federal Register titled, "Vehicle/Track Interaction Safety Standards; High-Speed and High Cant Deficiency Operations" (Vol. 78, 16052–16126). The rule became effective on July 11, 2013. The 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. 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. In the process of developing the rule, certain provisions governing Track Classes 1–5 were also revised to ensure that the provisions applicable to both higher- and lower-speed track classes are consistent.

As a result of the new final rule, the current Track and Rail and Infrastructure Integrity Compliance Manual needs to be updated and republished. In the interim, this technical bulletin provides guidance for the provisions that have been changed and also serves as a reference in lieu of the entire compliance manual.

For ease of reference, this technical bulletin is formulated in a style similar to the current Track and Rail and Infrastructure Integrity Compliance Manual. Only the applicable sections of Title 49 Code of Federal Regulations (CFR) Part 213, Subparts A–F, that have been modified under this rule change are shown.

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.*

Guidance: This is simply to update the citation for Part 213.

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.*

Guidance: The text "In general" has been added to provide a certain degree of flexibility, to encompass track conditions not necessarily "existing in isolation." In particular, it refers to ''combined'' track alinement and surface deviations contained in the new § 213.65.

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;

* * * * *

Guidance: The changes to paragraphs (a)(2)(i) and (b)(2)(i) clarify that the requirements for a person to be qualified under this section concern the portions of Part 213 necessary for the person to perform his or her duties. The person is not required to know or understand specific requirements of this part that are not necessary to fulfill his or her duties. 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.

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.

Guidance: Rather than define what is meant by curved track in each section where requirements for curved track apply, it was 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 degrees. This definition is intended to apply to all sections where limits for curved track are specified, unless otherwise provided.

Please note that, by implication of this section, track measurement systems required for compliance with Part 213 must be able to detect curves with this minimum specified degree of curvature.

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[1] may not be more than—(inches)	*The deviation of the mid-ordinate from a 31-foot chord[2] may not be more than—(inches)*	*The deviation of the mid-ordinate from a 62-foot chord[2] may not be more than— (inches)*
Class 1 track	*5*	*N/A[3]*	*5*
Class 2 track	*3*	*N/A[3]*	*3*
Class 3 track	*1¾*	*1¼*	*1¾*
Class 4 track	*1½*	*1*	*1½*
Class 5 track	*¾*	*½*	*⅝*

[1] 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.

[2] 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.

[3] N/A—Not Applicable

Guidance: This paragraph is redesignated as § 213.55(a) as a result of the addition of what is now § 213.55(b).

(b) For operations at a qualified cant deficiency, E_u, 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[1] may not be more than—(inches)	*The deviation of the mid-ordinate from a 62-foot chord[1] may not be more than—(inches)*
Class 1 track[2]	*N/A[3]*	*1¼*
Class 2 track[2]	*N/A[3]*	*1¼*
Class 3 track	*¾*	*1¼*
Class 4 track	*¾*	*⅞*
Class 5 track	*½*	*⅝*

[1] 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.

[2] Restraining rails or other systems may be required for derailment prevention.

[3] N/A—Not Applicable

Guidance: This new paragraph applies only to operations at a qualified cant deficiency of more than 5 inches. Note that the limits for Class 4 and lower track have been tightened—most notably for Class 1 and 2 track. The limits in this paragraph were established based on computer simulations to provide sufficient margins of safety, as higher cant deficiency operations will result in higher lateral wheel loads.

For any operation involving more than 5 inches of cant deficiency, the track owner or railroad must have the necessary FRA approval or documentation showing that the operations are qualified for a cant deficiency higher than 5 inches.

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.

Guidance: 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. The phrase "except

when engineered to address specific track or operating conditions" is intended to address special cases, such as a turnout that comes off the high rail in a curve, to allow reverse elevation to be designed into the curve out of necessity and for safety reasons.

(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).[1]

E_u = Qualified cant deficiency[2] *(inches) of the vehicle type.*

D = Degree of curvature (degrees).[3]

[1] *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.*

[2] *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.*

[3] *Degree of curvature, D, is determined by averaging the degree of curvature over the same track segment as the elevation.*

Guidance: The designation of V_{max} has been changed from "maximum allowable operating" speed to "maximum allowable posted timetable operating speed." Track owners or railroads can use it to establish the "posted timetable operating speed" based on the qualified cant deficiency (E_u) and the design values of elevation (E_a) and curvature (D). The V_{max} value will then be the target or reference speed. Track inspectors can use the formula to assess compliance in two ways:

1. Calculating cant deficiency by inserting the reference V_{max}, elevation (E_a), and curvature (D) at the time of inspection. If the resulting actual cant deficiency is higher than the qualified cant deficiency, there is potentially a limiting speed defect.
2. Calculating maximum allowable speed by inserting the elevation (E_a) and curvature (D) at the time of inspection and qualified cant deficiency (E_u). If the resulting speed is lower than the reference speed, there is potentially a limiting speed defect.

Footnote 1 has been clarified to establish the actual elevation E_a—11 points at 15.5-foot spacing through the 155-foot evaluation segment will be averaged. This clarification to footnote 1 makes the footnote more consistent with the manner in which the rule is intended to be applied. 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.

A new footnote 2 has been added 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. The note 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. The intent is to allow this tolerance for "local crosslevel or curvature conditions" that result in track degradation below the maintenance limits of the track owner or railroad. The footnote is not intended to provide a tolerance to be factored into the maintenance limits themselves. For example, if the "maximum allowable posted timetable operating speed" is based on a V_{max} corresponding to 3 inches of cant deficiency, the track owner or railroad should not establish maintenance practices that are intended to result in operation of equipment at a speed that produces up to 4 inches of cant deficiency. Yet, in this example, if the equipment actually operates at a speed that produces more than 3 inches of cant deficiency due to track degrading below the intended maintenance limits of the track owner or railroad, the track owner or railroad should not be penalized merely because the cant deficiency exceeds 3 inches (see below for additional guidance).

The limiting speed defect can range from a few feet to the entire curve length. Therefore, the defect length alone cannot determine whether the limiting speed defect arose from track degradation or from the failure to carry out appropriate track maintenance.

As noted above, footnote 2 provides that if the actual elevation and degree of curvature change as a result of track degradation, the actual amount of cant deficiency in a curve may be greater than the approved amount of cant deficiency, E_u, but not by more than 1 additional inch. This footnote is consistent with FRA's enforcement practice—namely, to provide a tolerance for limited exceedances of the approved amount of cant deficiency, E_u, in curves. Because a tolerance is now part of the regulation, not all exceedances are actual defects (i.e., actual instances of noncompliance). The inspector should only record the condition as a defect if there is evidence that the maintenance practices of the track owner or railroad created a condition where the actual amount of cant deficiency exceeded the approved value. In this case, FRA expects the track owner or railroad to take appropriate remedial action. The inspector should consider writing a recommendation for civil penalty if the level of cant deficiency—based on the maximum speed, elevation, and curvature—exceeds the approved value, E_u, by more than 1 inch. When the actual cant deficiency is found to exceed the approved level, there are many scenarios that could involve compliance or noncompliance with the regulation, and all of these different scenarios cannot be easily described here. The inspector should consider multiple factors when determining whether to assess a defect or recommend a violation. For example, if the inspector can establish that a track has been recently machine-tamped and that it was not possible for the track to have degraded to the level causing an exceedance of the approved cant deficiency in the time period after the tamping, the inspector may assess a defect. In another example, if the track owner or railroad voluntarily performs spot maintenance on a curve, typically by manual tamping, to bring the curve to uniformity (in terms of curvature and elevation), and the amount of cant deficiency still exceeds the approved level by a nominal amount, the inspector should exercise his or her discretion whether to assess a defect. The inspector should consider assessing a defect when the

exceedance is close to the maximum tolerance, which leaves little room for further track degradation. In all cases, if the inspector cannot determine whether a condition is out of compliance, or whether to assess a defect or recommend a civil penalty, he or she should consult with the regional track specialist.

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

(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.

Guidance: This paragraph provides that all vehicle types are considered qualified for up to 3 inches of cant deficiency, as allowed by the former rule.

(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.

Guidance: The rule no longer limits cant deficiency to a maximum of 4 inches in Track Classes 1 through 5, which has necessitated waivers. To be consistent with the higher-speed standards in § 213.329, the requirements limit (1) vertical wheel load remaining on the raised wheels to no less than 60 percent of their static level values and (2) 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. The rule no longer imposes a 6-inch superelevation static lean requirement. This requirement was intended to look at the likelihood of a vehicle overturning due to excessive track cant when a vehicle stops in a curve. This is a problem for all equipment, not just those operating at a higher cant deficiency and is covered in a separate industry standard.

Now, only the amount of superelevation will be 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 former 5.7-degree roll limit, which limited steady-state carbody lateral acceleration to 0.1g has been removed.

The requirements in paragraph (d) may be met by either static or dynamic testing. The static lean test limits the vertical wheel load remaining on the raised wheels and the roll of a passenger carbody with respect to the horizontal plane to the thresholds mentioned above. 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 intended to provide consistency with the 8.6-degree roll limit in the static lean test, which corresponds to the lateral acceleration a passenger would experience in a standing vehicle with its carbody rolled 8.6 degrees with respect to the horizontal.

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. Although other FRA vehicle/track interaction (VTI) 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. This steady-state, carbody lateral acceleration will result in a lateral force, pulling passengers to one side of the carbody. It is not the same as sustained, carbody lateral oscillatory accelerations, or continuous side-to-side oscillations (hunting) of the carbody in response to track conditions, which could exist on both curved and tangent track.

(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,[1] 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

[1] The test procedure may be conducted so that 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.

(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.

Guidance: This paragraph clarifies the submittal requirements to FRA to obtain approval for the qualifying cant deficiency of a vehicle type, including 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, such as a freight car operated in a freight train, and then only to safety-critical components.

Former footnote 3 is being redesignated as footnote 4 and modified in conformance with the changes in the final rule. New footnote 4 refers to "the proposed cant deficiency" instead of 4 inches of cant deficiency. The new rule removed the statement in the former footnote that the "test procedure may be conducted in a test facility," to eliminate potential confusion that testing may be conducted only in a test facility.

(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.

Guidance: The paragraph requires that a track owner or railroad notify FRA prior to the implementation of the approved higher curving speeds. The paragraph 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.

(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.

Guidance: This paragraph was formerly designated as paragraph (e). This paragraph is identical to two other provisions in this final rule: § 213.329(g), the Subpart G counterpart to this section, and § 213.345(i).

(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 segments(s).

Guidance: This paragraph clarifies that vehicle types that have been permitted by FRA to operate at cant deficiencies, E_u, greater than 3, but no more than 5, inches prior to this final rule are considered qualified under this section to operate at those permitted cant deficiencies for any track segment. FRA believes that extending the nature of the qualification for operation over other track segments 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. 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 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, the provision in paragraph (h)(2) restricts the "portability" of cant deficiency qualification for vehicle types that have been permitted by FRA to operate at cant deficiencies, E_u, greater than 5 inches. Operation at cant deficiencies greater than 5 inches over other track segments must be newly qualified in accordance with this rule, consistent with the additional requirements that have been introduced to provide for the safety of operations at cant deficiencies greater than 5 inches.

(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).

Guidance: This paragraph applies to operations at more than 5 inches of cant deficiency. It refers to §§ 213.333, Automated vehicle-based inspection systems (specifically paragraphs (a) through (g), (j), (k), (1), and (m)); 213.345, Vehicle/track system qualification; and 213.369, Inspection records (specifically paragraph (f)).

Section 213.333(a)(1) requires a qualifying Track Geometry Measurement System (TGMS) to be operated over Class 1 through 5 track that supports cant deficiency operations of more than 5 inches. The frequency for the TGMS inspections is at least twice per calendar year with no less than 120 days between inspections. Sections 213.333(b) through (e) list the TGMS system criteria. Section 213.333(f) continues to require that the track owner, within 2 days after the TGMS inspection, field verify and institute remedial action for all exceptions to the class of track. Section 213.333(g) requires the track owner or railroad to maintain a copy of the plot and the exception report for the required TGMS inspection. Section 213.333(j)(1) requires that a vehicle having dynamic response characteristics that are representative of other vehicles assigned to the service 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, and shall be operated each calendar quarter. Section 213.333(k) describes the acceleration testing requirements. Section 213.333(m) requires the track owner or railroad to maintain a copy of the most recent exception records for the inspections required under paragraphs (j) and (k).

Please note that complete guidance on the revisions to § 213.333 and other provisions of Subpart G is not provided here but will be at a later date, along with that for all of Subpart G. As always, the final rule may be referenced for guidance on any provision.

(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.

Guidance: Paragraph (j)(2) explains the term "vehicle type." The paragraph is of particular importance when determining if a vehicle type is subject to the qualification requirements of this section. For example, a vehicle type with modified primary springs to improve high-speed performance may be considered a new vehicle type.

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).*

Guidance: The final rule makes a conforming change to this section's reference to § 213.57(b) to reflect the changes adopted in that section. "[M]aximum allowable operating speed" has been changed to "maximum allowable posted timetable operating speed" to be consistent with revised § 213.57(b). No other change is intended.

8. Section 213.63 is revised to read as follows:

§ 213.63 Track surface.

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

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[*1,2]	*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*

[1] *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.*

[2] *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.*

Guidance: This new paragraph (a) is the entire former § 213.63, and has been designated as paragraph (a) due to the addition of new paragraph (b). This new paragraph (a) generally mirrors the former section, but substitutes the wording "prior to June 22, 1998" (to reference when the Track Safety Standards were revised in 1998) to replace "prior to the promulgation of this rule" in the asterisked portion of the table.

(b) For operations at a qualified cant deficiency, E_u, of more than 5 inches, each track owner shall maintain the surface of the curve within the limits 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*[1]	*N/A*[1]	*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*

N/A—Not Applicable

Guidance: The newly added paragraph (b) contains tighter, single-deviation geometry limits for operations above 5 inches of cant deficiency on curves. These limits include tighter 62-foot mid-chord offset (MCO) limits and new limits for 31-foot MCO and 10-foot warp—the difference in crosslevel between any two points less than 10 feet apart. The other limits in rows 1, 3, 4, and 5 in paragraph (a) are still applicable.

The new limits for operations above 5 inches of cant deficiency provide an equivalent margin of safety for operations at higher cant deficiency. They are based on the results of simulation studies to determine the safe amplitudes of track geometry surface variations.

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_u, 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_m = *measured alinement deviation from uniformity (outward is positive, inward is negative).*

A_L = *allowable alinement limit as per § 213.55(b) (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 § 213.63(b) (always positive) for the class of track.*

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

Guidance: FRA has added this new section, which contains limits addressing combined track alinement and surface deviations for operations above 5 inches of cant deficiency on curves.

The equation is given for computing the combined track alinement and surface deviations within a single chord length. The limits are intended to be used only with a TGMS, and applied on the outside rail in curves.

The Track Safety Standards have traditionally prescribed limits on geometry variations existing in isolation. However, a combination of track alinement and surface variations may result in undesirable vehicle response, even though neither the alinement nor the surface variation individually amounts to a deviation from the requirements in § 213.55 and § 213.63.

Paragraph § 213.333(a)(1) of the rule adds TGMS inspection requirements for high cant deficiency operations over Class 1 through 5 track. These requirements apply as required by § 213.57(i). Trains operating at high cant deficiencies increase the lateral wheel force exerted on track during curving, and hence decrease the margin of safety associated with the VTI safety limits in § 213.333. The equation-based safety limit in this section is needed to provide a margin of safety for vehicle operations at higher cant deficiencies regardless of speed.

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[2], 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—

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—

$$PLG24 = UTG + A \times (LTG - UTG)$$

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.

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[2] 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.

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

Guidance: This section specifies procedures for using a Gage Restraint Measurement System (GRMS) to assess the ability of track to maintain proper gage. FRA has amended this section to make it consistent with the changes to the GRMS requirements in § 213.333 in Subpart G. The changes are principally to ensure that the terminology and references are consistent. These minor changes are intended to neither diminish nor add to the requirements of this section.

This rule adds footnote 5 to this section, 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 footnote 10 (formerly, footnote 7), which applies to § 213.333, Automated vehicle-based inspection systems, to ensure conformity between this section and its Subpart G counterpart.

Please also note that paragraphs (c), (d), and (e) have been modified to correct the units for the lateral load "L" and the vertical load "V" from pounds to *kips*, and factor "A" has also been corrected.

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

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

* * * * *

Guidance: The equation for Gage Widening Projection (GWP) replaces the former Gage Widening Ratio (GWR). The GWP is intended to compensate for the weight of the testing vehicle. Use of the GWP provides at least the same level of safety and 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 (http://www.fra.dot.gov/eLib/Details/L02543).

By making the criteria in this section consistent with the changes to the GRMS requirements in § 213.333 in Subpart G, 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 in Subpart G.

(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[1]	*If measurement value exceeds*	*Remedial action required*
First Level Exception		
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.....*	
Second Level Exception		
LTG.....	*57 ¾ inches on Class 4 and 5 track*[2]*.....*	*(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.....*	

[1] Definitions for the GRMS parameters referenced in this table are found in paragraph (p) of this section.

[2] 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.

Guidance: FRA has corrected the table in paragraph (l) to renumber the remedial action specified for a second-level exception. The remedial action has been designated as (1), (2), and (3) in the "Remedial action required" column, to be consistent with the remedial action specified for a first-level exception. FRA has reformatted the table to distinguish more clearly between first-level and second-level exceptions.

(p) As used in this section—

* * * * *

(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.

Guidance: FRA has modified the text defining GWP. Likewise, in § 213.333(i)(2), for Track Classes 6 through 9, FRA has also modified the rule so that the units are correspondingly stated in kips.