Federal Railroad Administration
Track Safety Standards
Compliance Manual

Chapter 5
Track Safety Standards
Classes 1 through 5

Office of Safety Assurance and Compliance
Track and Structures Division

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CHAPTER 5

Track Safety Standards Classes 1 Through 5

Introduction

This chapter provides the necessary information for FRA Inspectors to properly apply the Track Safety Standards (TSS) during inspection activities (the term "FRA Inspector" also includes State Inspectors that are participants in the Federal program). This manual is not to be construed as a modification, alteration, or revision of the published TSS.

Any legal proceeding instituted against a railroad must be based on the regulations found in 49 CFR Part 213. Inspectors should refer to this manual as often as necessary to understand the intent of any particular rules, thereby assuring to the extent practicable, the nationally uniform application of these rules as intended by Congress in the Federal Railroad Safety Act of 1970.

Inspectors will not, under any circumstances, adjust, correct, or repair track, or appurtenances nor authorize, suggest, or recommend any movements over any track. Full responsibility for these matters rests with the railroad. The Inspector will immediately inform the railroad of any track condition found to be not in compliance with the TSS.

This manual is based on the TSS published on June 22, 1998 (see 63 FR 33992), the Gage Restraint Measurement System (GRMS) amendments published on January 10, 2001 (see 66 FR 1894), and the continuous welded rail (CWR) Interim Final Rule (IFR) published on November 2, 2005 (see 70 FR 66288). Inspectors are encouraged to provide suggestions for enhancement of future editions of this manual.

Appendix B contains the defect codes for each subsection of the regulation. Defect codes are important analytical tools for FRA's data collection. If an Inspector cannot find a defect code corresponding to a violation of the TSS, the Inspector may still submit the violation.

This chapter addresses track Classes 1 through 5. Chapter 6 addresses Classes 6 through 9.

Text in italic font of this manual is regulatory language, whereas indented paragraphs provide field guidance for FRA Inspectors. Indented paragraphs are not to be construed as regulatory language in any manner.

Subpart A - General

§213.1 Scope of part

(a) This part prescribes minimum safety requirements for railroad track that is part of the general railroad system of transportation. The requirements prescribed in this part apply to specific track conditions existing in isolation. Therefore, a combination of track conditions, none of which individually amounts to a deviation from the requirements in this part, may require remedial action to provide for safe operations over that track. This part does not restrict a railroad from adopting and enforcing additional or more stringent requirements not inconsistent with this part.

Guidance. It is important to note that the TSS are minimum safety requirements and are not appropriate for track maintenance purposes.

This section also notes that, while the TSS address specific track conditions that exist in isolation, there can sometimes be a combination of track conditions (none of which individually amounts to a deviation of the TSS) that require remedial action to provide for safe operations over that track. Experience has shown that such an event occurs only rarely, but if an Inspector should encounter such a condition, the Inspector should immediately bring the condition to the attention of the accompanying railroad official, explain the hazard of such a condition, and encourage its rapid removal. Where the Inspector is not able to convince the railroad to initiate some action, the Inspector should refer to the Regional Track Specialist for assistance.

(b) Subparts A through F apply to track Classes 1 through 5. Subpart G and §§213.2, 213.3, and 213.15 apply to track over which trains are operated at speeds in excess of those permitted over Class 5 track.

Guidance. With the introduction of high-speed passenger train operations in the Nation, the TSS was revised in 1998 to provide two sets of requirements a) low speed/Classes 1 through 5, and b) high-speed/Classes 6 through 9. The high-speed standards include specific requirements for such operations, which also prescribe a number of track-vehicle interaction tests. Sections 213.2 (Preemptive effect), 213.3 (Application), and 213.15 (Penalties) apply to both high and low speed track.

§213.2 Preemptive effect

Under 49 U.S.C. 20106, these regulations generally preempt any State law, regulation, or order covering the same subject matter, except an additional or more stringent law, regulation, or order that is necessary to eliminate or reduce an essentially local safety hazard; is not incompatible with a law, regulation, or order of the United States Government; and that does not impose an unreasonable burden on interstate commerce.

Guidance. States cannot adopt or continue to enforce laws related to the matter covered in this rule, unless such laws are needed to address a local safety or security hazard and they impose no undue burden on interstate commerce. Although the courts ultimately determine preemption in any particular factual context, this section provides a statement of Agency intent and promotes national uniformity of regulation in accordance with the statute.

§213.3 Application

3(a) Except as provided in paragraph (b) of this section, this part applies to all standard gage track in the general railroad system of transportation.

Guidance. This applicability section specifically excludes from Part 213, track located inside an installation that is not part of the general railroad system of transportation. Additional language regarding plant trackage can also be found in 49 CFR Part 209, Appendix A, which explains that the track owner of any plant railroad trackage over which a general system railroad operates is responsible for the condition of track used by the general system railroad. Part 209 Appendix A is not meant to imply that all of the requirements of the TSS, including inspection frequencies and record keeping, become applicable to a plant railroad once a general system railroad enters the property. Rather, it is a statement meant to convey FRA's intent that plants should maintain, in a safe condition, that portion of their trackage used by a general system railroad.

3(b) This part does not apply to track - 1) Located inside an installation which is not part of the general railroad system of transportation; or 2) Used exclusively for rapid transit operations in an urban area that are not connected with the general railroad system of transportation.

Guidance. FRA does not have the manpower or resources to regularly inspect trackage within industrial installations. However, since the enactment of the Federal Railroad Safety Act of 1970, FRA has had at its disposal statutory authority to issue emergency orders to repair or discontinue use of industrial or plant trackage should the FRA find that track conditions pose a death or injury hazard. See 49 U.S.C. §20901. In other words, if FRA learns that a particular plant is in such disrepair so as to pose a threat of death or injury to a plant employee, a railroad employee, or the public at large, FRA has the option of exercising its authority. FRA may issue an emergency order ordering the plant to discontinue using the track until specified repairs are made. It is FRA's opinion that this emergency order is sufficient power to ensure track safety within plants. If conditions or events in the future tend to demonstrate that track safety within plants or installations should be more regulated, FRA will seek to change the track safety regulations accordingly.

Because it is a policy statement, Appendix A of Part 209 cannot override the text of the TSS, which clearly excludes plant railroads from the reach of the track regulations. Therefore, while the requirements of the TSS do not apply within plant railroads, those operations should use them as a guide to ensure that their tracks are capable of carrying rail traffic safely.

As a practical application of this policy, FRA expects that the trackage in a plant railroad, at a minimum, meet Class 1 standards on the segments where the general system trains operate in the facility. FRA does not expect that the plant comply with inspection requirements but only the geometric and structural elements of the TSS for Class 1 track. The TSS excludes urban area rapid transit systems that are not a part of the general system.

The regulations are not intended to make the TSS applicable to certain rapid transit systems whose only connection to the general system is a switch permitting receipt of shipments of non-revenue materials from the general system. Any questions concerning the applicability of the TSS must be referred to the Regional Track Specialist who will consult with the Office of Safety Assurance and Compliance and the Office of Chief Counsel for guidance concerning the particular entity.

§213.4 Excepted track

A track owner may designate a segment of track as excepted track provided that:

4(a) The segment is identified in the timetable, special instructions, general order, or other appropriate records which are available for inspection during regular business hours;

Guidance. The intent of this section is to permit portions of certain low density main tracks and associated yard tracks and sidings to be allowed "excepted status" and not comply with Subparts B, C, D, and E of the TSS unless otherwise expressly stated. However, by designating a track as excepted, the owner must restrict all train movements to a maximum of 10 m.p.h., restrict the number of placarded hazardous material cars in a train to five, and prohibit the movement of occupied passenger trains.

4(b) The identified segment is not located within 30-feet of an adjacent track which can be subjected to simultaneous use at speeds in excess of 10 m.p.h.;

Guidance. This paragraph prohibits excepted track designation of any track located within a 30-foot envelope of a track that can be subjected to simultaneous use at speeds in excess of 10 m.p.h. As shown in Figure 1, the 30-foot dimension is measured between track centerlines and applies to all tracks within that envelope (e.g., tracks converging at turnouts and rail crossings). Simultaneous use means movement of cars or locomotives on both tracks at the same time.

Operation on any track(s) located within 30-feet of excepted track may be restricted to 10 m.p.h. by the physical layout of the tracks, or by definite restrictions placed by the track owner by rule, timetable, special instruction, or other positive instruction or order. This criterion provides the positive protection of trains on higher speed track against a collision with fouling equipment from a potential derailment on the excepted track.

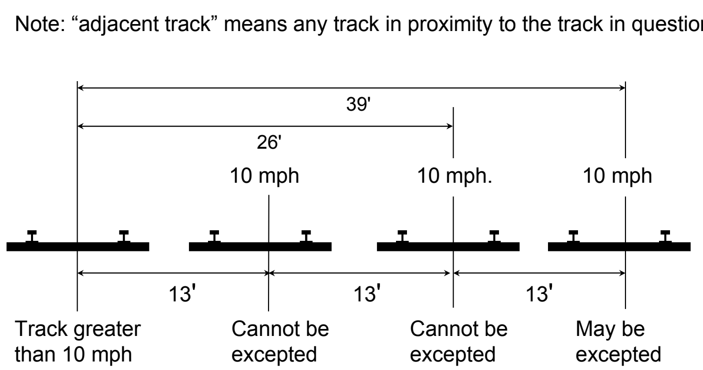


Figure 1

The term "train" is defined in 49 CFR §236.832 as, "A locomotive or more than one locomotive coupled, with or without cars." That definition applies to this rule.

A designation of excepted track need only be recorded by the track owner and implemented by issuance of appropriate instructions to all affected employees. The designation need not be filed with FRA. The TSS do not specify which employees the railroads must notify of excepted track designations; however, in order to ensure maximum safety and to ensure compliance with the requirements of this part, FRA recommends that railroads notify all employees who are involved with the operation of trains or with engineering functions on excepted track.

4(c) The identified segment is inspected in accordance with §213.233(c) and §213.235 at the frequency specified for Class 1 track;

Guidance. Pursuant to §213.5(b), a railroad may continue train operations on track segments designated as excepted track without complying with Subparts B, C, D, and E of Part 213. However, a railroad must still comply with the inspection requirements found in Subpart F for track segments designated as excepted track. Railroads must inspect excepted track in accordance with §213.233(c) and §213.235 at the frequency specified for Class 1 track.

4(d) The identified segment of track is not located on a bridge including the track approaching the bridge for 100-feet on either side, or located on a public street or highway, if railroad cars containing commodities required to be placarded by the Hazardous Materials Regulations (49 CFR Part 172), are moved over the track; and

Guidance. In the application of this paragraph, a public street or highway is defined as a roadway that is open to the public and is owned and maintained by a public entity. This paragraph includes both crossings of public roadways at grade and longitudinal running of the track for extended distances in a public roadway (street trackage).

Under §214.7, a railroad bridge is defined as follows: 1) a railroad bridge is any structure supporting one or more railroad tracks with a span length of 12 feet or more measured along the track centerline, and 2) the term "bridge" shall apply to the entire structure between the faces of the backwalls of abutments or equivalent components, regardless of the number of spans. The term shall include all structures, whether of timber, stone, concrete, metal, or any combination thereof.

4(e) The railroad conducts operations on the identified segment under the following conditions:

(1) No train shall be operated at speeds in excess of 10 m.p.h.;

(2) No occupied passenger train shall be operated;

(3) No freight train shall be operated that contains more than five cars required to be placarded by the Hazardous Materials Regulations (49 CFR Part 172); and

(4) The gage on excepted track shall not be more than 4'10¼ inches. (This paragraph (e)(4) is applicable September 21, 1999.)

Guidance. In reference to (e)(1) through (4), a well-documented pattern of repeated or widespread deviations from these requirements by a track owner, including train operations in excess of 10 m.p.h., will effectively terminate the privilege afforded by this section. The affected track would then become subject to all requirements of the TSS.

The word ''occupied'' in (e)(2) refers to paying and non-paying passengers. It does not include train crew members, track maintenance crews, and other railroad employees who must travel over the track to attend to their work duties.

The gage requirement only applies to the actual measurement itself under load, and does not extend to the evaluation of crossties and fasteners that provide the gage restraint. In the case of non-compliance with the gage requirement in excepted track, the railroad may invoke §213.9(b) as remedial action. [See §213.9(b) for restrictions.]

4(f) A track owner shall advise the appropriate FRA Regional Office at least 10 days prior to removal of a segment of track from excepted status.

Guidance. The track owner is required to notify the appropriate FRA Regional Office 10 days before removing trackage from excepted status. A railroad may not move the track from excepted to non-excepted status to operate an occupied passenger train or a train containing more than five cars placarded in accordance with 49 CFR Part 172, unless proper notification procedures are followed.

Inspectors will continue to inspect excepted track and report these inspections on the F 6180.96 form. If serious deficiencies are discovered, they will be shown on the inspection form, noting that the track is in excepted status. The track owner would not be legally obligated by the TSS to correct the deficiencies noted, except for gage deviations in excess of 4-feet 10¼-inches (defect code 213.53.05). However, if the condition of the track continues to constitute a hazard to life and limb and the track owner fails to alleviate the hazard, the Inspector should notify the Regional Track Specialist immediately. Issuance of an emergency order would be appropriate to address any serious defects that would pose an immediate safety threat to railroad employees or the public.

This notification provision is intended to prevent the practice FRA has witnessed in the past by some railroads. Specifically, those who remove trackage from excepted status only long enough to move a passenger excursion train or a train with more than five cars containing hazardous materials.

The following examples are provided to Inspectors to determine compliance with the provision of excepted track.

Example One. On January 15, 1998, a railroad designates a 2 mile segment of its yard track number 1, which is Class 1 track, as excepted track. The excepted track segment is located within 25 feet of an adjacent track over which simultaneous operations at speeds up to 20 m.p.h. are authorized. On January 25, 1998, an Inspector finds five locations in that segment at which Class 1 gage requirements are not being met.

> Result: The segment of yard track number 1 involved is ineligible for designation as excepted track because it violates §213.4(b) simultaneous use restriction. Therefore, the segment remains subject to all provisions of the TSS. FRA may cite any deviation from the TSS discovered in the segment, such as the five gage defects, for violation. The railroad may also be cited, at the FRA Inspectors' discretion, for a violation of section 213.4(b). If the Inspector determines that violations are warranted, normally the substantive defects (e.g., gage, alinement, crossties) should be cited.

Example Two. A railroad designates yard track number 6, which is classified as Class 1 track, as excepted track on November 30, 1998. The railroad does not conduct any inspections over the track during December.

> Result: Yard track number 6 loses its eligibility for designation as excepted track on January 1, 1999, and remains ineligible thereafter until the inspections required by §213.4(c) begins. Starting January 1, 1999, the track becomes subject to all provisions of the TSS; it remains subject to those requirements until such time as the inspections begin. Violation citations arising from inadvertent violations of the inspection requirement ordinarily should be issued only where safety was impaired or there is evidence of continued non-compliance.

In contrast to violations of the definitional requirements, the unit of violation for non-compliance with the operational limitations is the train. We refer here to occasional and inadvertent non-compliance with operational limitations. A persistent and well documented pattern of non-compliance with respect to a particular segment may cause the railroad to lose its privilege of designating the segment as excepted track (i.e., the track would no longer qualify for such designation), or force FRA to use more drastic enforcement remedies such as emergency orders. The following examples illustrate this concept.

Example Three. A railroad properly designates a track segment as excepted track, 10 days later it operates a freight train containing 10 placarded tank cars over the track segment.

> Result: One violation of §213.4(e)(3) by the railroad has occurred, not five, because the unit of violation is the train rather than each of the placarded cars exceeding the five car limit. The segment continues to be excepted track because a violation of an operational limitation does not render the track ineligible for excepted track status.

Example Four. Railroad A properly designates one of its track segments as excepted track. Railroad B's freight train 2425, using the segment pursuant to a trackage rights agreement with Railroad A, operates over the segment at a speed of 20 m.p.h.

Result: One violation has occurred of §213.4(e)(1) by Railroad A. The track owner is the responsible party for illegal operations over the excepted track. The segment continues to be excepted track.

§213.5 Responsibility for compliance

5(a) Except as provided in paragraph (b) of this section, any owner of track to which this part applies who knows or has notice that the track does not comply with the requirements of this part, shall -

(1) Bring the track into compliance;

(2) Halt operations over that track; or

(3) Operate under authority of a person designated under §213.7(a), who has at least one year of supervisory experience in railroad track maintenance, subject to conditions set forth in this part.

Guidance. This paragraph describes the action that must be taken by track owners once they know that the track is not in compliance with the TSS. The track owner must:

(1) Bring the track into compliance by either repairing the defects or imposing an appropriate speed restriction;

(2) Remove the track from service; or

(3) Operate under authority of a qualified person designated under §213.7 in accordance with the following provisions:

- §213.9(b) Class of track – 30-day provision;
- §213.11 Restoration or renewal of track under traffic conditions; or
- §213.113 Rail defects.

For additional information concerning the required corrective action for defects, see the guidance under §213.9 (Classes of track; operating speed limit).

5(b) If an owner of track to which this part applies designates a segment of track as "excepted track" under the provisions of §213.4, operations may continue over that track without complying with the provisions of Subparts B, C, D, and E, unless otherwise expressly stated.

Guidance. The owner may designate the track "excepted," provided it meets the requirements of §213.4.

5(c) If an owner of track to which this part applies assigns responsibility for the track to another person (by lease or otherwise), written notification of the assignment shall be provided to the appropriate FRA Regional Office at least 30 days in advance of the assignment. The notification may be made by any party to that assignment, but shall be in writing and include the following --

(1) The name and address of the track owner;

(2) The name and address of the person to whom responsibility is assigned (assignee);

(3) A statement of the exact relationship between the track owner and the assignee;

(4) A precise identification of the track;

(5) A statement as to the competence and ability of the assignee to carry out the duties of the track owner under this part; and

(6) A statement signed by the assignee acknowledging the assignment to him of responsibility for purposes of compliance with this part.

Guidance. Section 213.5(c) gives a track owner the responsibility to notify the FRA, through the appropriate Regional Office, when the responsibility for compliance with this part is assigned. Notification must contain the specific information required in this paragraph and shall be made 30 days before the assignment of the responsibility.

5(d) The Administrator may hold the track owner or the assignee or both responsible for compliance with this part and subject to penalties under §213.15.

Guidance. This section concerns situations where the track is not owned by the operating railroad through an arrangement such as a lease agreement. When recommending civil penalties typically the operating railroad will be cited. However, it may be appropriate to recommend civil penalties against the operating railroad and the owner when both parties contributed to the deficiency. Inspectors must determine the responsible party when recommending civil penalties for non-compliance and alert FRA's Chief Counsel when violation reports involve parties other than the track owner.

This paragraph also provides that the party responsible for compliance can be other than the actual owner of the track through assignment of responsibility or if the Surface Transportation Board (formerly Interstate Commerce Commission) has issued a directed service order. FRA may hold responsible any party contracted by the track owner to ensure compliance with this part. The FRA may hold the track owner, the assignee, or both responsible.

5(e) A common carrier by railroad which is directed by the Surface Transportation Board to provide service over the track of another railroad under 49 U.S.C. 11123 is considered the owner of that track for the purposes of the application of this part during the period the directed service order remains in effect.

Guidance. On rare occasions, such as a cessation of service by a railroad, the Surface Transportation Board has directed a railroad other than the track owner to provide service. In such cases, the designated operator shall be considered as the owner for the purposes of compliance of the TSS.

5(f) When any person, including a contractor for a railroad or track owner, performs any function required by this part, that person is required to perform that function in accordance with this part.

Guidance. This paragraph specifies that both employees of railroads and track owners, and contractors to railroads, are subject to the requirements of the TSS when they perform functions required by the TSS.

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

7(a) Each track owner to which this part applies shall designate qualified persons to supervise restorations and renewals of track under traffic conditions. Each person designated shall have -

(1) At least -

(i) 1 year of supervisory experience in railroad track maintenance; or

(ii) A combination of supervisory experience in track maintenance and training from a course in track maintenance or from a college level educational program related to track maintenance;

(2) Demonstrated to the owner that he or she -

(i) Knows and understands the requirements of this part;

(ii) Can detect deviations from those requirements; and

(iii) Can prescribe appropriate remedial action to correct or safely compensate for those deviations; and

(3) Written authorization from the track owner to prescribe remedial actions to correct or safely compensate for deviations from the requirements in this part.

7(b) Each track owner to which this part applies shall designate qualified persons to inspect track for defects. Each person designated shall have -

(1) At least -

(i) 1 year of experience in railroad track inspection; or

(ii) A combination of experience in track inspection and training from a course in track inspection or from a college level educational program related to track inspection;

(2) Demonstrated to the owner that he or she -

(i) Knows and understands the requirements of this part;

(ii) Can detect deviations from those requirements; and

(iii) Can prescribe appropriate remedial action to correct or safely compensate for those deviations; and

(3) Written authorization from the track owner to prescribe remedial actions to correct or safely compensate for deviations from the requirements of this part, pending review by a qualified person designated under paragraph (a) of this section.

Guidance. Inspectors may request from a track owner verification of the experience and qualifications of his supervisory and track inspection personnel. The submission of a seniority roster or job awarding bulletin is not to be considered as satisfactory identification of qualified employees or as a basis for their designation. The owner should make specific names of individuals and their qualifications available in writing. If the Inspector is in doubt as to the qualifications of the owner’s supervisory or inspection personnel, the Inspector should examine the owner’s inspection records. The TSS requires the retention of required track inspection reports for one year at the owner's division office. Should the records consistently fail to reflect the actual track conditions, questions can be raised as to the competence and/or qualifications of the person(s) included in list.

When in doubt as to the qualifications of an owner's supervisors or inspectors, the Inspector should discuss the matter with the railroad.

7(c) Persons not fully qualified to supervise certain renewals and inspect track as outlined in paragraphs (a) and (b) of this section, but with at least one year of maintenance-of-way or signal experience, may pass trains over broken rails and pull aparts provided that --

(1) The track owner determines the person to be qualified and, as part of doing so, trains, examines, and re-examines the person periodically within two years after each prior examination on the following topics as they relate to the safe passage of trains over broken rails

or pull aparts: rail defect identification, crosstie condition, track surface and alinement, gage restraint, rail end mismatch, joint bars, and maximum distance between rail ends over which trains may be allowed to pass. The sole purpose of the examination is to ascertain the person's ability to effectively apply these requirements and the examination may not be used to disqualify the person from other duties. A minimum of four hours training is adequate for initial training;

(2) The person deems it safe and train speeds are limited to a maximum of 10 m.p.h. over the broken rail or pull apart;

(3) The person shall watch all movements over the broken rail or pull apart and be prepared to stop the train if necessary; and

(4) Person(s) fully qualified under §213.7 of this part are notified and dispatched to the location promptly for the purpose of authorizing movements and effecting temporary or permanent repairs.

Guidance. Paragraph (c) allows employees to be qualified for the specific purpose of authorizing train movements over broken rails or pull aparts. This section requires the employees to have at least one year of maintenance-of-way or signal experience and a minimum of four hours of training and examination on requirements related to the safe passage of trains over broken rails and pull aparts. The purpose of the examination is to ascertain the person's ability to effectively apply these requirements. A railroad may use the examination to determine whether or not a person should be allowed to authorize train movements over broken rails or pull aparts.

The maximum speed over broken rails and pull aparts shall not exceed 10 m.p.h. However, movement authorized by a person qualified under this subsection may further restrict speed, if warranted by the particular circumstances. The person qualified under this paragraph must be present at the site and able to instantly communicate with the train crew so that the movement can be stopped immediately, if necessary.

Fully qualified persons under §213.7 must be notified and dispatched to the location promptly as to assume responsibility for authorizing train movements and effecting repairs. The word "promptly" is meant to provide the railroad with some flexibility in case there is only one train to pass over the condition prior to the time when a fully qualified person would report for a regular tour of duty, or where a train is due to pass over the condition before a fully qualified person is able to report to the scene. Railroads should not use persons qualified under §213.7(c) to authorize multiple train movements over such conditions.

7(d) With respect to designations under paragraphs (a), (b) and (c) of this section, each track owner must maintain written records of -

(1) Each designation in effect;

(2) The basis for each designation; and

(3) Track inspections made by each designated qualified person as required by §213.241.

These records must be kept available for inspection or copying by the Federal Railroad Administrator during regular business hours.

Guidance. Failure of the owner to have and maintain written records designating employees and the basis for each designation is a deviation from the TSS. Incomplete qualification records would also constitute a deviation from the standards. Designated employees include supervisors, inspectors, and those partially qualified to pass trains over broken rails and pull aparts. Inspectors are also instructed to note that incomplete qualification records may not reflect the actual qualification of an individual. As such, a record deficiency shall not be the sole basis for a defect or civil penalty recommendation for not having a qualified designated person performing these functions. If there are questions about the qualifications of an individual, it will be necessary for the Inspector to interview railroad or contractor employees.

§213.9 Classes of track: operating speed limits

9(a) Except as provided in paragraph (b) of this section and §213.57(b), 213.59(a), 213.113(a), and 213.137(b) and (c), the following maximum allowable operating speeds apply:

Over track that meets all of the requirements prescribed in this part for	*The maximum allowable speed for freight trains is*	*The maximum allowable speed for passenger trains is*
Excepted	*10*	*N/A*
1	*10*	*15*
2	*25*	*30*
3	*40*	*60*
4	*60*	*80*
5	*80*	*90*

Table 1

Guidance. The TSS classifies track solely on the basis of authorized speeds for freight and passenger trains. Tolerances are specified in the TSS for each class of track. A deviation beyond the limiting tolerances for Classes 1 through 5 requires repair, or reduction of speeds to the appropriate class. The only structural or geometry defect that is applicable on excepted track is gage exceeding 4-feet 10¼-inches.

The initial speed of any track is based on the design characteristics of the track. FRA does not set the speed, and railroads are required to keep track in compliance with the requirements of Part 213. In addition to track design characteristics, speeds may be set by other factors such as the type of signal apparatus. Maximum speeds are also limited if a signal system is not in place on a track (refer to 49 CFR §236.0 for further information).

If a deviation exceeds Class 1 standards, operations may continue for not more than 30-days over the deviation not exceeding Class 1 speeds. This is only permitted after a person designated in §213.7(a), with at least one year of supervisory experience in railroad track maintenance, determines that operations may safely continue and specifies limiting conditions, if any. The designated person must have personally seen and evaluated the deviation. This section may also govern a deviation exceeding allowable gage on excepted track.

As described in paragraph (a), the maximum allowable operating speed for each class of track is shown in the table. However, the maximum allowable operating speed on a curve is limited by the geometry parameters contained in §213.57(b) [Unbalance] and §213.59(a) [Superelevation]. For example, a speed for a passenger train based on the elevation at a curve may be only 18 m.p.h., even though the track may otherwise comply with a higher class.

One loose frog bolt out of several would seldom constitute an immediate hazard, provided that the frog was otherwise secure. On the other hand, a missing cotter pin in a critical location such as in a connecting rod could have serious consequences.

One or two loose braces are usually not considered to be an immediate hazard, provided that the other braces are in acceptable functional condition to support the stock rail. On the other hand, several consecutively loose braces, especially in the higher track classes, could be much more serious.

Intermittent patches of vegetation that brush the sides of rolling stock may not be an immediate hazard, but more severe vegetation might have the potential of contributing to the injury of an employee who is riding on the side of a car or looking out locomotive cab windows. The specific description for this type of defect is "vegetation brushing sides of rolling stock that prevents employees from visually inspecting moving equipment from their normal duty stations" (defect code 213.37.09).

As the above examples illustrate, non-class-specific defects must be considered in the context of the specific circumstances involved. The existence of a non-class-specific defect under one set of circumstances may not be serious, while the identical condition under other circumstances may constitute a serious safety concern.

Although some non-class-specific defects may not present an immediate hazard, these conditions will only degrade under train traffic. Therefore, it is important for the carrier and FRA Inspectors to record these defects so that they will not be left un-repaired. In summary:

(1) Record all non-complying conditions, including non-class-specific defects such as loose or missing frog bolts or switch braces. Care must be taken to conduct a thorough inspection, recording the location, type, and size of each defect discovered.

(2) Evaluate the remedial action taken by the carrier. If an Inspector becomes aware that the remedial action, or lack thereof, for a non-class-specific defect is not sufficient based on the circumstances, the Inspector should seek a more appropriate action from the carrier. For a non-class-specific defect that is an imminent hazard, such as a missing nut on a connecting rod, the Inspector should immediately inquire as to the remedial action planned by the carrier.

(3) If the railroad does not initiate an appropriate remedial action, the Inspector should consider recommending a violation. If the railroad has been advised that a violation has been recommended and has not initiated appropriate remedial action, the Inspector should be prepared to issue a Special Notice for Repairs, under the guidelines described in Chapter 4 of this manual.

(4) In the case of a non-class-specific defect that did not pose an immediate hazard when the defect was recorded and the Inspector discovers that no action was taken within a reasonable time frame after the carrier had knowledge of the defect, the Inspector should consider the enforcement options described in item 3 above. In any case, if no appropriate action was taken within a 30-day period, the Inspector should consider the enforcement tools outlined above.

When a railroad inspector discovers a non-class-specific defect (as with all defects) the railroad inspector must initiate immediate action in accordance with §213.233(d). The remedial action taken by the railroad inspector must be recorded in accordance with

§213.241(b). For non-class-specific defects, the record must show a reasonable explanation of the action taken. For example, "repaired before next train" would be appropriate for serious conditions. On the other hand, a notation for a defect such as vegetation that indicates it is scheduled for cutting by a weed mower by a specific date within 30-days may be appropriate.

When a railroad representative places a slow order on a segment of track for a defect for immediate corrective action, any other items within the same slow order segment would be "protected." For example, a FRA Inspector finds a defect at MP 5.5 and railroad immediately places a slow order from MP 5.0 to MP 6.0. During the same inspection, the FRA Inspector also finds a condition at MP 5.8 that would be a defect without the speed restriction. While the defect at MP 5.8 is under the slow order just imposed, it was obviously a defect prior to the placement of the temporary restriction. The FRA Inspector can record a defect at MP 5.8.

A non-class-specific defect may not pose an immediate hazard for one train movement, but the condition may deteriorate to become a hazard to following trains. It is reasonable to expect that conditions such as loose or missing frog bolts or braces be repaired as quickly as possible. However, a qualified railroad representative under §213.7 may determine that the condition is not an immediate hazard and decide to call for assistance to make the repairs, or the representative may decide to end the inspection, retrieve the necessary repair materials, and return later to make the repairs. In some cases, the representative may determine that a speed restriction is appropriate.

When non-class-specific defects are scheduled for repair, railroad inspectors shall continue to report the defect on their inspection reports until it is corrected. However, the 30-day limit for any given defective condition cannot be exceeded.

9(b) If a segment of track does not meet all of the requirements for its intended class, it is reclassified to the next lowest class of track for which it does meet all of the requirements of this part. However, if the segment of track does not at least meet the requirements for Class 1 track, operations may continue at Class 1 speeds for a period of not more than 30-days without bringing the track into compliance, under the authority of a person designated under §213.7(a), who has at least one year of supervisory experience in railroad track maintenance, after that person determines that operations may safely continue and subject to any limiting conditions specified by such person.

Guidance. A track segment must meet all the requirements for its designated class. Where a track segment does not meet all the requirements, railroads can reclassify the segment for the next lowest class for which it complies. For example, on a Class 3 track, where the alinement measured off a 62-foot chord in a tangent is 2 inches, the railroad can elect to reduce the speed equivalent to Class 2 track.

Trains may continue to operate over a non-complying condition under §213.9(b). However, the 30-day limit for any given condition cannot be exceeded. The 30-day period commences when:

- An FRA Inspector notifies the carrier or issues notice with a F 6180.96 form;
- A person designated under §213.7 records the defect on a track owner's record of inspection;
- Notices of substandard conditions are received from third parties; or

- The track owner is deemed to have constructive knowledge if the defects were discoverable through properly performed track inspections required by the TSS, even if the defects are not reported on the owner's record of inspection.

Several other points concerning §213.9(b) should be noted:

- FRA Inspectors should not attempt to predict an exact date on which a sub-Class 1 defect first existed. In most cases, a reasoned approximation (with accompanying explanation of the basis for the Inspector's conclusions) will be sufficient to show that §213.9(b) is not available to the track owner. Because of the serious enforcement problems presented by application of the constructive knowledge test, Inspectors should use this authority judiciously.
- Once a determination has been made that operations may safely continue over a segment, the 30-day period applies to all sub-Class 1 defects present in the segment at that time. The 30-day period is an appropriate remedial action for sub-Class 1 defects and the 30-day period can only be applied one time. At the expiration of the 30-day period the defects(s) must be repaired, track placed into excepted track status, or the track must be removed from service.
- The limiting conditions, if any, placed on operations must be in a form generally used by the track owner to communicate operating restrictions to its personnel and to any other railroads authorized to use the track involved. If a train operating over the track fails to comply with any such condition, one violation of §213.9(b) by the track owner has occurred, regardless of the identity of the operator of the train.
- Section 213.9(b) does not apply where defective rails are involved. Section 213.113 exclusively governs further operations over defective rails.

The following table shows examples of those sections in the TSS that are "class specific," "speed defined" and "non-class-specific." This table is not all-inclusive and is only a reference instrument. Inspectors should refer to the specific guidance under each section for further details and instructions on each item listed in the table.

Section	Topic	Class specific	Speed defined	Non-class-specific [1]
213.33	Drainage			X
213.37	Vegetation			X
213.57 (b)	Curves; elevation and speed limitations (V-Max)		X	
213.103	Ballast; general			X
213.109 (b)	Crossties not effectively distributed			X
213.110	Gage Restraint Measurement Systems	X		
213.113	Defective rails		X	
213.119	Continuous welded rail; general			X
213.121 (a)	Each rail joint, insulated joint, and compromise joint shall be of a structurally sound design and dimensions for the rail on which it is applied			X

Section	Topic	Class specific	Speed defined	Non-class-specific [1]
213.121 (c)	If a joint bar is cracked or broken between the middle two bolt holes it shall be replaced	X		
213.121 (d)	In the case of conventional jointed track, each rail shall be bolted…, and with at least one bolt on Class 1 track	X		
213.121 (e)	In the case of continuous welded rail track, each rail shall be bolted with at least two bolts at each joint	X		
213.121 (f)	Each joint bar shall be held in position by track bolts tightened to allow the joint bar to firmly support the abutting rail ends…..			X
213.127	Rail fastenings			X
213.133 (a)	Turnouts and track crossings generally			X [2]
213.133 (b)	Classes 3 through 5 … shall be equipped with anchors on each side of track crossings and turnouts…	X		
213.133 (c)	Each flangeway at turnouts and track crossings shall be at least 1½ inches wide	X		
213.135 (a)	Each stock rail must be securely seated in switch plates…			X
213.135 (b)	Each switch point shall fit its stock rail		X	X
213.135 (c)	Each switch shall be maintained so that the outer edge of the wheel tread cannot contact the gage side of the stock rail.			X
213.135 (d)	The heel of each switch rail shall be secure….			X
213.135 (e)	Each switch stand and connecting rod shall be securely fastened….			X
213.135 (f)	Each throw lever shall be maintained so that it cannot be operated with the lock or keeper in place.			X [2]
213.135 (g)	Switch position indicator			X
213.135 (h)	Unusually worn or chipped switch points…			X [2]
213.135 (i)	Tongue and plain mate switches…	X		
213.137 (b)	If a frog point is chipped, broken, or worn more than ⅝ inch down and 6 inches back, operating speed over that frog may not be more than 10 m.p.h.		X	
213.137 (c)	If the tread portion of a frog casting is worn down more than ⅜ inch below the original contour, operating speed over that frog may not be more than 10 m.p.h. …		X	

Section	Topic	Class specific	Speed defined	Non-class-specific [1]
213.139 (a)	The outer edge of a wheel shall not contact the gage side of a spring wing rail.			X [2]
213.139 (b)	The toe of each wing rail shall be solidly tamped…			X
213.139 (c)	Each frog with a bolt hole defect or head-web separation shall be replaced.	X		
213.139 (d)	Each spring shall have compression…			X
213.139 (e)	The clearance between the holddown housing and horn…			X
213.141	Self-guarded frogs	X		
213.205	Derails			X

[1] Non-class-specific defects found during an inspection by a qualified railroad inspector and not immediately repaired must be noted on the track inspection form. If not immediately repaired, remedial action shall be taken by an individual qualified under §213.7 (a). The 30-day period represents the maximum duration that FRA permits any non-class-specific defect(s) to remain in the track. Furthermore, it is not intended to create a 30-day timeline for all types of defects as immediate repair or a more restrictive appropriate action may be required at the time of the defect(s) discovery.

[2] While Part 213 does not require the railroad to take the track out of service, due to the severity of these defects, FRA recommends that railroads take the track out of service. At a minimum, however, the railroad should invoke §213.9(b).

Table 2

§213.11 Restoration or renewal of track under traffic conditions

If, during a period of restoration or renewal, track is under traffic conditions and does not meet all of the requirements prescribed in this part, the work on the track shall be under the continuous supervision of a person designated under §213.7(a) who has at least one year of supervisory experience in railroad track maintenance, and subject to any limiting conditions specified by such a person. The term "continuous supervision" as used in this section means the physical presence of that person at a job site. However, since the work may be performed over a large area, it is not necessary that each phase of the work be done under the visual supervision of that person.

Guidance. This section specifies that a person designated under §213.7(a) must provide continuous supervision during work periods when track with conditions not complying with the designated class is under traffic conditions. The section is specific in that each phase of the restoration or renewal need not be under the visual supervision of that person, but the person must be present at the job site in direct control of the work and have direct knowledge of the condition of the track over which they permit a train or trains to pass.

The qualified person at a work site may determine that it is safe to permit a train to pass through the work area at any speed up to the permanent speed on the track. For example, during a crosstie and resurfacing project, the qualified person may analyze the conditions present and authorize a speed higher than 10 m.p.h. through the limits of the work when temporary crosslevel conditions exceed the limits in §213.63 for Class 1 track. Similarly, a welder may permit a train to pass over a frog when the welding and grinding process temporarily removes the point more than 6 inches back and ⅝ inch down. At the end of the work period when the designated person leaves the work site, the track must be in compliance with the TSS. It is acceptable for the designated person to determine that the track is safe for operation at Class 1 speeds and use §213.9(b) as a remedial action.

Continuous supervision may be met if the work is broken into a number of segments over a large area. Inspectors must use judgment and experience in applying this limitation to the general rule. The essential questions are whether the specific circumstances of a given project actually permit effective supervision by the designated person, and whether such supervision is being properly exercised. An example of an acceptable application of this paragraph would be a large tie and surfacing unit that has cleared a track for a short period to allow the passage of a train based on the qualified person determining that the track is safe for operation. On the other hand, if a switch gang is working separately from the tie and surfacing crew in the same general vicinity, a qualified person must be with that work unit.

§213.13 Measuring track not under load

When unloaded track is measured to determine compliance with requirements of this part, the amount of rail movement, if any, that occurs while the track is loaded must be added to the measurements of the unloaded track.

Guidance. In addition to the static (unloaded) geometry measurements taken, the amount of visually detectable dynamic (loaded) deflection that occurs under train movement must be considered. This includes the amount of vertical or lateral rail deflection occurring between rail base and tie plate, a tie plate and crosstie, from voids between the crosstie and ballast section resulting from elastic compression, or any combinations of the above. Each deflection under the running rails must be measured and properly considered when computing the collective deviations under load. It is very important that consideration be given to both rails when measuring these deflections.

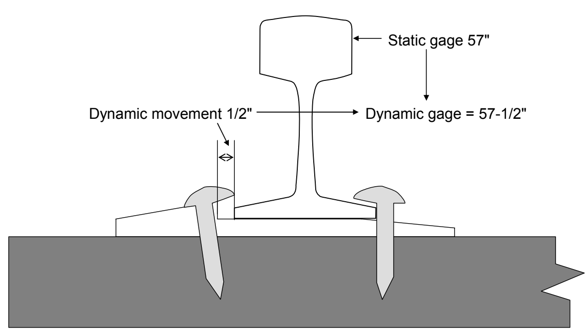


Figure 2

Vertical and lateral deflections may be found at locations such as rail joints and turnout locations with poor wooden crossties and conventional cut-spike fastening conditions or at bridge abutments and over culverts where the subgrade has settled.

§213.15 Penalties

15(a) Any person who violates any requirement of this part or causes the violation of any such requirement is subject to a civil penalty of at least $500 and not more than $11,000 per violation, except that: Penalties may be assessed against individuals only for willful violations, and, where a grossly negligent violation or a pattern of repeated violations has created an imminent hazard of death or injury to persons, or has caused death or injury, a penalty not to exceed $22,000 per violation may be assessed. "Person" means an entity of any type covered under 1 U.S.C. 1, including but not limited to the following: a railroad; a manager, supervisor, *official, or other employee or agent of a railroad; any owner, manufacturer, lessor, or lessee of railroad equipment, track, or facilities; any independent contractor providing goods or services to a railroad; any employee of such owner, manufacturer, lessor, lessee, or independent contractor; and anyone held by the Federal Railroad Administrator to be responsible under §213.5(d) or §213.303(c). Each day a violation continues shall constitute a separate offense. See Appendix B to this part for a statement of agency civil penalty policy.*

(b) Any person who knowingly and willfully falsifies a record or report required by this Part may be subject to criminal penalties under 49 U.S.C. 21311.

Guidance. This section covers all Subparts of Part 213 including a schedule of civil penalties found under Appendix B of this manual.

§213.17 Waivers

17(a) Any owner of track to which this part applies, or other person subject to this part, may petition the Federal Railroad Administrator for a waiver from any or all requirements prescribed in this part. The filing of such a petition does not affect that person's responsibility for compliance with that requirement while the petition is being considered.

Guidance. Inspectors have no authority under the TSS to grant waivers.

17(b) Each petition for a waiver under this section must be filed in the manner and contain the information required by Part 211 of this Chapter.

Guidance. Any petition for waiver must be filed by the owner or designated operator with the Docket Clerk, Office of Chief Counsel, in Washington, D.C. Refer to the General Manual for complete information regarding waiver procedures.

17(c) If the Administrator finds that a waiver is in the public interest and is consistent with railroad safety, the Administrator may grant the exemption subject to any conditions the Administrator deems necessary. Where a waiver is granted, the Administrator publishes a notice containing the reasons for granting the waiver.

Guidance. Inspectors must be notified of any waivers in effect in their assigned territory.

§213.19 Information collection

19(a) The information collection requirements of this part were reviewed by the Office of Management and Budget pursuant to the Paperwork Reduction Act of 1980 (44 U.S.C. 3501 et seq.) and are assigned OMB control number 2130-0010.

19(b) The information collection requirements are found in the following sections: 213.4, 213.5, 213.7, 213.57, 213.119, 213.122, 213.233, 213.237, 213.241, 213.303, 213.305, 213.317, 213.329, 213.333, 213.339, 213.341, 213.343, 213.345, 213.353, 213.361, 213.369.

Subpart B - Roadbed

§213.31 Scope

This subpart prescribes minimum requirements for roadbed and areas immediately adjacent to roadbed.

§213.33 Drainage

Each drainage or other water carrying facility under or immediately adjacent to the roadbed must be maintained and kept free of obstruction, to accommodate expected water flow for the area concerned.

Guidance. One of the most essential elements of track maintenance is a comprehensive drainage system. Drainage facilities (bridges, trestles, or culverts) should be given careful detailed consideration during inspections. Openings under the track are used to channel and divert water from one side of the roadbed to the other.

The rule specifies that each drainage structure shall be maintained and the Inspector should note conditions that would affect the integrity of the structure, such as culvert pull aparts or separations, crushing or uneven settlement due to failure of or lack of head walls (in conjunction with frost action), too steep a gradient, and insufficient support.

Drainage openings must also be inspected and notice given where debris has accumulated to such an extent that expected water flow cannot be accommodated.

Most railroad drainage structures have existed for many years and, if properly maintained and kept free of debris, they are considered adequately designed to accommodate expected water flow, even though recent high-water marks may be slightly above the inlet opening.

Culverts designed with submerged inlets are common. Where questions are raised concerning the adequacy of drainage structures, the Regional Track Specialist should be consulted.

Inspectors must take note of the conditions of:

- Right-of-way ditches;
- Culverts, trestles, and bridge inlets;
- Water carrying structures or passageways;
- Outlets or tail ditches;
- Berm ditches;
- Scouring of embankments, piling or piers in channels or at abutments; and
- Filling in of passageways from silting, sand wash, or debris.

Inspectors must notify the track owner of any drainage condition deemed hazardous, or potentially hazardous, to the safety of train operations over the track.

§213.37 Vegetation

Vegetation on railroad property which is on or immediately adjacent to roadbed shall be controlled so that it does not --

37(a) Become a fire hazard to track-carrying structures;

Guidance. Inspectors must be aware that live and dead growth, drift, tumbleweeds, debris, etc., can constitute fire hazards to timber bridges, trestles, wooden box culverts, and other track carrying structures.

37(b) Obstruct visibility of railroad signs and signals;

(1) along the right-of-way, and

(2) at highway-rail crossings;

Guidance. This paragraph includes a requirement to clear vegetation from signs and signals along railroad rights-of-way and at highway-rail grade crossings. Because the scope of Part 213 limits vegetation requirements to railroad property, this is not intended to be an attempt to dictate standards for surrounding landowners. This paragraph also requires signs and signals on railroad property at highway-rail grade crossings be kept clear of vegetation and is intended to provide adequate visibility of these devices for the traveling public. It is not intended to preempt State or local requirements for the clearing of vegetation on railroad rights-of-way at highway-rail grade crossings.

Obstruction of the visibility of railroad signs and signals by vegetation is a deviation from the TSS. Although all signals are important, the visibility of certain signals must be closely observed [i.e., block signals, interlocking signals, speed signs (or other signs affecting the movement of trains), close clearance signs, whistle posts, and mileposts].

37(c) Interfere with railroad employees performing normal trackside duties;

Guidance. Judgment must be exercised by the Inspector in determining whether trackside vegetation will interfere with the railroad employees' performance of normal trackside duties. Weeds covering the track that hinder the ability of an Inspector to see track structure components is not necessarily a non-complying condition.

37(d) Prevent proper functioning of signal and communication lines; or

Guidance. Before citing the railroad for vegetation interfering with signal or communication lines, the Inspector must confirm that the line is active. Occasionally Inspectors may observe vegetation in lines that they are unsure if they are functional. Communication between the Track Inspector and the FRA Signal and Train Control Inspector is necessary if the railroad representative cannot confirm the status of a signal or communication line. When interfering with active lines, vegetation may cause false signal indications and/or disrupt communications that are vital to safe train operations. When there are questions regarding vegetation and the signal lines, joint inspections by track and signal personnel are encouraged. The Track Inspector will issue violation reports, if necessary, with concurrence of the Signal Inspector.

37(e) Prevent railroad employees from visually inspecting moving equipment from their normal duty stations.

Guidance. There are several ways which vegetation can prevent railroad employees from visually inspecting moving equipment. For example, if vegetation is striking the window of the locomotive cab, that can interfere with a train crew's ability to observe rolling stock. Or, if vegetation is striking trains, that can interfere with a ground employees' ability to observe the rolling stock during switching operations.

Subpart C – Track Geometry

§213.51 Scope

This subpart prescribes requirements for the gage, alinement, surface of track, and the elevation of outer rails and speed limitations for curved track

Guidance. See Figure 3 for an illustration of basic track geometry concepts.

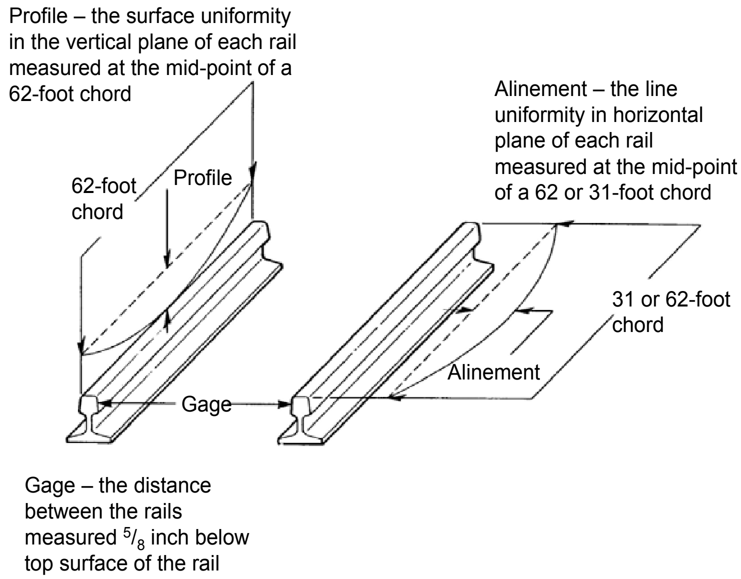


Figure 3

§213.53 Gage

53(a) Gage is measured between the heads of the rails at right angles to the rails in a plane five-eighths of an inch below the top of the rail head.

Guidance. See Figure 4 for an illustration of gage measurements.

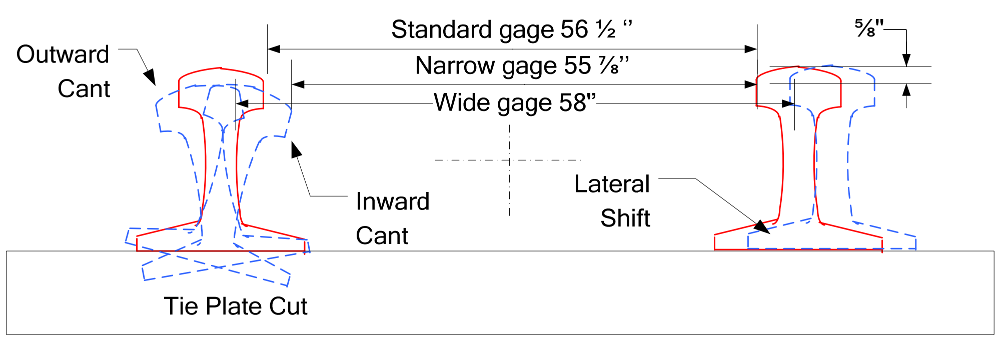


Figure 4

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

Class of Track	*The gage must be at least*	*But not more than*
Excepted track	*N/A*	*4'10¼"*
1	*4' 8"*	*4' 10"*
2 and 3	*4' 8"*	*4' 9¾"*
4 and 5	*4' 8"*	*4' 9½"*

Table 3

Guidance. This rule establishes the minimum and maximum limits for gage on all tracks and differentiates with the authorized speed, including a maximum gage dimension of 4 feet 10¼ inches for track in excepted status under §213.4.

Inspectors will make measurements at sufficient intervals to assure that track is being maintained within the prescribed limits. Particular attention should be given to track gage in turnouts or locations where high lateral train forces are expected or evident. These areas include the curved closure rails, the toe and heel of frogs, the curved track behind the frog and several feet ahead of the switch points.

Where line or surface irregularities are observed by the Inspector, the gage should be measured. Remember to look for evidence of lateral rail movement as required in §213.13.

An accurate standard track gauge device or a rule graduated in inches is an acceptable measuring device. Gage not within the specified limits of the TSS is in non-compliance.

§213.55 Alinement

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

[1] The ends of the line must 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 must be used for the full length of that tangential segment of track.

[2] The ends of the chord must 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.

Table 4

Guidance. This rule establishes the maximum alinement deviations allowed for tangent and curved track in Classes 1 through 5 track.

Alinement (also spelled alignment) is the local variation in curvature of each rail of the track. 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. The Inspector should note that the procedures for determining uniformity in Classes 6 through 9 are similar to the procedures described below. However, there are differences in the spacing of the stations and the application of the chord measurements.

The point of greatest alinement deviation usually can be detected visually or may be located by moving the chord along the track in increments until the point with maximum deviation is found. In curves, the mid-ordinate, alternatively called mid-chord offset (MCO), require "stations" to be marked at regular intervals on the high rail in both directions from the point in question. In tangent track, the MCO is measured directly with a 62-foot chord and graduated ruler. In curves, a 62-foot chord is used in Classes 1 through 5 and a 31-foot chord is also used in Classes 3 through 5. The term MCO is used interchangeably for "mid-ordinate" and "mid-offset" and represents the distance from the rail to the chord at the mid-point of the chord. For curves in Classes 3 through 5 track, an alinement defect may be in non-compliance with either the maximum limits for the 31-foot chord or the 62-foot chord, or both. A 31-foot chord is particularly necessary for determining short alinement deviations. Inspectors must be aware that a 62-foot chord may be “blind” to short alinement conditions, whereby a 31-foot chord can detect those non-complying conditions. See Figure 5.

In Classes 3 through 5, both the 31-foot and 62-foot chords must be used, and corresponding measurements must be calculated to determine compliance with the required alinement thresholds. If alinement defects are found using both the 31-foot and the 62-foot chord, the Inspector should report the item as one defect and note that the defect does not comply with the requirements for the second chord, e.g., “1¾ inches alinement deviation on curved track for 62-foot chord. Note: 1⅜ inches alinement deviation for 31-foot chord at this location.”

The chord line (string) will be stretched and held taut between two points on the rail, ⅝ inch below the top running surface of the rail. Measure the MCO between the rail and the string with a graduated ruler, using blocks to compensate for shallow curvature and special trackwork, if necessary.

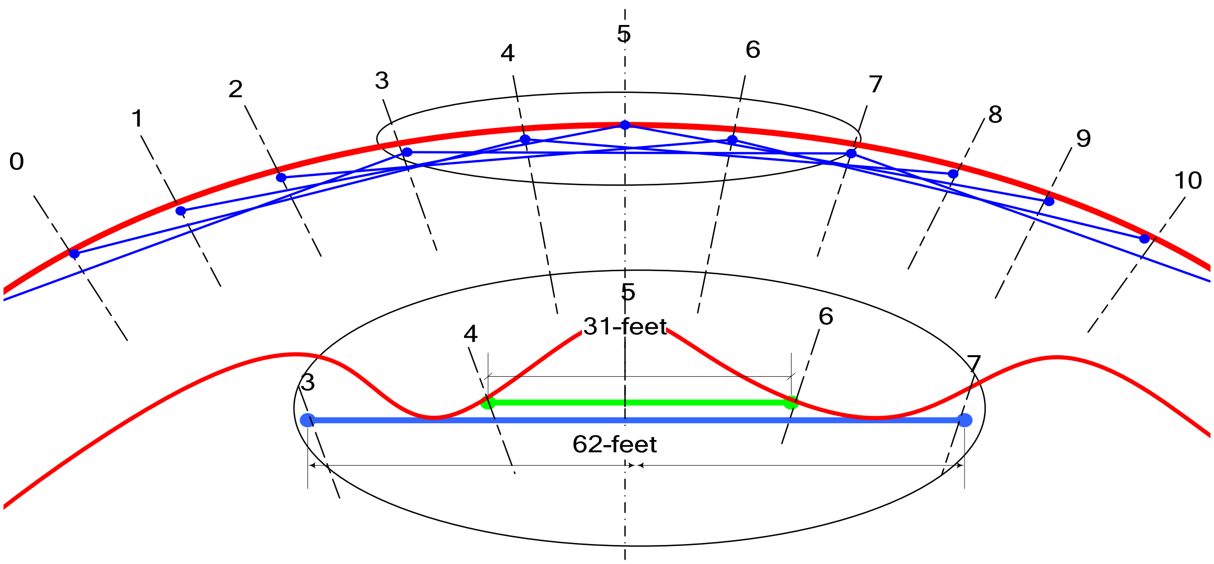


Figure 5

Since a true tangent has zero MCO, the measurement taken can be compared directly to the alinement table under §213.55 to determine compliance. On a curve of constant curvature or each arc of a compound curve, mid-ordinates at all station points are equal when measured from chords of equal length, exclusive of spirals. MCO’s, when measured from chords of equal length, are nearly proportional to the degree of curvature.

Degree of curvature is the angle subtended at the center of a simple curve by a 100 foot chord. Degree of curvature can be conveniently measured using either a 31 or a 62-foot chord. Obtaining the degree of curvature coupled with the average elevation in the area in question is necessary to determine maximum authorized speed. Please refer to §213.57 for a discussion on the determination of curvature.

Deviation of alinement on a curve requires determination of the MCO over a specified number of stations and the average of those values. The difference between the MCO at the point of concern and the average must not exceed the maximum deviation specified in the table in §213.55.

As shown in Table 5, an optional method to determine average alinement includes 17 stations spaced at 15-feet 6 inches. For curves in Track Classes 3 through 5, it is necessary to determine compliance with the requirement for the maximum deviation of the MCO from a 31-foot chord in addition to the 62-foot chord. Figure 6 illustrates the method to determine alinement deviation using both chords.

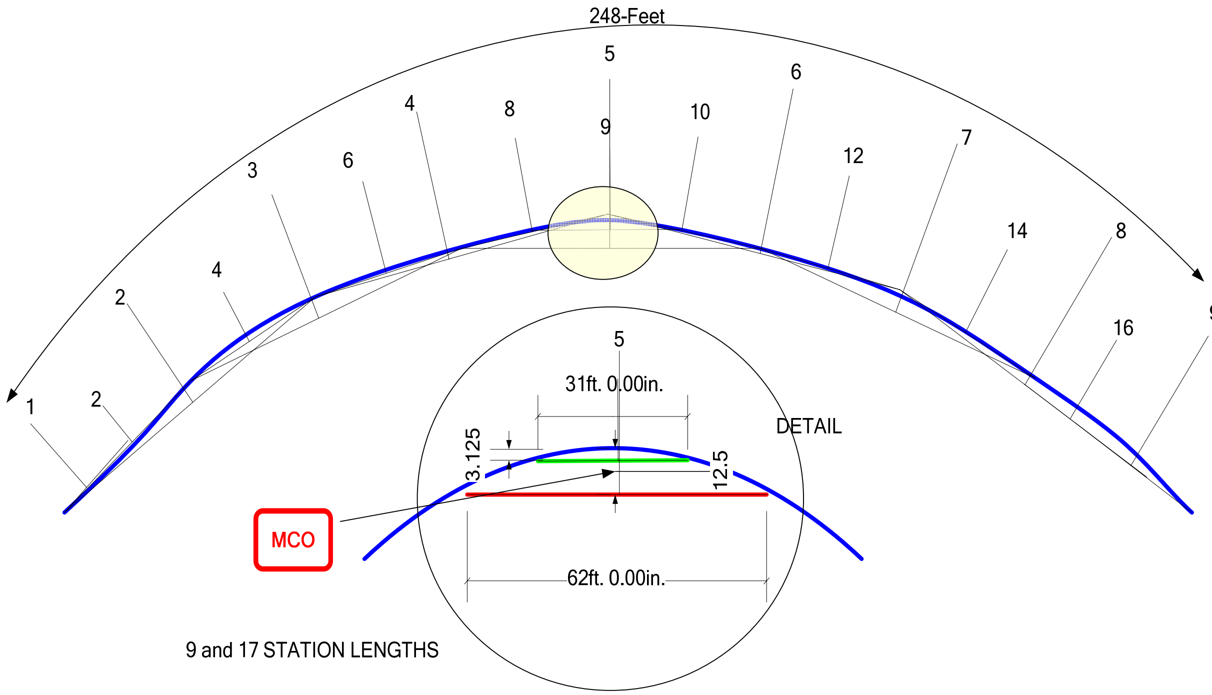


Figure 6

When using the above procedures, the distance between the first and last MCO will be 248 feet. However, note that in order to measure the MCO at the first and last stations, the Inspector must place the end of the string a station beyond the first and last one measured. As a reference, the following table summarizes the acceptable proper chords, station spacing, and number of stations to determine alinement compliance.

Alignment Stations					
Geometry	Class	Chord (feet)	Total No. Stations	Station Spacing (feet)	Curve Length (feet)
Curve	1-2	62	9 or	31	248
		62	17	15½	248
	3-5	31&	17	15½	248
		62	9 or	31	248
		62	17	15½	248
Tangent	1 - 5	62	1	n/a	n/a

Table 5

As previously indicated, the suspected alinement location in a curve body is calculated by measuring an equal number of stations on each side of the area in question. For the majority of occurrences, averaging the MCOs on both sides of the location in question will develop sufficient data to determine "uniform alinement." However, if the location in question is close to or in a spiral, uniformity must be determined in a different manner. If the location is located at the portion of a curve body close to a spiral, measure the stations in the curve body only. That is, shift the averaging area sufficiently so that none of the MCOs are in the spiral.

When measuring the body of a curve with a length that is less than the distance spanned by the required number of stations, reduce the numbers of stations accordingly. When measuring a compound curve, it will be necessary to measure the MCOs within a sufficient portion of the entire curve to determine where the curve bodies exist. Treat each curve body as a separate curve and be governed by the above instructions.

Over the years, railroads have traditionally used a 31-foot chord to determine MCOs for higher degree curves. Although it is more difficult to measure from the rail to the MCO at high degree curves, the Inspector must determine alinement compliance in accordance with both the 62 and 31-foot chords described in this section.

In spirals, the alinement gradually changes from tangent to the full degree of curvature at the curve body. Therefore, to determine an alinement deviation at a given point in a spiral, it will be necessary to determine the proper MCO based on the projected value at each point of concern. The best method to determine the projected value at each point is to measure the MCOs through the entire spiral in question. It is important to determine MCOs a sufficient distance into the adjoining curve body and tangent track to accurately determine the tangent to spiral (TS) and spiral to curve (SC). Place the measured values in a graph and plot the spiral. The deviation at the point of concern will be the difference between the MCO and the projected value. Use the curve values from the alinement table to determine compliance in spirals.

Figure 7 shows a spiral calculation for 62-foot chord with MCO units in $^{1}/_{16}$ inch increments. A similar analysis is required for 31-foot chord for Classes 3 through 5. At station 5, the existing value is 18 units (1⅛ inches) and the projected value is 12 units (¾ inch), therefore, the deviation from uniformity is 6 units (⅜ inch).

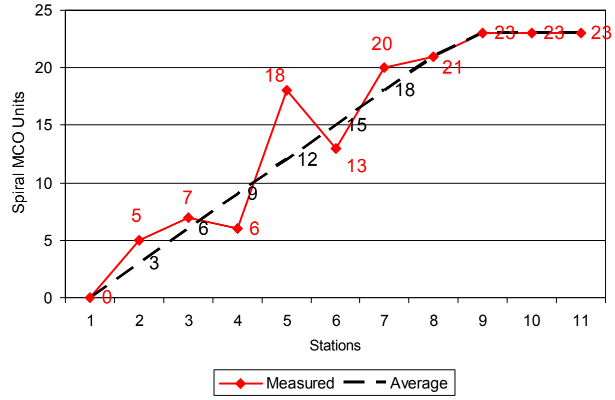


Figure 7

§213.57 Curves; elevation and speed limitations

57(a) The maximum crosslevel on the outside rail of a curve may not be more than 8 inches on track Classes 1 and 2 and 7 inches on Classes 3 through 5. Except as provided in §213.63, the outside rail of a curve may not be lower than the inside rail.

Guidance. Paragraph (a) does not imply that more than 6 inches of superelevation is recommended in a curve; rather the paragraph limits the amount of crosslevel in a curve to control the unloading of the wheels on the high rail, especially at low speeds. The crosslevel limits notwithstanding, this standard establishes the maximum crosslevel at any point on the curve, which may not be more than 8 inches on track Classes 1 and 2 and 7 inches on track Classes 3 through 5. In curves, crosslevel is measured by subtracting the relative difference in height between the top surface (tread) of the inside (low) rail from the tread of the outside (high) rail. Both §213.63 and this section limit the amount of reverse elevation (outside rail lower than the inside rail). While the table in §213.63 permits reverse elevation on a curve, the Vmax formula must also be checked when reverse elevation is encountered. The Inspector must substitute a negative number for the actual elevation in the formula as discussed below. The Vmax formula applies only in the body of a curve.

57(b) (1) The maximum allowable operating speed for each curve is determined by the following formula –

$$V_{max} = \sqrt{\frac{Ea+3}{0.0007D}}$$

Where:

V_{max} = *Maximum allowable operating speed (miles per hour).*

E_a = *Actual elevation of the outside rail (inches)*[1].

D = *Degree of curvature (degrees)*[2].

[1]*Actual elevation for each 15-foot track segment in the body of the curve is determined by averaging the elevation for 10 points through the segment at 15.5-foot spacing. If the curve length is less than 155-feet, average the points through the full length of the body of the curve*

[2]*Degree of curvature is determined by averaging the degree of curvature over the same track segment as the elevation*

Guidance. Paragraph (b)(1) prescribes the formula to be used to determine the maximum train speed in curves based on average curve alinement in degrees, and the amount of superelevation at the same location. Several combinations of curvature and elevation resulting in speed limitations may exist and should be considered throughout the curve when determining compliance with this section.

A railroad car traveling around a curve is subjected to an outward horizontal centrifugal force that acts conceptually through a car's center of gravity away from the center of the curve and tends to overturn the car by directing its weight toward the outside rail. To counteract the centrifugal force, the outer rail is elevated over the lower rail, or super elevated. In effect, the combined effect of centrifugal force and weight produces a resultant force that is intentionally moved toward the center of the track. A balanced (equilibrium) condition implies the vertical forces on each rail are equal. Figure 8 illustrates the three types of balance conditions.

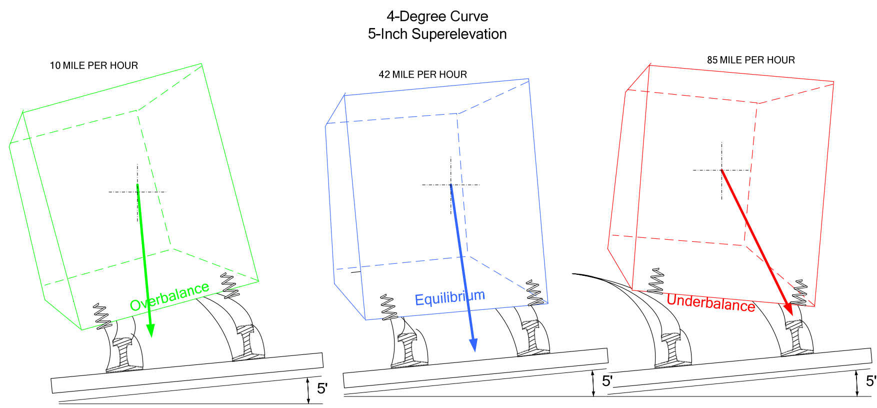


Figure 8

In practice, railroads generally do not operate trains at balanced speed; that is, train speeds are set to move the resultant force toward the outer rail, resulting in an unbalance typically less than 3 inches. Unbalance or cant deficiency is the theoretical amount of elevation that would have to be added to the existing elevation to achieve a balanced condition. The TSS for Classes 1 through 5 limits the amount of unbalance to 3 inches except that 4 inches is permitted for authorized and approved equipment types. Waivers have been granted for operation at even higher levels of cant deficiency.

Safe curving speeds are dependent on the engineering characteristics of the specific equipment involved, as well as the track conditions. Equipment factors such as center of gravity height, suspension characteristics, reaction to wind and other factors are considered when FRA makes a decision to approve a particular level of cant deficiency for specified equipment.

The application of the Vmax formula uses an averaging technique over a 155 foot "window." As indicated in sub-note 1, maximum train speed is based on values obtained from the curve body only. The actual elevation and curvature to be used in the 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-feet station spacing (31 and 62-foot chords). If a curve's length is less than 155 feet, the measurements are averaged over the full length of the curve. In order to determine the average curvature, Inspectors must calculate the degree of curvature based on the chord length used (either 31 or 62-foot) and the mid-chord offset measured at each station. For a 31-foot chord, the degree of curvature is determined by multiplying the mid-chord offset by a factor of four (e.g., ¼ inch equals 1 degree). For a 62-foot chord, a one-to-one relationship exists (e.g., 1 inch equals 1 degree).

In addition to the limitations on reverse elevation contained in the table in §213.63, the Vmax formula limits the maximum authorized speed on a curve. Reverse elevation occurs when the inside rail is higher than the outside rail; that is usually the unintended consequence of track degradation. The condition can also occur where a turnout has been installed in a main track (e.g., an equilateral turnout constructed in a left-hand curve). Calculation of the maximum authorized speed for the curve with negative elevation is performed in the same manner as one with positive elevation. For example, the maximum authorized speed is approximately 13 m.p.h. for a curve segment with an average curvature of 4 degrees and 2½ inches of reverse elevation (both calculated over the 155 foot window or the length of the curve), the calculation for 3 inches of unbalance would be as shown below:

$$V\max = \sqrt{\frac{Ea+3}{0.0007D}} \quad V\max = \sqrt{\frac{-2.5+3}{0.0007*4}} \quad V\max = \sqrt{\frac{0.5}{0.0028}} \quad V\max = \sqrt{178.57} \quad \text{Vmax=13mph}$$

57(b)(2) Table 1 of Appendix A is a table of maximum allowable operating speed computed in accordance with this formula for various elevations and degrees of curvature.

Guidance. See Appendix A.

57(c)(1) For rolling stock meeting the requirements specified in paragraph (d) of this section, the maximum operating speed for each curve may be determined by the following formula –

$$V_{max} = \sqrt{\frac{Ea+4}{0.0007D}}$$

Where:

V_{max} *= Maximum allowable operating speed (miles per hour)*

E_a *= Actual elevation of the outside rail (inches)*[1]

D *= Degree of curvature (degrees)*[2]

Guidance. Paragraph (c) permits approved types of equipment that have been qualified and approved by FRA in accordance with paragraph (d), to operate at maximum allowable operating speeds based on 4 inches of unbalance (cant deficiency). Inspectors must be aware of those vehicles that have been approved by the Associate Administrator for Safety for operation at 4 inches of unbalance.

57(c)(2) Table 2 of Appendix A is a table of maximum allowable operating speed computed in accordance with this formula for various elevations and degrees of curvature.

Guidance. See Appendix A.

57(d) Qualified equipment may be operated at curving speeds determined by the formula in paragraph (c) of this section, provided each specific class of equipment is approved for operation by the Federal Railroad Administration and the railroad demonstrates that:

(1) When positioned on a track with a uniform four inch superelevation, the roll angle between the floor of the equipment and the horizontal does not exceed 5.7 degrees; and

(2) When positioned on a track with a uniform six inch superelevation, no wheel of the equipment unloads to a value of 60 percent of its static value on perfectly level track, and the roll angle between the floor of the equipment and the horizontal does not exceed 8.6 degrees.

(3) The track owner shall notify the Federal Railroad Administrator no less than 30 calendar days prior to the proposed implementation of the higher curving speeds allowed under the formula in paragraph (c) of this section. The notification shall be in writing and shall contain, at a minimum, the following information --

(i) A complete description of the class of equipment involved, including schematic diagrams of the suspension systems and the location of the center of gravity above top of rail;

(ii) A complete description of the test procedure[3] *and instrumentation used to qualify the equipment and the maximum values for wheel unloading and roll angles which were observed during testing;*

(iii) Procedures or standards in effect which relate to the maintenance of the suspension system for the particular class of equipment; and

(iv) Identification of line segment on which the higher curving speeds are proposed to be implemented.

[3] *The test procedure may be conducted in a test facility whereby all the wheels on one side (right or left) of the equipment are alternately raised and lowered by four and six inches and the vertical wheel loads under each wheel are measured and a level is used to record the angle through which the floor of the equipment has been rotated.*

Guidance. The engineering test described in paragraph (d) is known as the “static lean test” which has been used by FRA for several years to evaluate a vehicle’s curving performance.

For modern rail cars with a high center of gravity (90 to 98 inches), low speed curve negotiation under excessive levels of superelevation places the vehicle in an increased state of overbalance. This condition creates the possibility of wheel unloading and subsequent wheel climb when warp conditions are encountered within the curve, as explained by footnote 1 of the surface table in §213.63.

57(e) A track owner, or an operator of a passenger or commuter service, who provides passenger or commuter service over trackage of more than one track owner with the same class of equipment may provide written notification to the Federal Railroad Administrator with the written consent of the other affected track owners.

Guidance. Paragraph (e) states that a track owner, or an operator of a passenger or commuter service over trackage of more than one track owner with the same class of equipment, may provide written notification to the FRA with the written consent of the other track owner. Under paragraph (f) equipment presently operating at higher levels of unbalance by reason of conditional waivers granted by FRA is considered to have complied with the provisions of paragraph (d).

57(f) Equipment presently operating at curving speeds allowed under the formula in paragraph (c) of this section, by reason of conditional waivers granted by the Federal Railroad Administration, shall be considered to have successfully complied with the requirements of paragraph (d) of this section.

Guidance. Where FRA has approved higher levels of unbalance, it becomes imperative that the Inspector monitor the maximum authorized speeds based on the approved unbalance. The calculation of the maximum authorized speed for a particular segment of track involves the substitution of the approved unbalance in the Vmax formula. This calculation is based on

10 stations, plus the point of concern, for a total of 11 stations spaced 15-feet 6 inches apart for a 62 or 31-foot chord. For example, if FRA approved 5 inches of cant deficiency for a particular type of equipment, the maximum curving speed for a 6 degree curve segment with 4½ inches of elevation would be calculated as follows:

$$V\max = \sqrt{\frac{Ea + Eu}{0.0007D}} \quad V\max = \sqrt{\frac{4.5 + 5}{0.0007 * 6}} \quad V\max = \sqrt{\frac{9.5}{0.0042}} \quad V\max = 47\text{mph}$$

To determine an enforcement action, it is also necessary for the Inspector to determine the actual unbalance based on the speed that the railroad is operating around the curve and the actual track conditions. In order to calculate the unbalance, the Inspector must solve the following formula, which is the same Vmax formula represented in a different form:

$$E_u=Vmax^2(0.0007)(D)-E_u$$

For example, if the railroad was operating around a curve at 100 m.p.h. and the Inspector determined, by field measurements, that the average curvature and average elevation for a particular curve segment was 2 degrees and 5½ inches of elevation, respectively. The unbalance would be calculated as follows:

$$E_u=(100)^2(0.0007)(2)-5.5$$

$$E_u=(10{,}000)(0.0007)(2)-5.5$$

$$E_u=14-5.5=8.5''$$

Where FRA has not approved more than 3 inches of unbalance and the operating speed on the curve produces more than 3 inches of unbalance, the Inspector will record the circumstance as a defect. However, the Inspector should consider writing a recommendation for civil penalty if the level of unbalance based on the maximum speed, elevation, and curvature exceeds 4 inches. When vehicle types have been approved by FRA for curving speeds producing more than 3 inches unbalance, Inspectors will not consider recommending a violation when operating speeds for that equipment only produce a marginal level of cant deficiency above the approved level. The Regional Track Specialist should be consulted when questions arise concerning limiting speeds in curves.

Figure 9 is an example showing the relationship between curvature, elevation, and speed.

Stations Spaced 15.5'

Points	Elev. Inches	MCO Inches	Degree
-5	0.625	1.000	1.000
-4	0.500	0.875	0.875
-3	0.500	1.000	1.000
-2	0.375	0.875	0.875
-1	0.750	0.750	0.750
0	0.250	0.625	0.625
1	0.333	0.875	0.875
2	0.375	0.875	0.875
3	0.375	0.875	0.875
4	0.375	1.125	1.125
5	0.375	0.750	0.750
Total	4.833	9.625	9.625
Average	0.439		0.875

10 points plus spot of concern = 11 points (Total/11 = average)

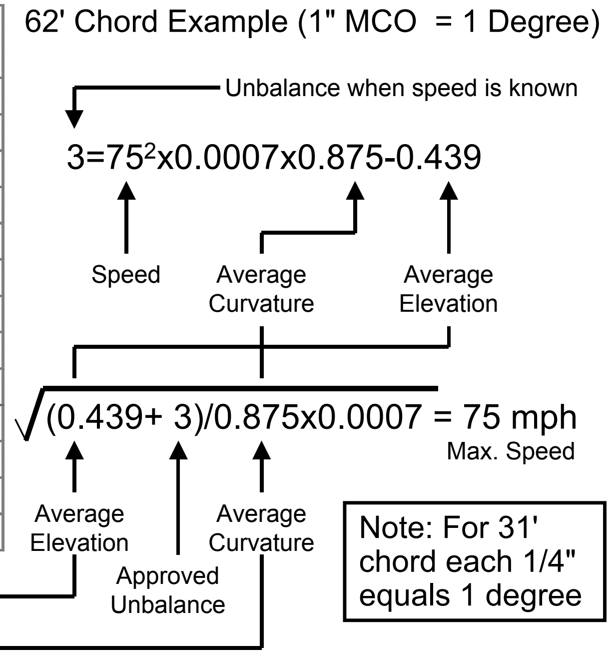


Figure 9

57(g) A track owner or a railroad operating above Class 5 speeds, may request approval from the Federal Railroad Administrator to operate specified equipment at a level of cant deficiency greater than four inches in accordance with §213.329(c) and (d) on curves in Class 1 through 5 track which are contiguous to the high speed track provided that --

(1) The track owner or railroad submits a test plan to the Federal Railroad Administrator for approval no less than thirty calendar days prior to any proposed implementation of the higher curving speeds. The test plan shall include an analysis and determination of carbody acceleration safety limits for each rail car type which indicate wheel unloading of 60 percent in a steady state condition and 80 percent in a transient (point by point) condition. Accelerometers shall be laterally-oriented and floor-mounted near the end of a representative rail car of each type;

(2) Upon FRA approval of a test plan, the track owner or railroad conducts incrementally increasing train speed test runs over the curves in the identified track segment(s) to demonstrate that wheel unloading is within the limits prescribed in paragraph (g)(1) of this section;

(3) Upon FRA approval of a cant deficiency level, the track owner or railroad inspects the curves in the identified track segment with a Track Geometry Measurement System (TGMS) qualified in accordance with §213.333 (b) through (g) at an inspection frequency of at least twice annually with not less than 120 days interval between inspections; and

(4) The track owner or railroad operates an instrumented car having dynamic response characteristics that are representative of other equipment assigned to service or a portable device that monitors on-board instrumentation on trains over the curves in the identified track segment at the revenue speed profile at a frequency of at least once every 90 day period with not less than 30 days interval between inspections. The instrumented car or the portable device shall monitor a laterally-oriented accelerometer placed near the end of the rail car at the floor

level. If the carbody lateral acceleration measurement exceeds the safety limits prescribed in paragraph (g)(1), the railroad shall operate trains at curving speeds in accordance with paragraph (b) or (c) of this section; and

(5) The track owner or railroad shall maintain a copy of the most recent exception printouts for the inspections required under paragraphs (g)(3) and (4) of this section.

Guidance. Paragraph (g) permits a high-speed railroad (operating at Classes 6 through 9 speeds) with contiguous (within or next to) curves Classes 1 through 5 to operate at a higher level of unbalance on those curves provided that additional inspections and requirements are maintained. Inspectors should compute allowable speeds through curves to determine compliance with this section and report defects when train speed exceeds the allowable based on the formula.

In most cases, the high-speed railroad will accomplish the testing requirements for the Classes 1 through 5 curves during the qualification testing under §§213.345 and 213.329 over the entire route which includes both low and high-speed curves. In those cases, FRA approval will generally apply to all curves on the route. However, FRA may approve different speeds or cant deficiencies for different track segments, depending upon the results of the testing.

§213.59 Elevation of curved track; (runoff)

59(a) If a curve is elevated, the full elevation must be provided throughout the curve, unless physical conditions do not permit. If elevation occurs in a curve, the actual minimum elevation must be used in computing the maximum allowable operating speed for that curve under §213.57(b).

Section 213.59 is closely connected to §§213.57 and 213.63. When determining whether curved track is in compliance with the TSS, Inspectors should consider §§213.57, 213.59, and 213.63 in conjunction with one another. Because the language in §213.59 is explanatory in nature and intertwined with the requirements in §§213.57 and 213.63, §213.59 should not stand alone in support of an alleged violation. FRA Inspectors should cite either §213.57 or §213.63, whichever is most applicable. Accordingly, FRA has not included any defect codes for §213.59.

59(b) Elevation must be at a uniform rate, within the limits of track surface deviation prescribed in §213.63 and it must extend at least the full length of the spirals. 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.

Items to consider with respect to runoff include the following:

- If elevation commenced within the body of the curve rather than at the point of curve-spiral, the least average elevation that exists in the body of the curve will govern the allowable operating maximum speed throughout the full curve.
- Elevation at the end of curves, or between segments of compound curves, must be at a uniform rate within the limits of track surface deviations prescribed in the table under §213.63.
- Particular attention must be given to the prescribed limits for difference in crosslevel between any two points less than 62 feet apart on spirals.

- If physical conditions do not permit a spiral long enough to accommodate the minimum length of runoff, the runoff may be carried into the tangent. In these circumstances, the surface table parameters under §213.63 will govern.
- The actual minimum elevation and actual degree of curvature is determined by using the averaging techniques described under §213.57.

Figure 10 illustrates how a railroad can reduce superelevation in the body of the curve to accommodate a highway-rail grade crossing for unqualified equipment (3 inches unbalance).

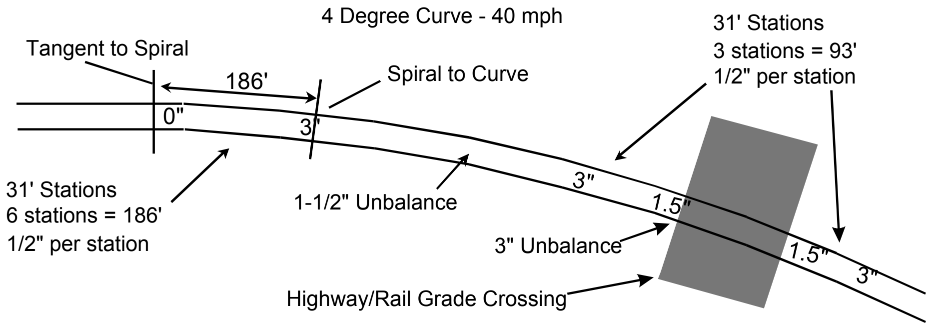


Figure 10

§213.63 Track Surface

Each owner of the track to which this part applies shall maintain the surface of its track within the limits prescribed in the following table

Track Surface	*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 the promulgation of this rule, 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 six 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 7 low joints. Track with joints staggered less than 10 feet shall not be considered as having staggered joints. Joints within the 7 low joints outside of the regular joint spacing shall not be considered as joints for purposes of this footnote.*					

Table 6

Guidance. Track surface is the evenness or uniformity of track in short distances measured along the tread 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. Track surface irregularities can lead to serious consequences if ignored.

Allowable deviations in track surface, which include runoff at the end of a raise, deviation from uniform profile, deviation from zero crosslevel at any point on tangent or reverse crosslevel elevation on curves, and the difference in crosslevel between any two points less than 62 feet apart, are specified in the track surface table. In addition, the table includes footnotes that address three special circumstances.

The first parameter in the table in this section refers to the runnoff (ramp) in any 31 foot segment at the end of a raise where the track is elevated as a result of automatic or manual surfacing or bridge work. Conditions created by track degradation (e.g., settlement or frost heaves) are to be addressed using the uniform profile parameter, under this section. Trains encountering a ramp (up or down) will experience a vertical pitch or bounce if the change in elevation occurs in too short a distance. As in the more general profile parameter, damage to car components, undesirable brake applications or derailments may occur; especially when the vehicle experiences a lateral force such as a buff force. Figure 11 illustrates the measurement of the runoff of raised track.

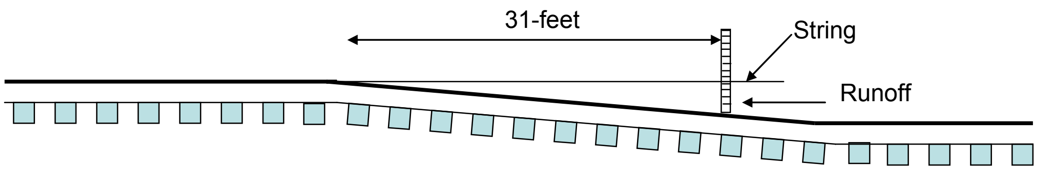


Figure 11

The second parameter, profile, relates to the elevation of either rail along the track. When trains encounter short dips or humps in the track it can result in vertical separation of couplers, broken springs, bolsters, and truck frames. Dips can result from mud spots, or develop at the ends of fixed structures (e.g., bridges, highway rail grade and track crossings). Profile is determined by placing the mid-point of a 62-foot chord at the point of maximum measurement, irrespective of vertical curves. Profile may also be a track "hump" cause by a frost heave or other occurrence. Figure 12 illustrates the measurement of profile conditions.

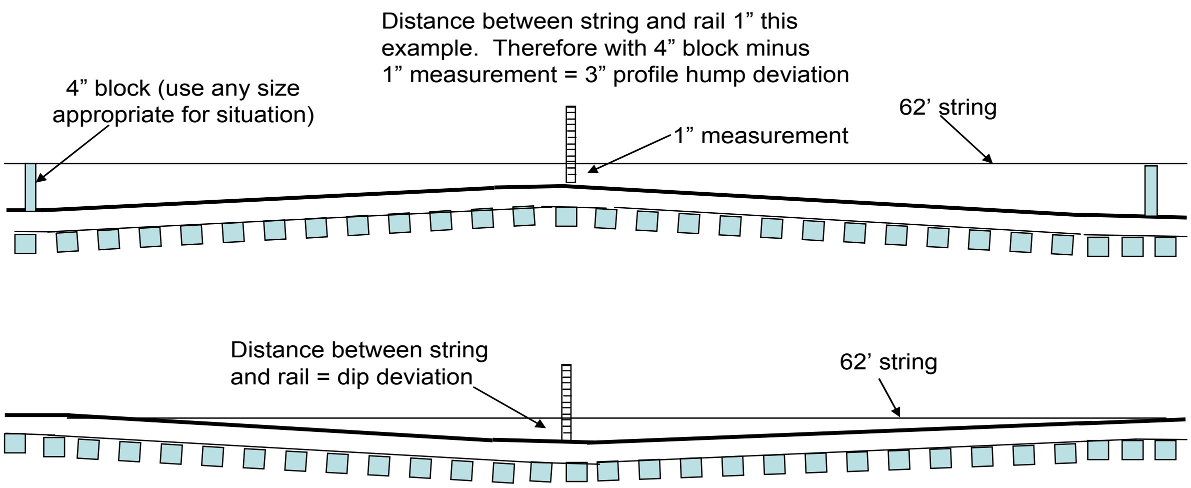


Figure 12

Remember to consider any combination of rail and tie plate or crosstie and ballast section voids to the mid-ordinate distance, according to §213.13 (dynamic loading).

When encountering a hump (e.g., frost heaves over culverts), place two uniform (reference offset) blocks on top of the running rail. Stretch (taut) a 62 foot string positioned over the blocks, with the observed highpoint at the midpoint of the string. Measure the distance from the string to the running surface of the rail. Subtract this distance from the height of the (offset) blocks to determine the mid-offset.

The third parameter in the table refers to the deviation from zero crosslevel at a point or reverse crosslevel in a curve. Crosslevel, utilizing a levelboard, is measured by subtracting the difference in height between the top surface (tread) of one rail to the tread of the opposite rail. On tangent track both rails by design should be the same height, a term known as zero crosslevel. On the spiral or body of a curve, the outer rail may not be lower than inner rail (reverse elevation) beyond the limits provided in the surface table. Also consider what implications, if any, Vmax (§213.57) may impose at a curve body where reverse elevation is encountered.

The parameter for the difference in crosslevel between any two points less than 62 feet apart is commonly referred to as the "warp" parameter. This parameter provides maximum change in crosslevel between two points within specific distances along the track. The warp parameter is, perhaps, the most critical of the surface parameters. Excessive warp contributes to wheel climb derailments. Figure 13 illustrates warp measurements.

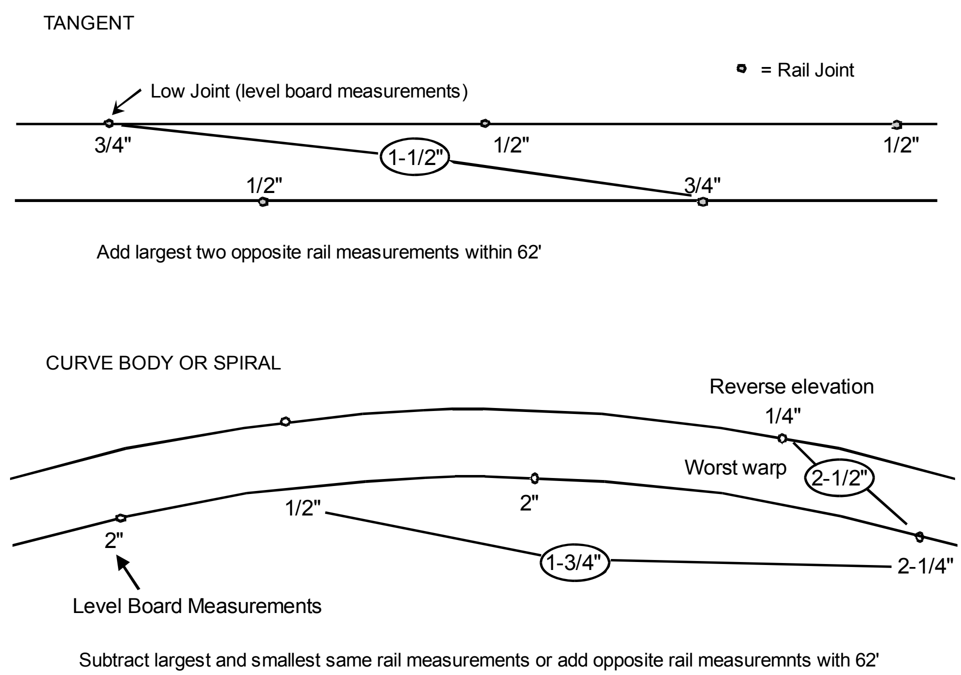


Figure 13

The threshold values for warp represent minimum safety standards that apply across the entire regulated industry and encompass the full range of rolling stock in present day operating fleets. Inspectors should be aware that some rolling stock, because of certain design and/or demonstrated performance characteristics, may be subject to additional operating restrictions and/or more restrictive warp thresholds as determined by individual railroads. The limits for warp, applies anywhere along the track, (curves, spirals, and tangent segments), except that the limits shown in footnote "*" of the §213.63 table (Table 6) apply in the special case in spirals where physical conditions prevent the more restrictive limits in the general warp parameter.

The footnote designated by a "*" of the §213.63 table (Table 6) is an exception to the above warp requirement in spirals in those few situations where the railroad has made a prior engineering decision, due to physical restrictions, to design a shorter spiral that would be found in standard construction. When encountering a spiral that does not have a sufficient length to "runoff" elevation in accordance with the warp parameter, the Inspector must determine if the "short spiral" is a result of a man made or other natural obstruction. In short spirals, the amount of warp is determined by measuring the "variation" in crosslevel between two points 31-feet apart.

Examples of "short spiral" situations include rock cuts, tunnels, station platforms, etc. Figure 14 illustrates the application of the "*" footnote.

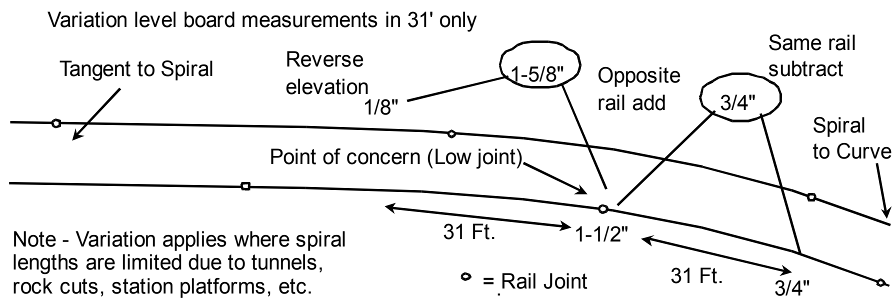


Figure 14

Railroads are expected to apply the variation parameter and thresholds only at locations where there is a clear history of restrictive physical characteristics.

When measuring track surface parameters remember the location of the transition points between tangent, spiral, and curve body are determined by actual physical layout and are not assumed to be synonymous with railroad markers, tags, curve charts, or similar information. Therefore, be governed accordingly when applying the "*" footnote or any other track geometry parameter.

Under footnote 1 of the §213.63 table (Table 6), where the Elevation At Any Point in a curve equals or exceeds 6 inches, the difference (warp) in crosslevel within 62 feet between that point and a point with greater elevation may not be more than 1½ inches regardless of track class. This footnote is included to address the condition where a vehicle is operating on a curve with a large amount of elevation and then encounters a warp condition. Since the vehicle is typically in an unbalanced condition, the warp may induce wheel climb. Slow speed curve negotiation is a particular concern since the wheels on the outside rail of the curve will tend to unload due to the overbalanced condition of the vehicle. Where this condition is found, the appropriate corrective action would be reduction to Class 1 speed under the provisions of §213.9(b).

Figure 15 illustrates a warp exceeding 1½ inches at a curve with 6 inches of elevation.

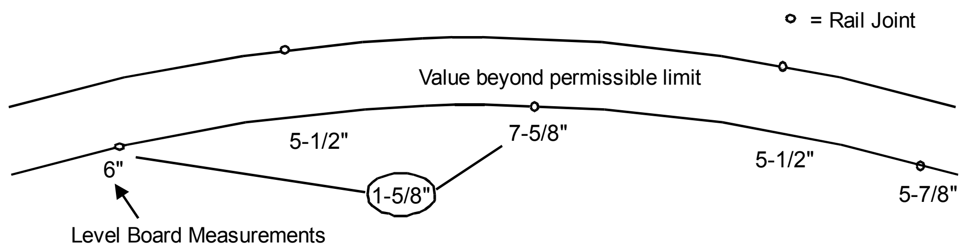


Figure 15

Footnote 2 of the §213.63 table (Table 6) addresses the critical harmonic rock-off condition that may result in the vehicle rocking back and forth and derailing following wheel climb. It is considered rare that this condition could occur in continuous welded rail (CWR), but it may occur where "joint memory exists." In this case, while the condition is not a defect unless it exceeds the warp limits specified in the table, the Inspector should call the condition to the attention of the railroad. The crosslevel difference (warp) may not exceed 1¼ inches on all six consecutive pairs of joints, under the conventional joint spacing (33, 36, 39-foot long rails). Each one of the six pairs must exceed 1¼ inches for this condition to be a defect. Additional joints that have been introduced outside of the regular joint spacing, characteristically as a result of rail repair, are not considered harmonic "joints" for the purposes of this footnote. Figure 16 illustrates a harmonic rock-off condition.

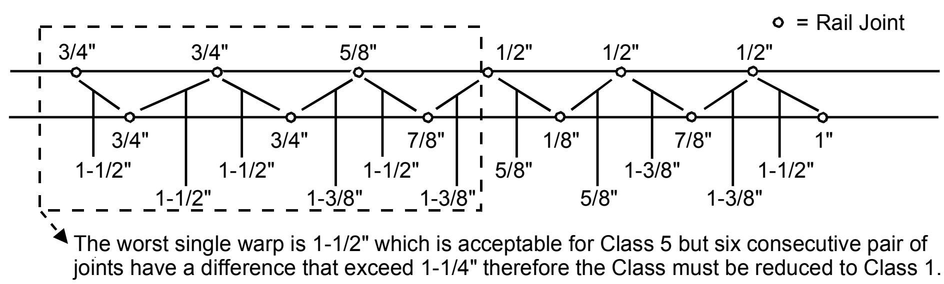


Figure 16

A condition with consecutive low bolted joints may be in non-compliance with either the warp limits specified in the table or the requirements of footnote 2 of the §213.63 table (Table 6). Inspectors shall consider any contiguous group of joints as one defect and note the number of joints. If the harmonic condition continues beyond the seven joints, the Inspector is not required to record another defect, but must note the number of consecutive joints that make up the harmonic condition.

Jointed rail stagger that is not identical from stagger to stagger, such as in a curve or when a rail slightly longer than the original construction is installed, shall be considered in the harmonic calculation. Additional joints introduced by the installation of short rails are ignored in evaluating a harmonic condition.

Construction consisting of 79 or 80 foot rails does not result in harmonic rock-off conditions since they occur outside of vehicle truck spacing. For 79 or 80 foot rails and stagger spacing less than 10 feet, this footnote is not applicable and Inspectors shall review the condition for compliance with other track surface parameters.

Inspectors shall carefully apply the provisions of footnote 2 of the §213.63 table (Table 6). An acceptable remedial action is to raise and tamp one or two joints in the middle of the consecutive low joints. This will break up the harmonics.

Subpart D - Track Structure

§213.101 Scope

This subpart prescribes minimum requirements for ballast, crossties, track assembly fittings, and the physical conditions of rails.

§213.103 Ballast; general

Unless it is otherwise structurally supported, all track shall be supported by material which will --

103(a) Transmit and distribute the load of the track and railroad rolling equipment to the subgrade;

103(b) Restrain the track laterally, longitudinally, and vertically under dynamic loads imposed by railroad rolling equipment and thermal stresses imposed by the rails;

Guidance. Ballast may consist of crushed slag, crushed stone, screened gravel, pit-run gravel, chat, cinders, scoria, pumice, sand, mine waste, or other native material, and is an integral part of the track structure. Ballast, regardless of the material, must satisfy the requirements stated in the TSS.

103(c) Provide adequate drainage for the track; and

103(d) Maintain proper track crosslevel, surface, and alinement.

Guidance. Inspectors should consider the overall condition of a track when citing fouled ballast. Because ballast conditions can be subjective in nature, Inspectors should also look to other indicators, such as a geometry condition. For example, a fouled ballast violation might be appropriate if the track has poor drainage and there is a geometry condition.

The term “geometry condition” used here and elsewhere in this manual means a track surface, gage, or alinement irregularity that does not exceed the allowable threshold for the designated track class. It exists due to the reduced or non-existent capability of one or more track structural components to hold the track into its preferred geometric position.

§213.109 Crossties

109(a) Crossties shall be made of a material to which rail can be securely fastened.

109(b) Each 39-foot segment of track shall have –

(1) A sufficient number of crossties which in combination provide effective support that will -

(i) Hold gage within the limits prescribed in §213.53(b);

(ii) Maintain surface within the limits prescribed in §213.63; and

(iii) Maintain alinement within the limits prescribed in §213.55.

(2) The minimum number and type of crossties specified in paragraphs (c) and (d) of this section effectively distributed to support the entire segment; and

(3) At least one crosstie of the type specified in paragraphs (c) and (d) of this section that is located at a joint location as specified in paragraph (f) of this section.

Guidance. The TSS determines the adequacy of crosstie support by including its functional requirements to maintain track geometry within the limits specified in Subpart C. The failure of the crossties to meet any of the three above criteria constitutes a deviation from the TSS.

Effective distribution of non-defective has not been defined, but must not be interpreted by the Inspector as synonymous with equally spaced. The language is intended to address situations where all of the non-defective or defective ties exist in a group at a short area of the 39-foot segment of track in question. Evidence that crossties are not effectively distributed includes, primarily, indications of an actual deviation or a geometry condition.

No criterion exists for the maximum distance between non-defective ties, and this measurement should not be used to describe a tie defect. If such a description is appropriate, it should be in terms of the number of consecutive defective ties in a group.

When citing defect code 213.109.03 (Crossties not effectively distributed to support a 39-foot segment of track), the Inspector must show evidence of one or more of the geometry conditions cited in §213.109(b)(1). Several factors may be documented if the defect is being cited. These factors include, but are not limited to:

- Geometry conditions;
- Class of track;
- Curvature;
- Traffic density (annual tonnage);
- Rail weight and condition; and
- Condition of other components of the track.

When determining compliance with this section, the Inspector must determine that crossties meet the requirements of effectiveness as defined above and make geometry measurements to verify that each 39-foot segment of track has:

- A sufficient number of effective ties to maintain geometry;
- The required number of non-defective ties for the track class as described in paragraph (d); and
- The proper placement of non-defective ties as described in paragraph (d) and positioned as required in paragraph (f) to support joints.

The majority of crossties throughout the nation are made from wood. However, there are varieties of alternate designed crossties made from materials such as composites, steel, and concrete. These types of crossties are becoming more common throughout the industry. Because of the increased use of these alternate design crossties and their associated resilient type rails fasteners, Inspectors should more rigorously consider the rail/crosstie interface. Also, see §213.127, Rail fastenings.

109(c) Each 39-foot segment of: Class 1 track shall have five crossties; Classes 2 and 3 track shall have eight crossties; and Classes 4 and 5 track shall have 12 crossties, which are not:

(1) Broken through;

(2) Split or otherwise impaired to the extent the crossties will allow the ballast to work through, or will not hold spikes or rail fasteners;

(3) So deteriorated that the tie plate or base of rail can move laterally more than ½ inch relative to the crossties; or

(4) Cut by the tie plate through more than 40 percent of a ties' thickness.

Guidance. Paragraph (c) above has been superseded by (d) which became effective on September 21, 2000.

109(d) Each 39-foot segment of track shall have the minimum number and type of crossties as indicated in the following table:

Class of track	*Tangent track and curves ≤ 2 degrees*	*Turnouts and curved track over 2 degrees*
1	*5*	*6*
2	*8*	*9*
3	*8*	*10*
4 and 5	*12*	*14*

Table 7

Guidance. Paragraph (d) addresses curved track greater than 2 degrees and will be determined by actual field measurements. Turnouts, regardless of their location (tangent or curve), shall have the same number of effective crossties as required for curves greater than 2 degrees.

When determining compliance with the minimum number of non-defective crossties per 39-foot segments, the Inspector is reminded that the 39-foot segment may be taken anywhere along the track and need not coincide with joint locations. This portion of the rule does not require associated evidence of an actual deviation, or geometry condition or other defects.

109(e) Crossties counted to satisfy the requirements set forth in the table in paragraph (d) of this section shall not be –

(1) Broken through;

(2) Split or otherwise impaired to the extent the crossties will allow the ballast to work through, or will not hold spikes or rail fasteners;

(3) So deteriorated that the tie plate or base of rail can move laterally ½ inch relative to the crossties; or

(4) Cut by the tie plate through more than 40 percent of a crosstie's thickness.

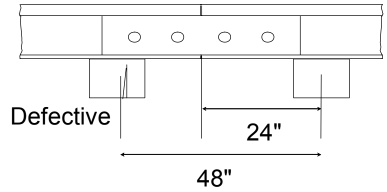
Guidance. When a crosstie exhibits any one or more of the conditions described in the four criteria for evaluation [§213.109(d)1-4] it may be considered non-effective itself, although that determination may not always result in a defective condition that can be recorded under defect codes 213.109.01, 213.109.02, 213.109.03, or 213.109.04.

If track geometry measurements fail to meet the requirements of Subpart C, and there are an insufficient number of effective crossties, both geometry and crossties could be cited as defects. If geometry measurements exceed the allowable tolerance, but a determination cannot be made that crossties are the cause, it is appropriate to cite only the defective geometry.

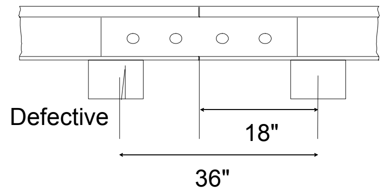
FRA Inspectors may use a Portable Track Loading Fixture (PTLF) described in §213.110 for the purposes of measuring loaded gage to determine effective distribution of crossties. Refer to Appendix E - PTLF instructions for non-GRMS territory under §213.53.

109(f) Class 1 and Class 2 track shall have one crosstie whose centerline is within 24 inches of each rail joint location, and Classes 3 through 5 track shall have one crosstie whose centerline is within 18 inches of each rail joint location or, two crossties whose centerlines are within 24 inches either side of each rail joint location. The relative position of these ties is described in the following figure:

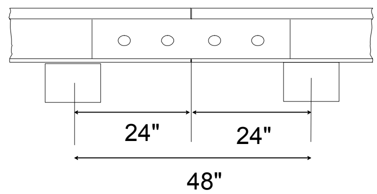
Each rail joint in Classes 1 and 2 track shall be supported by at least one crosstie specified in paragraph (c) and (d) of this section whose centerline is within 48."



Each rail joint in Classes 3 through 5 track shall be supported by at least one crosstie specified in paragraph (c) and (d) of this section whose centerline is within 36", or:



Two crossties, one on each side of the rail joint, whose centerlines are within 24" of the rail joint location shown above.



Guidance. A non-defective joint tie must be found within the prescribed distance of the centerline of the joint measured at the rail end. In Classes 3 through 5, joint tie placement can be satisfied by either a one tie configuration, or by a two tie configuration.

For clarity of measurement and description:

1. Where a short piece of rail only inches in length is inserted between the rail ends and incorporated into the joint bar assembly, measure from the bar centerline. Also see §213.121 (d), Rail Joints.
2. Where non-symmetrical bars exist, (e.g., five hole heel block bars, five hole compromise bars) measure from the design point where rail ends normally abut.

109(g) For track constructed without crossties, such as slab track, track connected directly to bridge structural components and track over servicing pits, the track structure shall meet the requirements of paragraphs (b)(1)(i), (ii), and (iii) of this section

Guidance. This paragraph addresses track constructed without crossties or bridge timbers, such as concrete-slab track, in which running rails are secured through fixation to another structural member.

Guidance, General. With respect to crossties in general, criticism has arisen over Inspector evaluation of crosstie condition, stating that decisions were subjective based on an Inspector's maintenance experience and varied widely among the Inspectors. We may never escape this type of criticism entirely, although it can be substantially reduced if Inspectors evaluate tie condition solely on the basis of the definitions provided in this section. Each crosstie must be evaluated individually by these criteria. As with all provisions of the TSS, the Inspector must use judgment and discretion in the application of the crosstie standards. They should be used to describe conditions that constitute a risk to the safe operation of trains, and should not be applied in doubtful cases.

Gage rods are not an effective substitute for a proper crosstie and rail fastening system. Gage rods can be subject to sudden failure, they provide no vertical rail support, and they provide no resistance to rail roll-over forces. However, gage rods may be installed when they are used as a secondary means of support for maintaining gage. Where gage rods are used and it is obvious that the condition of the crosstie and fastening system in the immediate vicinity is incapable of maintaining adequate gage, then the Inspector should consider citing a crosstie or fastener defect.

Certain crossties may not be able to hold spikes or rail fasteners in their present condition. In these cases, it may be possible to bring the crossties into compliance by either plugging and re-spiking, or adding additional rail-holding or plate-holding spikes, or both.

Where conditions are closer to a rail fastener issue (e.g., sound ties in track are not fastened to the rail), Inspectors should refer to the guidance under §213.127.

§213.110 Gage Restraint Measurement Systems

110(a) A track owner may elect to implement a Gage Restraint Measurement System (GRMS), supplemented by the use of a Portable Track Loading Fixture (PTLF), to determine compliance with the crosstie and fastener requirements specified in §§213.109 and 213.127 provided that--

(1) The track owner notifies the appropriate FRA Regional office at least 30 days prior to the designation of any line segment on which GRMS technology will be implemented; and

(2) The track owner notifies the appropriate FRA Regional office at least 10 days prior to the removal of any line segment from GRMS designation.

Guidance. This paragraph provides for the implementation of a GRMS, supplemented by the use of a PTLF, to determine compliance with the crosstie and rail fastener requirements specified in §§213.109 and 213.127. Track owners electing to implement this technology must provide the appropriate FRA Regional Office with notification that specifically identifies the line segment(s) where GRMS will be used. The appropriate FRA office is the headquarters location for the FRA region in which the GRMS designated line segment is located.

The notification must be provided to FRA at least 30 days prior to the designation of any line segment which will be subject to the requirements of this section. Even though the notification requirement is satisfied, and the GRMS vehicle is determined to meet the minimum design requirements, the actual "triggering event," which places the line segment under the GRMS requirements, is the initial track survey with the GRMS vehicle.

Track owners must also provide FRA with at least 10 days notice prior to the removal of a line segment from GRMS designation. This requirement provides FRA with advance notice of the criteria change for the inspection of crossties and fasteners, and places some control over the random removal of line segments from GRMS designation.

110(b) Initial notification under paragraph (a)(1)of this section shall include--

(1) Identification of the line segment(s) by timetable designation, milepost limits, class of track, or other identifying criteria; and

(2) The most recent record of million gross tons of traffic per year over the identified segment(s).

Guidance. This paragraph specifies what information track owners should include in their notifications to FRA about line segments designated for GRMS inspection. The information must include, at a minimum, the segment's timetable designation, milepost limits, track class, million-gross-tons of traffic per year, and any other identifying characteristics of the segment.

For reasons of safety, GRMS vehicles have their split-axle in the retracted position when testing through special trackwork such as turnouts, at grade rail-to-rail crossing (diamond), expansion joints, lift rail assemblies, etc. Where certain trackage within is not part of the designation, notifications should identify what and where these locations are and what distance approaching and leaving these locations are also excluded from GRMS designation. Locations excluded from GRMS designation will be subject to the requirements of §§213.109 and 213.127.

110(c) The track owner shall also provide to FRA sufficient technical data to establish compliance with the minimum design requirements of a GRMS vehicle which specify that–

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

(A) At an interval not exceeding 16 inches;

(B) Under an applied vertical load of no less than 10,000 pounds per rail; and

(C) Under an applied lateral load which provides for a lateral/vertical load ratio between 0.5 and 1.25, and a load severity greater than 3,000 pounds but less than 8,000 pounds.

Guidance. This paragraph describes minimum design requirements for GRMS vehicles. Track owners must submit to FRA sufficient technical data so that the Agency can establish whether or not the track owner is in compliance with these design requirements. This paragraph requires that gage must be measured between the heads of the rail at an interval not exceeding 16 inches. The paragraph provides for design flexibility by establishing acceptable ranges for the lateral/vertical load ratio and the resulting lateral load severity, both of which can be satisfied by various load configurations, provided that the applied vertical load is not less than 10,000 pounds per rail.

The rule provides for design flexibility by establishing acceptable ranges for various loading requirements. These ranges are considered absolute, and loading configurations that fall outside of the prescribed ranges will not be considered acceptable. Some loading configurations may develop high lateral/vertical load ratios and therefore lubrication of the gage face of the rail ahead of the split axle may be required to reduce the coefficient of friction to prevent wheel climb.

110(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 (pounds).
L = Actual lateral load applied (pounds).
c = Coefficient of friction between the rail/tie which is assigned a nominal value of (0.4).
V = Actual vertical load applied (pounds).

(e) The measured gage values shall be converted to a Projected Loaded Gage 24 (PLG 24) as follows–

PLG 24 = UTG + A X (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 24,000 pound lateral load and a 33,000 pound vertical load.

For all track - "A" - in the above formula is:

$$A = \frac{13.153}{(.001 \times L - .000258 \times V) - .009 \times (.001 \times L - .000258 \times V)^2}$$

Note: The A factor shall not exceed (3.184) under any circumstances.

Where -
L = Actual lateral load applied (pounds).
V = Actual vertical load applied (pounds).

(f) The measured gage value shall be converted to a Gage Widening Ratio (GWR) as follows –

$$GWR = \frac{(LTG - UTG)}{L} \times 16{,}000$$

Guidance. Paragraphs (d), (e), and (f) prescribe formulas to be used in the calculation of the Gage Widening Ratio (GWR) and the Projected Loaded Gage 24 (PLG 24). The accurate measurements of unloaded gage, GRMS loaded gage, and the lateral load applied are of critical importance because these measurements are used in the calculation of PLG 24 values and the values for GWR, values which constitute a direct measure of track strength. Therefore, to avoid any influence from adjacent loads, design requirements specify that the unloaded track gage must be measured by the GRMS vehicle at a point no less than 10-feet from any lateral or vertical load application. Loaded track gage measured by the GRMS vehicle shall be measured at a point no more than 12 inches from the lateral load application point.

110(g) The GRMS vehicle shall be capable of producing output reports that provide a trace, on a constant-distance scale, of all parameters specified in paragraph (l) of this section.

110(h) The GRMS vehicle shall be capable of providing an exception report containing a systematic listing of all exceptions, by magnitude and location, to all the parameters specified in paragraph (l) of this section.

110(i) The exception reports required by this section shall be provided to the appropriate person designated as fully qualified under §213.7 prior to the next inspection required under §213.233.

Guidance. Paragraphs (g), (h), and (i) require that GRMS vehicles be capable of producing strip-chart traces of all the parameters specified in paragraph (l) of this section, as well as a printed exception report listing by magnitude and location all exceptions from these parameters. The exception report listing must be provided to the appropriate person(s) designated as fully qualified under §213.7 prior to the next inspection required under §213.233 of the TSS.

Since the premise behind GRMS technology is to identify areas of weak gage restraint that either need immediate attention, or must be continually monitored until the next GRMS inspection, the exception report listing must be retained and be available for review by the

§213.7 inspection personnel. FRA Inspectors will obtain, or have access to, this exception report when conducting regular compliance inspections over GRMS designated line segments.

110(j) The track owner shall institute the necessary procedures for maintaining the integrity of the data collected by the GRMS and PTLF systems. At a minimum, the track owner shall–

(1) Maintain and make available to the Federal Railroad Administration documented calibration procedures on each GRMS vehicle which, at a minimum, shall specify a daily instrument verification procedure that will ensure correlation between measurements made on the ground and those recorded by the instrumentation with respect to loaded and unloaded gage parameters; and

(2) Maintain each PTLF used for determining compliance with the requirements of this section such that the 4,000-pound reading is accurate to within five percent of that reading.

Guidance. This paragraph requires the track owner to institute procedures that will ensure the integrity of data collected by the GRMS and PTLF systems. Track owners must maintain documented calibration procedures on each GRMS vehicle and make them available upon request from an FRA representative. A daily instrument verification procedure is required to ensure that measurements of loaded and unloaded gage recorded by the instrumentation correlate to actual field measurements. Track owners must also develop and implement the necessary PTLF inspection and maintenance procedures so that the 4,000-pound reading is accurate within plus or minus 5 percent.

110(k) The track owner shall provide training in GRMS technology to all persons designated as fully qualified under §213.7 and whose territories are subject to the requirements of this section. The training program shall be made available to the Federal Railroad Administration upon request. At a minimum, the training program shall address--

(1) Basic GRMS procedures;

(2) Interpretation and handling of exception reports generated by the GRMS vehicle;

(3) Locating and verifying defects in the field;

(4) Remedial action requirements;

(5) Use and calibration of the PTLF; and

(6) Recordkeeping requirements.

Guidance. This paragraph recognizes the need for persons designated as fully qualified under §213.7, and whose territories are subject to the requirements of this section, to receive training on the implementation of GRMS technology. The track owner therefore is required to develop a formal GRMS training program which must be made available to FRA upon request. The training of affected employees is another “triggering event” that must be satisfied prior to a line segment being designated as GRMS territory under this section.

The training program must provide detailed instruction on the specific areas identified in this paragraph. In particular, the training must address basic GRMS operational procedures, interpretation and handling of exception reports, how to locate and verify GRMS defects in the field, remedial action requirements to be initiated when defects are verified, how to use and calibrate the PTLF, and the recordkeeping requirements associated with the implementation of GRMS technology.

The requirement for GRMS training applies to fully qualified §213.7 personnel under paragraphs (a) and (b) who are going to be subject to the requirements of this section. This is not to say that all fully qualified §213.7 personnel need this training (e.g., welder foreman, production gang foreman, etc.). It is also not necessary for all fully qualified §213.7 personnel who receive the GRMS training to be issued PTLF's. However, if circumstances arise where they need a PTLF, they should have access to one and be trained in how to use it and interpret the results.

The track owner must also take into consideration any relief personnel, newly qualified personnel, or personnel transferred from non-GRMS territory into a GRMS territory, who will be subject to the GRMS requirements. These personnel must be provided with sufficient instructions and training that enable them to demonstrate to the track owner that they know and understand the requirements of this section.

110(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–

<table>
<tr><th>GRMS Parameter [1]</th><th>If Measurement Value Exceeds</th><th>Remedial Action Required</th></tr>
<tr><td colspan="3">First Level Exceptions</td></tr>
<tr><td>UTG</td><td>58"</td><td rowspan="4">(1) Immediately protect the exception location with a 10 m.p.h. speed restriction; then verify location; and
(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) of this part as measured with the PTLF.</td></tr>
<tr><td>LTG</td><td>58"</td></tr>
<tr><td>PLG24</td><td>59"</td></tr>
<tr><td>GWR</td><td>1.0"</td></tr>
<tr><td colspan="3">Second Level Exceptions</td></tr>
<tr><td>LTG</td><td>57¾" on Class 4 and 5 track [2]</td><td rowspan="3">[2] Limit operating speed to no more than the maximum allowable under §213.9 for Class 3 track; then verify location; and
(1) Maintain in compliance with PTLF criteria as described in paragraph (m) of this section; and
(2) Maintain compliance with §213.53(b) of this part as measured with the PTLF.</td></tr>
<tr><td>PLG24</td><td>58”</td></tr>
<tr><td>GWR</td><td>0.75”</td></tr>
<tr><td colspan="3">[1] Definitions for the GRMS parameters referenced in this table are found in paragraph (p) of this section.
[2] This note recognizes that typical good track will increase in total gage by as much as ¼ inch due to outward rail rotation under GRMS loading conditions. For Class 2 & 3 track, the GRMS LTG values are also increased by ¼ 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 track owner must take the appropriate remedial actions. This ¼ 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) will apply.</td></tr>
</table>

Table 8

Guidance. This paragraph specifies the parameters and threshold levels required to be reported as a record of lateral restraint following an inspection by a GRMS vehicle. The regulation requires that two levels of exceptions be reported during the GRMS inspection. Specific remedial actions are required for each level, as identified in the Remedial Action Table in this section. First Level Exceptions are required to be immediately protected by a 10 m.p.h. speed restriction until verification and corrective action can be instituted. Second Level Exceptions are to be monitored and maintained within the PTLF criteria outlined in paragraph (m) of this section.

The prior knowledge criteria is satisfied for those locations that are identified as First or Second Level exceptions on the record of lateral restraint which is generated following each GRMS inspection. Where field inspections conducted between GRMS inspections reveal an exception location that does not comply with either the track strength requirement or the gage requirement that are identified in paragraph (m) of this section, the Inspector should consider recommending civil penalties. For locations that do not comply with the requirements of paragraph (m), and have not been identified on the record of lateral restraint as either a First or Second Level exception, the Inspector shall exercise discretion to determine whether or not civil penalties should be recommended.

Footnote 2 in the Remedial Action Table of this section recognizes that typical good track will increase in total gage by as much as ¼ inch due to outward rail rotation under GRMS loading conditions. Accordingly, for Class 2 and Class 3 track, the GRMS loaded track gage values are also increased by ¼ inch to a maximum of 58 inches. GRMS loaded track gage values in excess of 58 inches must always be considered First Level exceptions. This ¼ inch increase in gage applies only to GRMS loaded gage, and does not apply to PTLF gage measurements or to measurements made by more traditional methods.

110(m) Between GRMS inspections, the PTLF may be used as an additional analytical tool to assist fully qualified §213.7 individuals in determining compliance with the crosstie and fastener requirements of §§213.109 and 213.127. When the PTLF is used, whether as an additional analytical tool or to fulfill the requirements of paragraph (l), it shall be used subject to the following criteria–

(1) At any location along the track that the PTLF is applied, that location will be deemed in compliance with the crosstie and fastener requirements specified in §§213.109 and 213.127 provided that–

(i) The total gage widening at that location does not exceed ⅝ inch when increasing the applied force from 0 to 4,000 pounds; and

(ii) The gage of the track under 4,000 pounds of applied force does not exceed the allowable gage prescribed in §213.53(b) for the class of track.

(2) Gage widening in excess of ⅝ inch shall constitute a deviation from Class 1 standards.

(3) A person designated as fully qualified under §213.7 retains the discretionary authority to prescribe additional remedial actions for those locations, which comply with the requirements of paragraph (m)(1)(i) and (ii) of this section.

(4) When a functional PTLF is not available to a fully qualified person designated under §213.7, the criteria for determining crosstie and fastener compliance shall be based solely on the requirements specified in §§213.109 and 213.127.

(5) If the PTLF becomes non-functional or is missing, the track owner will replace or repair it before the next inspection required under §213.233.

(6) Where vertical loading of the track is necessary for contact with the lateral rail restraint components, a PTLF test will not be considered valid until contact with these components is restored under static loading conditions.

Guidance. While the remedial action table in paragraph (l) requires the use of the PTLF to measure compliance with the lateral restraint and gage requirements at identified exception locations in GRMS territory, paragraph (m) also provides for the use of a PTLF as an additional analytical tool by fully qualified §213.7 individuals at other locations in GRMS territory. Paragraph (m) also describes the manner in which a PTLF must be used in GRMS territory, whether it is being used as an additional analytical tool or being used to meet the remedial action requirements set forth in paragraph (l). Compliance with §§213.109 and 213.127 will be demonstrated when a PTLF is applied and (1) the total gage widening at that location does not exceed ⅝ inch when increasing the applied force from 0 to 4,000 pounds, and (2) the gage of the track measured under 4,000 pounds of applied force does not exceed the allowable gage prescribed in §213.53(b) of this section for the class of track involved. Gage widening in excess of ⅝ inch shall constitute a deviation from Class 1 standards.

At locations where compliance with the crosstie and rail fastener requirements have been demonstrated through the use of a PTLF, a fully qualified §213.7 individual retains the discretionary authority to prescribe additional remedial actions, such as the placement of speed restrictions, if the individual deems it necessary. FRA Inspectors will determine compliance with the crosstie and fastener requirements for gage restraint solely on the basis of the PTLF measurements.

Where crossties are found to be so severely split or plate-cut to the extent that they are incapable of providing adequate vertical support, and conditions have degraded to the point where track surface conditions are approaching the allowable limit for the Class of track, Inspectors shall continue to consider writing a defect. In such a case use defect code 213.109.03, "crossties not effectively distributed to support a 39-foot segment of track." Inspectors should record the track surface geometry condition as well as the contributing condition of the crossties in the description column.

When a functional PTLF is not available to a fully qualified §213.7 individual during a scheduled inspection under §213.233 of this part, the track owner must repair or replace the PTLF prior to the next inspection required under §213.233, or crosstie and rail fastener compliance will be based solely on the requirements specified in §§213.109 and 213.127.

At locations where crosstie or rail fastening compliance is questioned and vertical loading of the track structure is necessary to restore contact with the lateral rail restraint components, the crossties must be raised until lateral restraint contact is restored and a PTLF measurement must then be made.

If the track owner fails to immediately restore contact between the rail and the fastening system so that a valid PTLF test can be performed, this non-action will in effect remove this location from the GRMS standard and the Inspector will determine compliance based on §§213.109 and 213.127.

Likewise, where gage rods have been installed which preclude a valid PTLF test to determine gage restraint of crossties and fasteners, this action will in effect remove the location from the GRMS standard and the Inspector will determine compliance based on §§213.109 and 213.127.

110(n) The track owner shall maintain a record of the two most recent GRMS inspections at locations which meet the requirements specified in §213.241(b). At a minimum, records shall indicate the following--

(1) Location and nature of each First Level exception; and

(2) Nature and date of remedial action, if any, for each exception identified in paragraph (n)(1) of this section.

Guidance. This paragraph requires the track owner to maintain a record of the two most recent GRMS inspections at locations meeting the requirements specified in §213.241(b). The records must indicate the location and nature of each First Level Exception and, the nature and date of initiated remedial action, if any, for each First Level Exception. First Level exceptions are described in the Remedial Action Table in Paragraph (l).

The record required under paragraph (n) is also the official record of lateral restraint and needs to identify both exception levels; however the remedial action taken is required to be shown only for First Level Exceptions. Records will be maintained at locations that meet the requirements specified in §213.241(b).

110(o) The inspection interval for designated GRMS line segments shall be such that--

(1) On line segments where the annual tonnage exceeds two million gross tons, or where the maximum operating speeds for passenger trains exceeds 30 m.p.h., GRMS inspections must be performed annually at an interval not to exceed 14 months; or

(2) On line segments where the annual tonnage is two million gross tons or less and the maximum operating speed for passenger trains does not exceed 30 m.p.h., the interval between GRMS inspections must not exceed 24 months.

Guidance. Paragraph (o) details the GRMS inspection requirements which is illustrated in the following table:

TRAFFIC	GRMS INSPECTION INTERVAL
If annual tonnage exceeds 2MGT, or passenger train speeds (if applicable) exceed 30 m.p.h., then	GRMS inspections must be performed annually at an interval not to exceed 14 months [1]
If annual tonnage is 2MGT or less, and where passenger train speeds (if operated) do not exceed 30 m.p.h., then	The interval between GRMS inspections must not exceed 24 months [2]

Table 9

[1] The maximum interval of 14 months is intended to provide some flexibility for scheduling when it may not be possible to schedule annual inspections within the same calendar month each year.

[2] This extended frequency is an attempt to make the technology more accessible to short line operators who may not have the financial or equipment resources available to larger railroads. For example, a GRMS inspection may be scheduled at up to 24 month intervals if the railroad had 2 million annual tons or less and passenger trains were not authorized to operate at more than 30 m.p.h.

110(p) As used in this section--

(1) Gage Restraint Measurement System (GRMS) means a track loading vehicle meeting the minimum design requirements specified in this section.

(2) Gage Widening Ratio (GWR) means the measured difference between loaded and unloaded gage measurements, linearly normalized to 16,000 pounds of applied lateral load.

(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. GRMS vehicles using load combinations developing L/V ratios which exceed 0.8 must be operated with caution to protect against the risk of wheel climb by the test wheelset.

(4) Load severity means the amount of lateral load applied to the fastener system after friction between rail and tie is overcome by any applied gage-widening lateral load.

(5) Loaded Track Gage (LTG) means the gage measured by the GRMS vehicle at a point no more than 12 inches from the lateral load application point.

(6) Portable Track Loading Fixture (PTLF) means a portable track loading device capable of applying an increasing lateral force from 0 to 4,000 pounds on the web/base fillet of each rail simultaneously.

(7) Projected Loaded Gage (PLG) means an extrapolated value for loaded gage calculated from actual measured loads and deflections. PLG 24 means the extrapolated value for loaded gage under a 24,000 pound lateral load and a 33,000 pound vertical load.

(8) Unloaded Track Gage (UTG) means the gage measured by the GRMS vehicle at a point no less than 10-feet from any lateral or vertical load.

Guidance. This paragraph prescribes a list of definitions of terms essential to the implementation of GRMS technology.

A well documented pattern of repeated or widespread deviations from the requirements of this section by the track owner will effectively terminate the options afforded by this section. The affected track would then become subject to the requirements of §§213.109 and 213.127.

§213.113 Defective rails

(a) When an owner of track to which this part applies learns, through inspection or otherwise, that a rail in that track contains any of the defects listed in the following table, a person designated under §213.7 shall determine whether or not the track may continue in use. If he determines that the track may continue in use, operation over the defective rail is not permitted until -- (1) The rail is replaced; or (2) The remedial action prescribed in the table is initiated.

RAIL DEFECT REMEDIAL ACTION TABLE					
Defect	Length of defect (inch)		Percent of rail head cross-sectional area weakened by defect		If defective rail is not replaced, take
	More than	But not more than	Less than	But not less than	the remedial action prescribed in note
Transverse fissure Compound fissure			70	5	B
			100	70	A2
				100	A
Detail fracture Engine burn fracture Defective weld			25	5	C
			80	25	D
			100	80	A2 or [E and H]
				100	A or [E and H]
Horizontal or Vertical split head Split web, Piped rail Head web separation	1	2			H and F
	2	4			I and G
	4				B
	Breakout in railhead				A
Bolt hole crack	½	1			H and F
	1	1½			H and G
	1½				B
	Breakout in railhead				A
Broken base	1	6			D
	6				A or [E and I]
Ordinary break					A or E
Damaged rail					D
Flattened rail	Depth ≥ ⅜ and Length ≥ 8				H

Table 10

Notes:

A. Assign person designated under §213.7 to visually supervise each operation over defective rail.

A2. Assign person designated under §213.7 to make visual inspection. After a visual inspection, that person may authorize operation to continue without continuous visual supervision at a maximum of 10 m.p.h. for up to 24 hours prior to another such visual inspection or replacement or repair of the rail.

B. Limit operating speed over defective rail to that as authorized by a person designated under §213.7(a), who has at least one year of supervisory experience in railroad track maintenance. The operating speed cannot be over 30 m.p.h. or the maximum allowable speed under §213.9 for the class of track concerned, whichever is lower.

C. Apply joint bars bolted only through the outermost holes to defect within 20 days after it is determined to continue the track in use. In the case of Classes 3 through 5 track, limit operating speed over defective rail to 30 m.p.h. until joint bars are applied; thereafter, limit speed to 50 m.p.h. or the maximum allowable speed under §213.9 for the class of track concerned, whichever is lower. When a search for internal rail defects is conducted under §213.237, and defects are discovered in Classes 3 through 5 which require remedial action C, the operating speed shall be limited to 50 m.p.h., or the maximum allowable speed under §213.9 for the class of track concerned, whichever is lower, for a period not to exceed 4 days. If the defective rail has not been removed from the track or a permanent repair made within 4 days of the discovery, limit operating speed over the defective rail to 30 m.p.h. until joint bars are applied; thereafter, limit speed to 50 m.p.h. or the maximum allowable speed under §213.9 for the class of track concerned, whichever is lower.

D. Apply joint bars bolted only through the outermost holes to defect within 10 days after it is determined to continue the track in use. In the case of Classes 3 through 5 track, limit operating speed over the defective rail to 30 m.p.h. or less as authorized by a person designated under §213.7(a), who has at least one year of supervisory experience in railroad track maintenance, until joint bars are applied; thereafter, limit speed to 50 m.p.h. or the maximum allowable speed under §213.9 for the class of track concerned, whichever is lower.

E. Apply joint bars to defect and bolt in accordance with §213.121(d) and (e).

F. Inspect rail 90 days after it is determined to continue the track in use.

G. Inspect rail 30 days after it is determined to continue the track in use.

H. Limit operating speed over defective rail to 50 m.p.h. or the maximum allowable speed under §213.9 for the class of track concerned, whichever is lower.

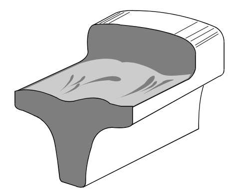
I. Limit operating speed over defective rail to 30 m.p.h. or the maximum allowable speed under §213.9 for the class of track concerned, whichever is lower.

(b) As used in this section --

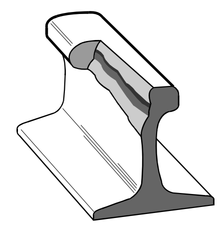
(1) Transverse fissure means a progressive crosswise fracture starting from a crystalline center or nucleus inside the head from which it spreads outward as a smooth, bright, or dark, round or oval surface substantially at a right angle to the length of the rail. The distinguishing features of a transverse fissure from other types of fractures or defects are the crystalline center or nucleus and the nearly smooth surface of the development which surrounds it.

(2) Compound fissure means a progressive fracture originating in a horizontal split head which turns up or down in the head of the rail as a smooth, bright, or dark surface progressing until substantially at a right angle to the length of the rail. Compound fissures require examination of both faces of the fracture to locate the horizontal split head from which they originate.

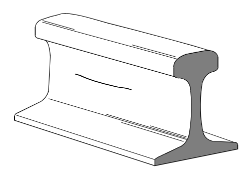
(3) Horizontal split head means a horizontal progressive defect originating inside of the rail head, usually ¼ inch or more below the running surface and progressing horizontally in all directions, and generally accompanied by a flat spot on the running surface. The defect appears as a crack lengthwise of the rail when it reaches the side of the rail head.



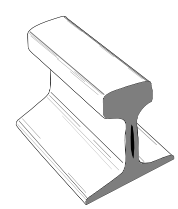
(4) Vertical split head means a vertical split through or near the middle of the head, and extending into or through it. A crack or rust streak may show under the head close to the web or pieces may be split off the side of the head.



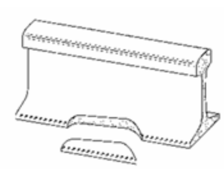
(5) Split web means a lengthwise crack along the side of the web and extending into or through it.



(6) Piped rail means a vertical split in a rail, usually in the web, due to failure of the shrinkage cavity in the ingot to unite in rolling.

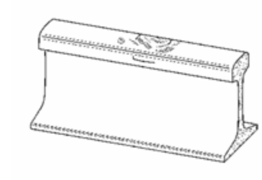


(7) Broken base means any break in the base of the rail.



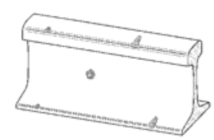
(8) Detail fracture means a progressive fracture originating at or near the surface of the rail head. These fractures should not be confused with transverse fissures, compound fissures, or other defects which have internal origins. Detail fractures may arise from shelly spots, head checks, or flaking.

(9) Engine burn fracture means a progressive fracture originating in spots where driving wheels have slipped on top of the rail head. In developing downward they frequently resemble the compound or even transverse fissures with which they should not be confused or classified.



(10) Ordinary break means a partial or complete break in which there is no sign of a fissure, and in which none of the other defects described in this paragraph (b) are found.

(11) Damaged rail means any rail broken or injured by wrecks, broken, flat, or unbalanced wheels, slipping, or similar causes.

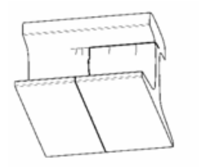


(12) Flattened rail means a short length of rail, not at a joint, which has flattened out across the width of the rail head to a depth of ⅜ inch or more below the rest of the rail. Flattened rail occurrences have no repetitive regularity and thus do not include corrugations, and have no apparent localized cause such as a weld or engine burn. Their individual length is relatively short, as compared to a condition such as head flow on the low rail of curves.

(13) Bolt hole crack means a crack across the web, originating from a bolt hole, and progressing on a path either inclined upward toward the rail head or inclined downward toward the base. Fully developed bolt hole cracks may continue horizontally along the head/web or base/web fillet, or they may progress into and through the head or base to separate a piece of the rail end from the rail. Multiple cracks occurring in one rail end are considered to be a single defect. However, bolt hole cracks occurring in adjacent rail ends within the same joint must be reported as separate defects.

(14) Defective weld means a field or plant weld containing any discontinuities or pockets, exceeding 5 percent of the rail head area individually or 10 percent in the aggregate, oriented in or near the transverse plane, due to incomplete penetration of the weld metal between the rail ends, lack of fusion between weld and rail end metal, entrainment of slag or sand, under-bead or other shrinkage cracking, or fatigue cracking. Weld defects may originate in the rail head, web, or base, and in some cases, cracks may progress from the defect into either or both adjoining rail ends.

(15) Head and web separation means a progressive fracture, longitudinally separating the head from the web of the rail at the head fillet area.



Guidance. The remedial actions required for defective rails specify definite time limits and speeds. The remedial actions also allow certain discretion to the track owner for the continued operation over certain defects. Inspectors should consider all rail defects dangerous and care should be taken to determine that proper remedial actions have been accomplished by the railroad. When more than one defect is present in a rail, the defect requiring the most restrictive remedial action shall govern.

The remedial action table and specifications in the rule address the risks associated with rail failure. These risks are primarily dependent upon defect type and size and should not be dependent upon the manner or mechanism that reveals the existence of the defect. Failure of the track owner to comply with the operational (speed) restrictions, maintenance procedures and the prescribed inspection intervals specified in this section and §213.237 (Defective rails and Inspection of rail, respectively), may constitute a violation of the TSS.

Note “A2” addresses mid-range transverse defect sizes. This remedial action allows for train operations to continue at a maximum of 10 m.p.h. up to 24 hours, following a visual inspection by a person designated under §213.7. If the rail is not replaced, another 24 hour cycle begins.

Note “B” limits speed to that as authorized by a person designated under §213.7(a) who has at least one year of supervisory experience in track maintenance. The qualified person has the responsibility to evaluate the rail defect and authorize the maximum operating speed over the defective rail based on the size of the defect and the operating conditions; however, the maximum speed over the rail may not exceed 30 m.p.h. or the maximum speed under §213.9 for the class of track concerned, whichever is lower.

Notes “C,” “D,” and "H" limit the operating speed, following the application of joint bars, to 50 m.p.h. or the maximum allowable speed, under §213.9 for the class of track concerned, whichever is lower. When the maximum speed specified in notes "B", "C", "D", and "H" exceeds the current track speed, the railroad is required to record the defect. For example, when a railroad determines that remedial action "B" is required and the track speed already is 30 m.p.h. or less, the railroad must record the defect. This indicates that the railroad is aware of the characteristics of the defective rail and has designated a permissible speed in compliance with the regulation.

When an FRA Inspector discovers a defective rail that requires the railroad representative to determine whether to continue the track in use and to designate the maximum speed over the rail, the Inspector should inquire as to the representative's knowledge of the defect and remedial action. If the railroad was not aware of the defect prior to the FRA inspection, the FRA Inspector should observe the actions taken by the railroad representative to determine compliance. If the railroad had previously found the defective rail, the FRA Inspector should confirm the proper remedial action was taken. During records inspections, the FRA Inspector should confirm that the defects were recorded and proper remedial actions were taken.

The remedial action table for defects failing in the transverse plane (transverse and compound fissures, detail and engine burn fractures, and defective welds) specifies a lower limit range base of 5 percent of the railhead cross-sectional area. If a transverse defect is reported to be less than 5 percent, the track owner is not legally bound to provide corrective action under the TSS. Defects reported less than 5 percent are not consistently found during rail breaking routines and therefore, defect determination within this range is not always reliable.

Transverse and compound fissure defects, weakened between 5 and 70 percent of cross-sectional head area require remedial action (note B). Defects in the range between 70 and less than 100 percent of cross-sectional head area, require remedial action (note A2), as prescribed. Defects that affect 100 percent of the cross-sectional head area require remedial action (note A) as prescribed, the most restrictive. Inspectors should be aware that transverse and compound fissures are defects that fail in the transverse plane and are characteristic of rail that has not been control-cooled (normally rolled prior to 1936).

Defects identified and grouped as detail fracture, engine burn fracture, and defective welds, will weaken and also fail in the transverse plane. Detail fractures are characteristic of control-cooled rail [usually indicated by the letters CC or CH on the rail brand (i.e., 1360 RE CC CF&I 1982 1111). Their prescribed remedial action relates to a low range between 5 and 25 percent and a mid-range between 25 and 80 percent, for note (C) and note (D), respectively. Those defects require joint bar applications and operational speed restrictions within certain time frames. Defects extending less than 100 and more than 80 percent require a visual inspection. If the rail is not replaced, effectively repaired, or removed from service, an elective would be to restrict operation to a maximum of 10 m.p.h. for up to 24 hours, then perform another visual inspection.

The second sentence in remedial action note (C) addresses defects which are discovered in Classes 3 through 5 track during an internal rail inspection required under §213.237, and which are determined not to be in excess of 25 percent of the rail head cross-sectional area. For these specific defects, a track owner may operate for a period not to exceed four days, at a speed limited to 50 m.p.h. or the maximum allowable speed under §213.9 for the class of track concerned, whichever is lower. If the defective rail is not removed or a permanent repair is not made within four days of discovery, the speed is limited to 30 m.p.h., until joint bars are applied or the rail is replaced.

The requirements specified in this second paragraph are intended to promote better utilization of rail inspection equipment and therefore maximize the opportunity to discover rail defects, which are approaching service failure size. The results of the FRA's research indicate that defects of this type and size range have a predictable slow growth life. Research further indicates that even on the most heavily utilized trackage in use today, defects of this type and size are unlikely to grow to service failure size in four days.

In the remedial action table, all longitudinal defects are combined within one group subject to identical remedial actions based on their reported size. These types of longitudinal defects all share similar growth rates and the same remedial actions are appropriate to each type.

Defective rails categorized as horizontal split head, vertical split head, split web, piped rail, and head-web separation, are longitudinal in nature. When any of this group of defects is more than 1 inch, but not more than 2 inches, the remedial action initiated, under note (H), is to limit train speed to 50 m.p.h., and note (F) requires reinspecting the rail in 90 days, if deciding operations will continue. Defects in the range of more than 2 inches, but not more than 4 inches, require complying with notes (I) and (G), speed is limited to 30 m.p.h. and the rail reinspected in 30 days, if they decide operations will continue. When any of the five defect types exceed a length of 4 inches, a person designated under §213.7(a) must limit the operating speed to 30 m.p.h., under note (B).

Another form of head-web separation, often referred to as a "fillet cracked rail," is the longitudinal growth of a crack in the fillet area, usually on the gage side of the outer rail of a curve. The crack may not extend the full width between the head and the web, but it is potentially dangerous. Evidence of fillet cracking is a hairline crack running beneath the head of rail with "bleeding" or rust discoloration. Fillet cracks often result from improper superelevation or from stress reversal as a result of transposing rail. The use of a mirror is an effective aid in examining rail and the determination of head-web cracks or separation in the body of the rail.

A "bolt hole crack" is a progressive fracture originating at a bolt hole and extending away from the hole, usually at an angle. They develop from high stress risers, usually initiating as a result of both dynamic and thermal responses of the joint bolt and points along the edge of the hole, under load. A major cause of this high stress is improper field drilling of the hole. Excessive longitudinal rail movement can also cause high stress along the edge of the hole. When evaluating a rail end, which has multiple bolt hole cracks, Inspectors will determine the required remedial action based on the length of the longest individual bolt hole crack.

Under note (H) and (F), the remedial action for a bolt hole crack, more than ½ inch, but not more than 1 inch, if the rail is not replaced, is to limit speed to 50 m.p.h., or the maximum allowable under §213.9 for the class of track concerned, whichever is lower, then reinspect the rail in 90 days, if operations will continue.

For bolt hole cracks greater than 1 inch, but not exceeding 1½ inches, notes (H) and (G) apply. These rails are required to be limited to 50 m.p.h. and reinspected within 30 days. For a bolt hole crack exceeding 1½ inches, a person qualified under §213.7(a) may elect to designate a speed restriction, which cannot exceed 30 m.p.h., or the maximum allowable under §213.9 for the class of track concerned, whichever is lower.

Under notes (F) and (G), where corrective action requires rail to be reinspected within a specific number of days after discovery, several options for compliance may be exercised depending on the nature of the defect. For those defects, which are strictly internal and are not yet visible to the naked eye, the only option would be to perform another inspection with rail flaw detection equipment, either rail-mounted or hand-held. For defects that are visible to the naked eye and therefore measurable, a visual inspection or an inspection with rail flaw detection equipment are acceptable options. For certain defects enclosed within the joint bar area, such as bolt hole cracks and head-web separations, the joint bars must be removed if a visual reinspection is to be made.

The reinspection prescribed in notes (F) and (G) must be performed prior to the expiration of the 30 or 90 day interval. If the rail remains in track and is not replaced, the reinspection cycle starts over with each successive reinspection unless the reinspection reveals the rail defect to have increased in size and has therefore become subject to a more restrictive remedial action. This process continues indefinitely until the rail is removed from track.

Where corrective action requires rail to be reinspected within a specific number of days after discovery, the track owner may exercise several options for compliance. One option would be to perform another inspection with rail flaw detection equipment, either rail-mounted or hand-held. Another option would be to perform a visual inspection where the defect is visible and measurable. In the latter case, for certain defects enclosed within the joint bar area such as bolt hole breaks, removal of the joint bars will be necessary to comply with the reinspection requirement. If defects remain in track beyond the reinspection interval, the railroad must continue to monitor the defects and take the appropriate actions as required in the remedial action table.

A broken base can result from improper bearing of the base on a track spike or tie plate shoulder, and from over crimped anchors, or it may originate in a manufacturing flaw. With today's higher axle loads, Inspectors can anticipate broken base defects in 75 pound and smaller rail sections with an irregular track surface, especially on the field side. For any broken base discovered that is more than 1 inch but less than 6 inches in length, the remedial action (note D) is to apply joint bars bolted through the outermost holes to defect within 10 days, if operations will continue. In Classes 3 through 5 track, the operating speed must be reduced to 30 m.p.h. or less, as authorized by a person under §213.7(a), until joint bars are applied. After that, operating speed is limited to 50 m.p.h. or the maximum allowable under §213.9 for the class of track concerned, whichever is lower.

Under note D, there are several acceptable "outermost hole" bolting arrangements for joint bars centered on a rail defect. See Figure 17 for an illustration of acceptable bolting arrangements. In all cases, railroads may not drill a bolt hole next to a defect that is being remediated with the application of joints bars (pursuant to note D). The reason for not drilling next to the defect is to prevent the propagation of the crack into the hole closest to the defect.

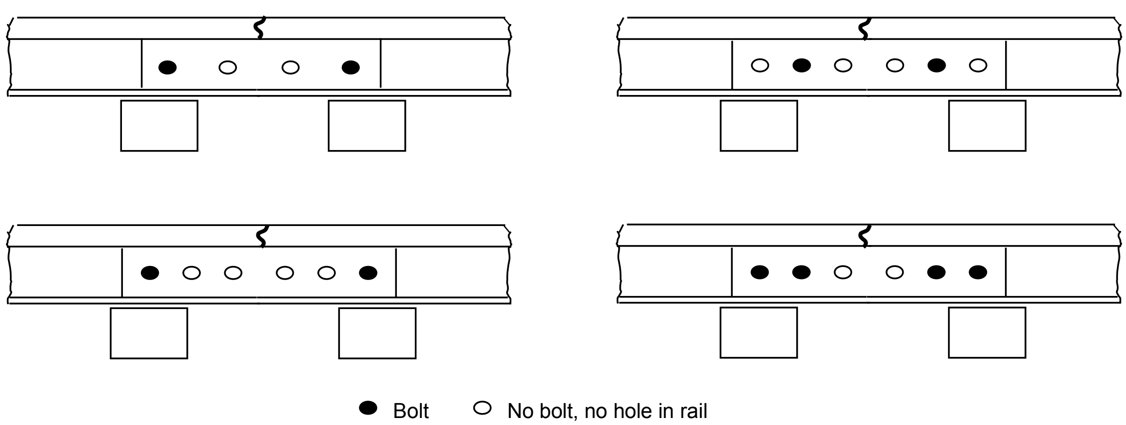


Figure 17

A broken base in excess of 6 inches requires the assignment of a person designated under §213.7 to visually supervise each train operation over the defective rail. The railroad may apply joint bars to the defect and bolt them in accordance with §213.121(d) and (e) and thereafter must limit train operations to 30 m.p.h. or the maximum allowable under §213.9 for the class of track concerned, whichever is lower. As reference, the dimensions between the outermost holes of a 24 inch joint bar vary between approximately 15 and 18 inches and a 36 inch joint bar approaches 30 inches.

Inspectors should point out to the track owner that broken bases nearing these dimensions may negate the purpose for which the joint bars are applied. A broken base rail may be caused by damage from external sources, such as rail anchors being driven through the base by a derailed wheel. It is improper to consider them "damaged rail," as this defect is addressed by more stringent provisions applicable to broken base rails, under note (A) or (E) and (I).

Damaged rail can result from flat or broken wheels, incidental hammer blows, or derailed or dragging equipment. Reducing the operational speed in Classes 3 through 5 track to 30 m.p.h. until joint bars are applied, lessens the impact force imparted to the weaken area. Applying joint bars under note (D) insures a proper horizontal and vertical rail end alinement in the event the rail fails.

Flattened rails (localized collapsed head rail) are also caused by mechanical interaction from repetitive wheel loadings. FRA and industry research indicate that these occurrences are more accurately categorized as rail surface conditions, not rail defects, as they do not, in themselves, cause service failure of the rail. Although it is not a condition shown to affect the structural integrity of the rail section, it can result in less than desirable dynamic vehicle responses in the higher speed ranges. The flattened rail condition is identified in the table, as well as in the definition portion of §213.113(b), as being ⅜ inch or more in depth below the rest of the railhead and 8 inches or more in length. As the defect becomes more severe by a reduced rail head depth, wheel forces increase.

The rule addresses flattened rail in terms of a specified remedial action for those of a certain depth and length. Those locations meeting the depth and length criteria shall be limited to an operating speed of 50 m.p.h. or the maximum allowable under §213.9 for the class of track concerned, whichever is lower.

"Break out in rail head" is defined as a piece that has physically separated from the parent rail. Rail defects meeting this definition are required to have each operation over the defective rail visually supervised by a person designated under §213.7. Inspectors need to be aware that this definition has applicability across a wide range of rail defects, as indicated in the remedial action table. Where rail defects have not progressed to the point where they meet the definition of a break out, but due to the type, length and location of the defect, they present a hazard to continued train operation, Inspectors should determine what remedial actions, if any, track owner should institute.

The following are two rail head break out examples where the "A" corrective action would be necessary:

Example One: There is a bolt hole break where the head of the rail is totally separated from the parent rail (either tight or loose), but that piece of rail will not physically lift out of the joint bars by hand. The Inspector might determine that the separation was total by the fact that the separated piece rattled when tapped. It is important that railroads take the appropriate remedial action in this situation, because it is potentially very unsafe. It is impossible to know what will happen when the next train operates over this defect. That train could cause the piece to become so loose that it comes out of the place, cocks at an angle and causes a wheel to ramp up.

Example Two: A vertical split head defective rail where rail head separation is apparent because the Inspector can determine that a physical separation has occurred through the rail head, but the rail head has not entirely separated over the entire length of the defect.

The issue of "excessive rail wear" continues to be evaluated by the Rail Integrity Task Force. The FRA believes that insufficient data exists at this time to indicate that parameters for this condition should be proposed as a minimum standard.

The Sperry Rail Service prints an excellent reference manual on rail defects. Inspectors are expected to be conversant with rail defect types, appearance, growth, hazards, and methods of detection.

Some railroads apply safety "weld straps" to thermite type field welds. These straps do not provide the same support of a joint bar. They would provide only limited support if a weld were to break under a train movement and as such, they do not comply with the provisions of corrective actions C, D, or E (installation of joint bars). Only a joint bar with full contact with the bottom of the rail head and rail base [see §213.121 (a)] and with a manufactured relief for the weld material would comply with corrective actions C, D, or E.

When an FRA Inspector finds a rail defect that appears to originate from fatigue at a bond wire attachment weld, the Inspector should cite the railroad for defect code 213.113.16. Inspectors must also identify in their narrative the type of the rail defect (e.g., defective weld, detail fracture, etc.). FRA has added this defect code based on a National Transportation Safety Board (NTSB) recommendation arising out of the NTSB investigation of a February 9, 2003, Canadian National (CN) derailment in Tamaroa, Illinois. The NTSB determined that the probable cause of this accident was CN's placement of bond wire welds on the head of the rail just outside the joint bars, where untempered martensite associated with the welds led to fatigue cracking that, because of increased stresses associated with known soft ballast conditions, rapidly progressed to rail failure.

§213.115 Rail end mismatch

Any mismatch of rails at joints may not be more than that prescribed by the following table –

Class of track	*Any mismatch of rails at joints may not be more than the following*	
	On the tread of the rail ends	*On the gage side of the rail ends*
1	*¼"*	*¼"*
2	*¼"*	*3/16"*
3	*3/16"*	*3/16"*
4 and 5	*⅛"*	*⅛"*

Table 11

Guidance. Use a straightedge to determine the mismatch by holding the straightedge longitudinally along the higher rail (tread) or along the gage side (⅝ inch down from the running surface) of the rail. Measure the distance directly between the straightedge and the rail. Disregard plastic overflow (gage side rail edge lipping), if any.

One example of mismatch occurs when a section of a rail is placed in the track where the existing rail head is gage and/or tread worn. Mismatch can also occur when the joint bars are loose. However, if the loose bars do not result in mismatch exceeding the thresholds under this section, report the defect as loose joint bars (see §213.121).

The standards prescribe both tread and gage mismatch thresholds. A mismatch may result in high impact forces especially at higher speeds. If a mismatch in excess of the allowable results in significant rail end damage, a violation should be considered.

Particular attention should be given to the mismatch on the gage side of a rail. A thin flange, skewed truck, or combination of both may cause a wheel to climb, particularly on the outer rail of a curve. Figure 18 shows the proper method to measure gage and tread mismatch.

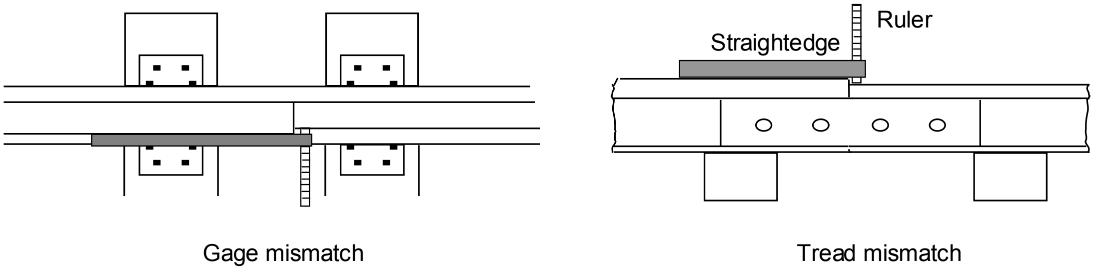


Figure 18

§213.119 Continuous welded rail (CWR); general

Guidance, General. Each railroad's written procedure should be reasonable and consistent with current research results. The FRA will review each plan for compliance with paragraphs (a) through (f). The FRA Headquarters Track Specialists and Regional Track Specialists shall have primary responsibility for reviewing each set of railroad CWR procedures. Inspectors may be requested to provide recommendations concerning the comprehensiveness of those procedures.

In addition to safety critical procedures listed in this section, the railroad may decide to include procedures based on administrative or economic considerations. For example, a railroad may choose to include instructions that limit the use of worn secondhand replacement rail because of an economic concern about the length of time that it might take to perform a satisfactory weld. The railroad may also include specific actions in their procedures that are to be taken when installation or maintenance work does not comply with its overall procedures.

Recording an activity that does not conform to the railroad's CWR procedures does not provide the railroad with indefinite relief from responsibility for compliance when its procedures are not followed. Continued non-compliance may lead to an unsafe condition. The recordkeeping procedure is intended to provide a safety net by flagging those activities of non-compliance which, if not brought into compliance in a timely manner, could lead to an unsafe condition. For example, CWR installed in the winter months without adequate rail anchors as prescribed by the written procedures and discovered in late summer would clearly be a deficient condition, whether it was recorded or not. When in doubt as to what activities are considered safety related, the Inspector should consult with the Regional Track Specialist.

Whenever conducting inspections on a railroad and that activity includes observation of CWR, FRA Inspectors are to include only one "CWRP" unit on the header of their RISPC inspection report. Record one CWRP unit, regardless of the amount of CWR mileage inspected. Record the actual track mileage units using the activity codes MTH, MTW, etc. When a defect is taken for any of the §213.119 paragraphs (119 defect codes), FRA Inspectors are to also designate CWRP for the line item "activity" cell. In addition, Inspectors are to use CWRP in each line item activity cell when performing records inspections and recording deficiencies concerning CWR joint records.

When conducting track inspections, FRA Inspectors should have with them the most recent copy of a railroad's CWR plan. This is important, because it will enable Inspectors to perform a proper inspection and determine compliance with the plan. Inspectors can obtain copies of railroad's CWR plans by logging into the FRA Secure website and downloading a copy of the plan on file with FRA. Where Inspectors discover that there are substantial discrepancies between the official plan on file at FRA headquarters and the plan in the field (or that there are substantial discrepancies between the official plan on file with FRA and a railroad field manual), they should notify their Regional Track Specialist.

A track owner may update or modify CWR procedures as necessary, and is required to notify FRA of those changes.

The definition "buckling incident" explains the industry definition for such an event. However, the rule recognizes the importance of conditions that are precursors to buckles.

The two failure modes associated with track constructed with CWR are track buckles and pull-aparts. A track buckle is considered the more serious of the two and is characterized by the formation of a large lateral misalinement caused by:

- High compressive forces in the rail (thermal and mechanical loads);
- Weakened track conditions (weak track resistance, alinement deviations); and
- Vehicle loads (a dynamic "wave" uplift and lateral vs. vertical ratios).

Each track owner with track constructed of CWR shall have in effect and comply with written procedures which address the installation, adjustment, maintenance and inspection of CWR, and a training program for the application of those procedures, which shall be submitted to the Federal Railroad Administration by March 22, 1999. FRA reviews each plan for compliance with the following:

119(a) Procedures for the installation and adjustment of CWR which include

(1) Designation of a desired rail installation temperature range for the geographic area in which the CWR is located; and

(2) De-stressing procedures/methods which address proper attainment of the desired rail installation temperature range when adjusting CWR.

Guidance. Track owners with track constructed of CWR are required to have in effect and comply with a CWR plan. This includes track owners who operate entirely on CWR track that has been designated as excepted track pursuant to §213.4. The requirements under §213.119 do not apply to excepted track. (See §213.5(b)). However, where a railroad designates a segment of track as excepted, it still must meet the requirements of at least Class 1 track for any portion of that track that is: 1) located within 30 feet of an adjacent track which is subjected to simultaneous use at speeds in excess of 10 m.p.h.; or 2) located on a bridge or on a public street or highway and there are trains with placarded cars. (See §213.4(d)).

Railroads typically establish a desired rail installation temperature range for the geographical area that is higher than the annual mean temperature. This higher installation temperature will account for the expected reduction of the force-free temperature caused by track maintenance, train traffic and other factors. A railroad's failure to establish a designated installation temperature range for a specific territory is addressed under §213.119(a).

119(b) Rail anchoring or fastening requirements that will provide sufficient restraint to limit longitudinal rail and crosstie movement to the extent practical, and specifically addressing CWR rail anchoring or fastening patterns on bridges, bridge approaches, and at other locations where possible longitudinal rail and crosstie movement associated with normally expected train-induced forces, is restricted.

119(c) Procedures which specifically address maintaining a desired rail installation temperature range when cutting CWR including rail repairs, in-track welding, and in conjunction with adjustments made in the area of tight track, a track buckle, or a pull-apart. Rail repair practices shall take into consideration existing rail temperature so that;

(1) When rail is removed, the length installed shall be determined by taking into consideration the existing rail temperature and the desired rail installation temperature range; and

(2) Under no circumstances should rail be added when the rail temperature is below that designated by paragraph (a)(1) of this section, without provisions for later adjustment.

119(d) Procedures which address the monitoring of CWR in curved track for inward shifts of alinement toward the center of the curve as a result of disturbed track.

Thermal and mechanical loads are opposed by three parameters: lateral, longitudinal, and torsional resistance of the track. Track buckles almost always occur in the lateral direction. Lateral resistance is the most important and is dependent upon weight and size of crosstie material, ballast material type, shoulder width, crib content and its level of consolidation, and vertical loads.

A crosstie's base, side (crib) friction and ballast shoulder resistance contribute to the overall lateral resistance sustained. In general, each contributes (base 50%, side 20-30%, and shoulder 20-30%) to this resistance but the ratios can vary dependent upon ballast condition. Lateral resistance varies in location depending on the ballast shoulder geometry, crosstie size and type, and state of ballast consolidation.

Thermal loads by themselves can cause a buckle and are often called "static buckling." However, most buckling occurs under a combination of thermal and vehicle loads, termed "dynamic buckling." Inspectors should place emphasis on vehicle (dynamic) effects on track lateral stability, where high rail temperatures and vehicle loading could progressively weaken the track due to dynamic uplift (flexural waves) and a buckle mechanism response induced by misalignment "growth."

Because the majority of buckles occur under dynamic train movements, loading is an important element in the buckling mechanism. Elements of track lateral instability include:

- Formation of initial track misalinement caused by reduced local resistance;
- High impact loads, initial rail surface (weld) imperfections, "soft" spots in ballast, and curve (radial breathing) shifting; and
- Misalinement growth caused by high lateral loads, increased longitudinal forces, track uplifts due to vertical loads, and train-induced vibration.

Inspectors may consider the above elements combined with related evidence of actual defects, geometry conditions, or other defective structural conditions when evaluating the adequacy of a railroad's CWR stability procedures under §213.119(b), (c), and (d). Locations where track buckling are more likely to occur include: horizontal and vertical curves, bottom of grades, bridge approaches, highway-rail grade crossings, recently disturbed track, and areas of heavy train starting or braking.

The signs or precursors of buckles include:

- Newly formed alinement deviations; wavy, kinky, snaky, etc.,
- Rails rotating or lifting out of the tie plates and intermittent loose tie plates;
- Excessive "running" rail causing ties to plow or churn the ballast;
- Insufficient and anchors not tight against the tie;
- Insufficient ballast section in the crib and shoulder areas; and
- Gaps at crosstie ends, especially on the low (inner) rail.

Curves are more prone to buckling because of the curvature effect, alinement imperfection sensitivity, and train loads. It is important for Inspectors to consider when and where a buckle may occur (e.g., on track segments where the CWR was laid below the desired rail installation temperature range and there was inadequate control of the laying temperature or inadequate adjustment of the rail afterwards). Also, Inspectors should observe areas of recent maintenance involving either ballast or rail, where there was inadequate reconsolidating time for disturbed ballast or inadequate temperature adjustment when replacing a defective rail. As curvature increases, the buckling resistance decreases. Under some conditions, high degree curvature can undergo gradual lateral shift (progressive buckling). Lateral alinement deviations reduce the track buckling strength and can initiate growth to critical levels. Vertical alinement deviations can also influence buckling.

Lateral misalinement is an important consideration because it reduces the ability of the track to resist buckling. An alinement offset or mid-ordinate within allowable limits may "grow" under the imposed loads. This is called "track shift." A longitudinal force in curved track will cause CWR rail to move radially. Compressive loads in the rail during the summer tend to move the track outwards and tensile loads in the winter will pull the track inward, a term known as "radial breathing." Inspectors should review the allowable limits, under §213.55, and evaluate the relevant alinement and track strength (§213.13, movement under load) due to repeated thermal and vehicle loadings.

Generally speaking, a decrease in the force-free temperature of 30 to 40 degrees from the installation temperature can be critical and lead directly to buckling. Inspectors should monitor the following factors that may influence shifts in the force-free temperature: improper rail installation, inadequate rail anchors or fastenings, lateral movements in curves through lining operations, "skeletonized" track segments (ballast removed for maintenance purposes), and inadequate ballast section. Lateral and longitudinal restraint is influenced by the factors mentioned above and, if improperly maintained or allowed to exist in a defective state, it increases the opportunity for a track buckle.

Track buckles occur less frequently in tangent than in curves. However, buckling in tangent track will generally occur suddenly and with more severe consequences.

The second of the two failure modes can be associated with track constructed with CWR is a pull-apart. A rail's decrease in temperature in the winter will create tensile forces. The maximum tensile load in the rail is determined by the difference in the installation or force-free temperature and the lowest rail temperatures. Enough tensile force can cause direct fracture at rail cross-sections with prior cracks, weak welds or shear joint bolts at CWR string end locations.

119(e) Procedures which control train speed on CWR track when –

(1) Maintenance work, track rehabilitation, track construction, or any other event occurs which disturbs the roadbed or ballast section and reduces the lateral or longitudinal resistance of the track; and

(2) In formulating the procedures under this paragraph (e), the track owner shall–

(i) Determine the speed required, and the duration and subsequent removal of any speed restriction based on the restoration of the ballast, along with sufficient ballast re-consolidation to stabilize the track to a level that can accommodate expected train-induced forces. Ballast re-consolidation can be achieved through either the passage of train tonnage or mechanical stabilization procedures, or both; and

(ii) Take into consideration the type of crossties used.

119(f) Procedures which prescribe when physical track inspections are to be performed to detect buckling prone conditions in CWR track. At a minimum, these procedures shall address inspecting track to identify –

(1) Locations where tight or kinky rail conditions are likely to occur;

(2) Locations where track work of the nature described in paragraph (e)(1) of this section have recently been performed; and

(3) In formulating the procedures under this paragraph (f), the track owner shall –

(i) Specify the timing of the inspection; and

(ii) Specify the appropriate remedial actions to be taken when buckling prone conditions are found.

119(g) Procedures which prescribe the scheduling and conduct of physical track inspections to detect cracks and other indications of incipient failures in joints in CWR. This paragraph is effective January 3, 2006.

(1) At a minimum, these procedures shall address periodic and special on-foot inspection of joints and of the track adjacent to joints, in order to identify–

(i) Joint bars with visible or otherwise detectable cracks;

(ii) Loose, bent, or missing joint bolts;

(iii) Rail end batter or mismatch that contributes to impact loads and instability of the joint; and

(iv) Evidence of excessive longitudinal rail movement in or near the joint, including, but not limited to, wide rail gap, defective joint bolts, disturbed ballast, surface deviations, gap between tie plates and rail, or displaced rail anchors.

(2) In formulating the procedures under subparagraph (g)(1), the track owner shall–

(i) Implement a system for identifying each joint by its location in track with sufficient precision that personnel can return to the joint and identify it without ambiguity;

(ii) List each joint in an inventory that will enable personnel to identify joints due for periodic inspection;

(iii) Specify the conditions of potential joint failure for which personnel must inspect, including, at a minimum, the items listed in subparagraph (g)(1);

(iv) Specify the appropriate remedial actions, consistent with this part, that should be taken when personnel find conditions of potential joint failure; and

(v) Specify the timing of the inspections, which should be based on the configuration and condition of the joint. At a minimum, track owners must specify that all joints in CWR in track classes 4 and higher must be inspected before October 31, 2006 and within 190 days of the previous inspection hereafter; and all joints in CWR in track Classes 3, and Class 2 track on which passenger trains operate, must be inspected before April 30, 2007 and within 370 days of the previous inspection thereafter.

(3) In lieu of the requirements for the inspection of rail joints contained in subparagraphs (g)(1) and (2), a track owner may seek approval from FRA to use alternate procedures.

(i) The track owner shall submit the alternate procedures and a supporting statement of justification to the Associate Administrator for Safety (Associate Administrator).

(ii) If the Associate Administrator finds that the alternate procedures provide an equivalent or higher level of safety than the requirements in subparagraphs (g)(1) and (g)(2), the Associate Administrator will approve the alternate procedures by notifying the track owner in writing. The Associate Administrator will specify in the written notification the date on which the procedures will become effective, and after that date, the track owner shall comply with the procedures. If the Associate Administrator determines that the alternate procedures do not provide an equivalent level of safety, the Associate Administrator will disapprove the alternate procedures in writing, and the track owner shall continue to comply with the requirements in subparagraphs (g)(1) and (2).

(iii) While a determination is pending with the Associate Administrator on a request submitted pursuant to subparagraph (g)(3), the track owner shall continue to comply with the requirements contained in subparagraphs (g)(1) and (2).

Guidance. To address safety issues related to joints in CWR, FRA issued an Interim Final Rule (IFR) on November 2, 2005, 70 Federal Register 66288, Docket No. FRA 2005–22522. Paragraph (g) now contains the new requirements under this IFR and a final rule is under development. This manual will be revised upon the completion of the Final Rule. Until the Final Rule is published, FRA Inspectors are to refer to the section-by-section analysis contained in the IFR.

119(h) The track owner shall have in effect a comprehensive training program for the application of these written CWR procedures, with provisions for periodic re-training, for those individuals designated under §213.7 of this part as qualified to supervise the installation, adjustment, and maintenance of CWR track and to perform inspections of CWR track.

119(i) The track owner shall prescribe recordkeeping requirements necessary to provide an adequate history of track constructed with CWR. At a minimum, these records must include:

(1) Rail temperature, location and date of CWR installations. This record shall be retained for at least one year;

(2) A record of any CWR installation or maintenance work that does not conform with the written procedures. Such record shall include the location of the rail and be maintained until the CWR is brought into conformance with such procedures;

(3) Information on inspection of rail joints.

(A) After the initial inspection of each joint in accordance with paragraph (g) of this section, the track owner must include in the record:

(i) The location of each joint in CWR with such precision that the joint can be located and identified in the field with no ambiguity;

(ii) The results of the inspection of each joint; and

(iii) Any remedial action required under the track owner's CWR plan.

(B) Track owners shall maintain records required by paragraph (i)(3)(A) in accordance with §213.241.

Guidance. FRA Inspectors should periodically review the information recorded in accordance with §213.119(i)(2) to determine if any work performed on CWR, which does not comply with the railroad procedures, is being properly recorded.

Inspectors must be aware of the procedures in effect before inspecting each railroad. When conducting inspections, the Inspector must make observations to determine if the railroad is following its basic safety procedures. If the railroad fails to follow its procedures and the failure may lead to a serious safety problem, the Inspector should consider citing the railroad for failure to comply with their CWR procedures. A violation memorandum must document the circumstances involved, including whether or not the railroad recorded the conditions as required under §213.119(i)(2). However, the Inspector should exercise judgment in the reporting of circumstances that do not fully comply with the written procedures. Minor deviations from written CWR procedures should not be considered for enforcement action unless, together with other violations, they are part of a larger safety problem.

119(j) As used in this section –

(1) Adjusting/De-stressing means the procedure by which a rail's temperature is re-adjusted to the desired value. It typically consists of cutting the rail and removing rail anchoring devices, which provides for the necessary expansion and contraction, and then re-assembling the track.

(2) Buckling Incident means the formation of a lateral mis-alinement sufficient in magnitude to constitute a deviation from the Class 1 requirements specified in §213.55 of this part. These normally occur when rail temperatures are relatively high and are caused by high longitudinal compressive forces.

(3) Continuous Welded Rail (CWR) means rail that has been welded together into lengths exceeding 400-feet.

(4) Desired Rail Installation Temperature Range means the rail temperature range, within a specific geographical area, at which forces in CWR should not cause a buckling incident in extreme heat, or a pull-apart during extreme cold weather.

(5) Disturbed Track means the disturbance of the roadbed or ballast section, as a result of track maintenance or any other event, which reduces the lateral or longitudinal resistance of the track, or both.

(6) Mechanical Stabilization means a type of procedure used to restore track resistance to disturbed track following certain maintenance operations. This procedure may incorporate

dynamic track stabilizers or ballast consolidators, which are units of work equipment that are used as a substitute for the stabilization action provided by the passage of tonnage trains.

(7) Rail Anchors means those devices which are attached to the rail and bear against the side of the crosstie to control longitudinal rail movement. Certain types of rail fasteners also act as rail anchors and control longitudinal rail movement by exerting a downward clamping force on the upper surface of the rail base.

(8) Rail Temperature means the temperature of the rail, measured with a rail thermometer.

(9) Tight/Kinky Rail means CWR which exhibits minute alinement irregularities which indicate that the rail is in a considerable amount of compression.

(10) Train-Induced Forces means the vertical, longitudinal, and lateral dynamic forces which are generated during train movement and which can contribute to the buckling potential.

(11) Track Lateral Resistance means the resistance provided by the rail/crosstie structure against lateral displacement.

(12) Track Longitudinal Resistance means the resistance provided by the rail anchors/rail fasteners and the ballast section to the rail/crosstie structure against longitudinal displacement.

§213.121 Rail joints

121(a) Each rail joint, insulated joint, and compromise joint shall be of a structurally sound design and dimensions for the rail on which it is applied.

Guidance. For proper rail load transfer to occur, rail joints must contact the head and base of the rails when the bolts are tight. Many rail joint designs have been used with varying degrees of success, and the TSS does not attempt to single out any particular design as the only acceptable joint. This could inhibit innovation in modern track design.

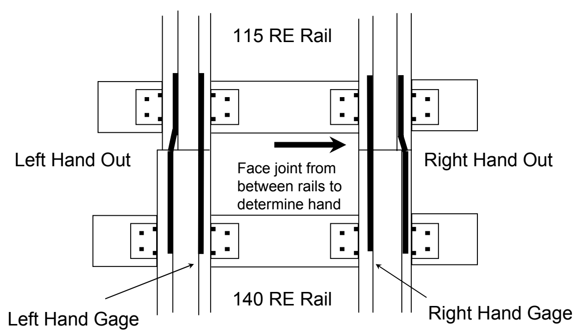


Figure 19

The TSS requires structural soundness and bolt condition based on maximum authorized train speed. Inspectors must be attentive to locations where standard joint bars are used to join dissimilar rail sections where it would be proper to have compromise bars.

The TSS recognize these important aspects of rail joints and begin this section with a requirement that rail joints have a structurally sound design and dimension for the rail on which they are applied.

Rail joints are considered to be a necessary discontinuity and require special attention by railroad maintenance personnel, railroad inspectors, and FRA Inspectors. As far as possible, a rail joint should provide the same relative strength, stiffness, flexibility, and uniformity as the rail itself. Figure 19 illustrates the proper application of compromise joint bars.

As shown in Figure 20, one of the design elements of joint bars to consider is if it's a head-contact or head-free design:

- The head-contact bar supports the rail ends with a box-type construction, carrying the load between the underside of the head and the base of the rail.
- The head-free joint bar does not contact the underside of the rail heads, but instead contacts the rail in the fillet area. The load distribution is referred to as a triangular load distribution.

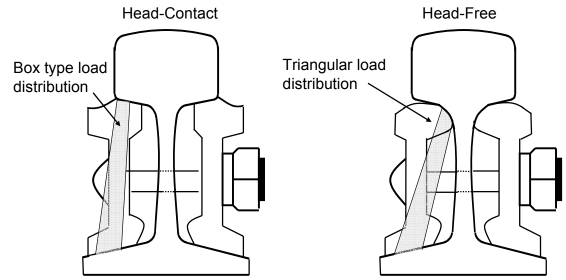


Figure 20

The use of a standard (non-compromise) joint bar of head-contact design on a rail section other than for designed may constitute a deviation. The differences between the head-contact joint bar and the head-free joint bar are significant.

It is evident the joint bar and the rails do not bend or flex exactly with each other along their length. Tests and measurements show that for positive bending, there exists a downward bearing pressure of the under side of the head of the rail on the top surface of the joint bars for some distance along the bar away from the rail ends, (approximately 2 inches). There is also an upward bearing pressure of the upper surface of the base of the rails at parts of the length of the bar further away from the rail end, (bearing distance approximately 3 inches). The converse is true for negative bending.

The head-free joint bar accepts bearing and shear forces from vertical loads in the rail's upper fillet. A head-contact bar is not designed to fit into the filet. Specifically, the head-contact joint bar accepts bearing from vertical loads on the flat underside of the rail's head: generally on a 1 to 4 slope. It is not designed to seat into the rail's upper filet. Although the vertical fishing dimension for the 112 and 115 RE rail sections is identical ($3^{3}/_{16}$ inches), the head filet radius is different:

- For the 115-pound section, radius equals ¾ inch
- For the 112-pound section, radius equals ⅜ inch

As shown in Figure 21, the 112 head-free bar fits the 115 rail filet practically at a point, most probably inducing joint bar stresses in excess of design which is a deviation from §213.121(a). The 115 head-free bar does not fit into the 112 rail fillet but bears in a very small area beneath the head of the rail, possibly inducing joint bar stresses in excess of design and exerting a wedge action between the rail head and rail web, promoting head and web separation. In addition, the joint bar may experience a twist, or torsional force from the tightening of the track bolts when used as a compromise between 115 and 112 rail. The torsional stress from twist will be the greatest at the head and toe of the bar at the rail ends.

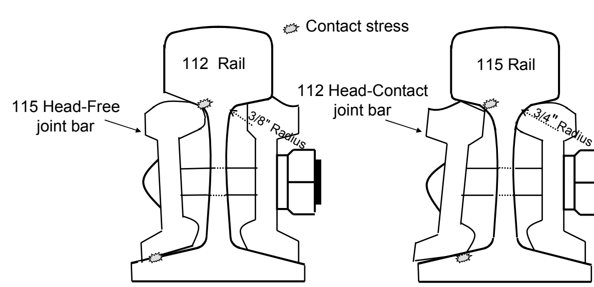


Figure 21

There are exceptions to the use of a joint bar of head-contact design on a rail section other than for designed. For example, a 131 pound or 132 pound head-contact joint bar may be used in lieu of a 131/132 or 131/136 compromise joint bar if rail drilling and joint bar punching is the same. The width of the rail head in these configurations is sufficient to allow full contact in the upper fishing wear surface. In summary:

- 112 pound RE joint bars should not be used as compromise joint bars between 112 RE and 115 RE rail.
- 115 pound RE joint bars should not be used as compromise joint bars between 112 RE and 115 RE rail.
- 131 RE head-contact bars or 132 RE head-contact bars may be used as compromise joint bars between 131 RE and 132 RE rail or 136 RE rail where rail drilling and joint bar punching are the same. (Note: FRA Standards do not prohibit the track owner from field drilling bolt holes to fit).

While the above addresses compromise joint bars, it is stressed that 112 RE bars are not to be used on 115 RE and 119 RE rail and vice versa. Joint bars with 131 RE head-free and 132 RE head-free design, or 131 RE head-free and 136 RE head-free joint bars, are not interchangeable and are not to be intermixed.

For a compendium of rail section dimensions in order to compare other rail sections for compatibility between joint bars on various rail sections refer to Appendix C of this manual.

121(b) If a joint bar on Classes 3 through 5 track is cracked, broken, or because of wear allows excessive vertical movement of either rail when all bolts are tight, it shall be replaced.

Guidance. Joint bars are designed to fit into the space between the bottom of the rail head and rail base (fishing). With the bolts tight, the joint bars are wedged into the fishing space to provide lateral and vertical beam strength thereby supporting the abutting rail ends. When held up against the rail with bolts, joint bars contact the rail at two points; bottom of the rail head (or fillet) and top of the rail base. These contact points, known as the “fishing surfaces,” can experience metal loss due to abrasion and mechanical wear that occurs during the cyclical train dynamic loading. After long-term service, the fishing surfaces of the rails and bars can wear to the point that joint bars are no longer wedged into the rail, even with tight bolts. In such cases, the joint assembly will no longer optimally support the abutting rail ends.

Joints with minimally worn fishing surfaces can provide for the safe passage of wheels in Classes 1 through 5. As a guide, excessive vertical movement would exist when there is significant fishing surface wear and wheel loads cause the abutting rail ends to exhibit tread mismatch approaching the thresholds under §213.115. If excessive vertical movement occurs, or there are any cracks, corrective action would be to replace the bars or take other proper corrective action.

Proper corrective action for a joint bar cracked or broken, other than center break, in Classes 3 through 5 track, would be replacement or a reduction to Class 2. If both joint bars are cracked or broken between the 1st and 2nd bolt hole (including through the 2nd bolt hole), it should be considered Class 1. This is because there is only one bolt in a rail end that is within the remaining section of the joint bar that is providing support.

121(c) If a joint bar is cracked or broken between the middle two bolt holes it shall be replaced.

Guidance. For a center cracked or broken bar, the appropriate corrective action would be replacement or reduction to Class 1 speeds under the provisions of §213.9(b).

121(d) In the case of conventional jointed track, each rail shall be bolted with at least two bolts at each joint in Classes 2 through 5 track, and with at least one bolt in Class 1 track.

Guidance. Track owners must have the number of required bolts in each rail in a joint. This paragraph does not prescribe a tightness (torque) standard for each bolt. A bolt that no longer can support the joint bar against the rail will continue to provide resistance to pull aparts when the rail is in tension. The ability of the bolts to hold bars against the rail to support the abutting rail ends is covered under §213.121(f).

A bolt does not fulfill the requirements of this paragraph if it is in imminent danger of complete failure (it no longer is holding the bar to the rail and no longer resists pull apart forces). For example, the nut is missing (it will likely fall out under subsequent train movements) or the bolt shaft is fractured.

121(e) In the case of continuous welded rail track, each rail shall be bolted with at least two bolts at each joint.

Guidance. Rail in lengths more than 400-feet is considered CWR for purposes of applying the requirements of this paragraph. If there is only one bolt in a rail end at a joint, in a CWR string (400-feet or longer), that one bolt will be subject to all the tensile axial forces and will easily shear (break) resulting in a pull-apart.

121(f) Each joint bar shall be held in position by track bolts tightened to allow the joint bar to firmly support the abutting rail ends and to allow longitudinal movement of the rail in the joint to accommodate expansion and contraction due to temperature variations. When no-slip, joint-to-rail contact exists by design, the requirements of this paragraph do not apply. Those locations when over 400-feet in length, are considered to be continuous welded rail track and shall meet all the requirements for continuous welded rail track prescribed in this part.

Guidance. If the joint bars are loose, the joint is not in compliance with §213.121(f). In addition, a joint assembly is not in compliance when inadequately tightened bolts prevent it from supporting the abutting rail ends under the expected traffic loads.

Joint bolts can deteriorate sufficiently as to create a condition where the bars may become completely detached from the rail or cause a total lack of support, which can contribute to a broken rail. Such a condition can create a mismatch which exceeds the limits specified in §213.115 (Rail end mismatch). In such a case, the defect would be rail end mismatch (class specific) and Inspectors should also include a notation about the loose joint bars.

This paragraph also recognizes the design characteristic that enables the rail ends in a joint to move longitudinally to handle temperature changes (expansion/contraction) or rail creep (traffic flow). This type of joint bar assembly is standard for jointed rail because that type of track construction has lower axial forces than CWR. In CWR, it is desirable to contain the rail expansion and contraction in the remaining joints (i.e., insulated joints) in order to eliminate the pull-apart action that occurs in regular joints. In CWR, the track structure, by design, dissipates the axial forces. Accordingly, this paragraph allows joint designs that stop the axial rail movement within the assembly.

Except for the axial movement component of this paragraph, joint bars such as glued insulated joints are subject to all of the remaining requirements of this paragraph and all other paragraphs of §213.121. These types of assemblies are considered to be joints, even in CWR (see §213.119). However, for the definition as to what constitutes CWR, a glued joint is not a longitudinal discontinuity in a rail string. Glued joints are also considered joints under §213.109 with respect to the required positioning of non-defective ties at joints.

121(g) No rail shall have a bolt hole which is torch cut or burned in Classes 2 through 5 track.

Guidance. This paragraph prohibits the use of a rail containing a bolt hole that has been torch cut or burned in Classes 2 through 5 track.

121(h) No joint bar shall be reconfigured by torch cutting in Classes 3 through 5 track.

Guidance. This paragraph prohibits the reconfiguration of joint bars by torch cutting in Classes 3 through 5 track. By omission of the reference to Classes 1 and 2 track, this practice of reconfiguration is allowed in those classes. However, the joint bars that are reconfigured by torch cutting must meet certain criteria for structural soundness of design and dimension, which is required under (a) of this section.

§213.122 Torch cut rail

122(a) Except as a temporary repair in emergency situations no rail having a torch cut end shall be used in Classes 3 through 5 track. When a rail end is torch cut in emergency situations, train speed over that rail end shall not exceed the maximum allowable for Class 2 track. For existing torch cut rail ends in Classes 3 through 5 track the following shall apply –

(1) Within one year of September 21, 1998, all torch cut rail ends in Class 5 track shall be removed;

(2) Within two years of September 21, 1998, all torch cut rail ends in Class 4 track shall be removed; and

(3) Within one year of September 21, 1998, all torch cut rail ends in Class 3 track over which regularly scheduled passenger trains operate, shall be inventoried by the track owner.

Guidance. The regulation prohibits the torch cutting of rail ends in Classes 3 through 5 track except as a temporary repair in emergency situations. In such emergency situations, train speed shall not exceed the maximum allowable for Class 2 track.

Existing torch cuts must be removed from track in the following time frames:

- Class 5 track - by September 21, 1999.
- Class 4 track - by September 21, 2000.
- Class 3 track with passenger trains - by September 21, 1999, all torch cuts shall be inventoried by the track owner.

122(b) Following the expiration of the time limits specified in (a)(1), (2), and (3) of this section, any torch cut rail end not removed from Classes 4 and 5 track, or any torch cut rail end not inventoried in Class 3 track over which regularly scheduled passenger trains operate, shall be removed within 30 days of discovery. Train speed over that rail end shall not exceed the maximum allowable for Class 2 track until removed.

Guidance. Those torch cuts inventoried will be "grandfathered in" and any torch cuts found after the expiration of one year that are not inventoried must be slow ordered to Class 2 speed and removed within 30 days of discovery. If a railroad chooses to upgrade a segment of track to Class 3, and passenger trains are operated, all torch cuts must be removed before speeds can exceed the maximum for Class 2 track. If a railroad chooses to upgrade a segment of track from any lower class to Class 4 or 5, it must remove all torch cuts.

§213.123 Tie plates

123(a) In Classes 3 through 5 track, where timber crossties are in use, there must be tie plates under the running rails on at least 8 of any 10 consecutive ties.

123(b) In Classes 3 through 5 track no metal object which causes a concentrated load by solely supporting a rail shall be allowed between the base of the rail and the bearing surface of the tie plate. This paragraph (b) is applicable September 21, 1999.

Guidance. Inspectors should consider this section jointly with the requirements for crossties and rail fastenings and report tie plate conditions as defects where safety is impaired by the absence of tie plates.

In Classes 3 through 5 track no metal object that causes a concentrated load by solely supporting a rail shall be allowed between the base of rail and the bearing surface of the tie plate. The specific reference to “metal object” is intended to include only those items of track material that pose the greatest potential for broken base rails such as track spikes, rail anchors, and shoulders of tie plates. The phrase “causes a concentrated load by solely supporting a rail” further clarifies the intent of the regulation to apply only in those instances where there is clear physical evidence that the metal object is placing substantial load on the rail base, as indicated by a lack of loading on adjacent ties.

§213.127 Rail fastening systems

Track shall be fastened by a system of components which effectively maintains gage within the limits prescribed in §213.53(b). Each component of each such system shall be evaluated to determine whether gage is effectively being maintained.

Guidance. “Rail fastening systems” include modern day elastic fastening systems, which can consist of abrasion pads, insulator clips, shoulder inserts cast into concrete ties, as well as the fastener itself, of which many different designs are in use today. The fastening system can also be of the traditional cut spike variety, with or without tie plates. The failure of certain critical components within a particular system could adversely affect the ability of the individual fastener to provide adequate gage restraint. The wording of this regulation provides for an evaluation of all components within the system, if necessary, when degradation of the fastening system has resulted in problems maintaining gage within the limits prescribed in §213.53(b).

When an Inspector identifies a gage geometry condition where the fastener system has degraded and the location in question meets the factors described below, the Inspector must examine each component of the fastener system (e.g., clip, insulating pad, bolts, spiking pattern, etc.). The Inspector should describe the nature of the failed component(s) on the F 6180.96 form. If a fastener condition causes the gage to exceed the limits of §213.53, the Inspector shall report the condition as a gage defect and describe the nature of the fastener condition on the same defect line of the report.

This section requires the Inspector to exercise judgment in evaluating the condition of fasteners. The following factors should be considered in the evaluation:

- Gage exceeding the limits of §213.53 (in such cases gage and track class will govern);
- Gage close to the limits of §213.53 with evidence of recent widening;
- Evidence of recent rapid deterioration of gage with probable continued deterioration;
- Evidence of recent significant damage to rail fasteners to the extent that gage widening is probable;
- Evidence of recent maintenance work improperly performed resulting in lack of sufficient fasteners to prevent gage widening under expected traffic;
- Traffic conditions, including speed, tonnage, and type of equipment; and
- Conditions of curvature and grades.

FRA Inspectors may use a Portable Track Loading Fixture (PTLF) described in §213.110 for the purposes of measuring the effectiveness of fasteners. Refer to Appendix E - PTLF instructions for non-GRMS territory under §213.53.

A unique attribute of concrete crossties is the abrasion that can occur between the base of the rail and the rail-seat on the crosstie, a component of the rail fastening system. A variety of tie pad designs and materials are placed between the rail and the ties to mitigate abrasion. However, unequal or "wedged" abrasion of the rail seat can be problematic for a high-speed or high tonnage operating environment that may cause rail fasteners to become loose under load or in extreme cases cause rail-tilt or roll-out. See Figure 22. Accordingly, Inspectors should look for rail roll-out due to rail seat abrasion on concrete crossties, particularly in territory with heavy traffic levels and moderate curvature. The mechanics of this condition on concrete crossties include the following elements:

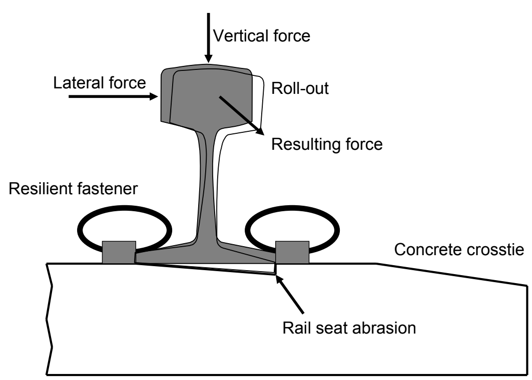


Figure 22

- Concrete wear or abrasion resulting in loose rail clips, insulators, and pads;
- Loose components allow more moisture and abrasives to enter rail seat; and
- Once the field side of the rail base wears through the tie pad and contacts the concrete tie rail seat, rapid cutting into the concrete (accelerated abrasion) can occur.

Signs and symptoms of concrete crosstie rail seat abrasion include;

- Tie pad crushed or squeezed-out (maintaining integrity of the tie pad is essential);
- Insulators crushed, moving or missing;
- Clips loose indicating loss of pressure on the rail base (loss of toe load);
- Longitudinal rail movement;
- Indications of cement colored paste in the ballast from the abraded rail seat; and

- Metal flaking or grease streaks in the center of the low rail in a curve caused by the outer rim of wheel (or false flange) placing excessive pressure on the head of the rail, a condition generally created by gage-widening.

Based on the above discussion, it is apparent that rail-seat abrasion on concrete ties causes rail roll-out. As rail roll-out occurs, it decreases the effectiveness of the rail fasteners and will often lead to gage geometry conditions. As a general rule, FRA Inspectors should cite this condition as a rail fastener defect (defect code 213.127.02). However, where rail roll-out causes the gage to exceed the threshold for the designated class of track, FRA Inspectors should cite this condition as a gage defect (see §213.53).

Rail anchors are not considered to be rail fastenings. Resilient rail fastenings that perform a dual function to restrain rail laterally and longitudinally, should only be evaluated on their ability to provide lateral restraint to prevent gage-widening in regard to this section.

An insufficient fastener defect should be written when an unsafe condition results from missing or defective fasteners (e.g., heads of cut spikes sheared off at throat) on otherwise supportive crossties.

§213.133 Turnouts and track crossing generally

133(a) In turnouts and track crossings, the fastenings must be intact and maintained so as to keep the components securely in place. Also, each switch, frog, and guard rail must be kept free of obstructions that may interfere with the passage of wheels.

Guidance. There are several types of fastenings, which include reinforcing straps, connecting rods, rail hold down clips, and braces. (For a more extensive compilation of fastenings, see the fasteners listed in defect codes 213.133.01 through 213.133.14). Where fastenings are loose or missing, FRA Inspectors should cite the railroad using defect code 213.133.20 (Turnout or track crossing fastenings not intact or maintained.) In addition, where fasteners are loose or missing and there is an apparent contributing condition (e.g., a large section of the casting is broken out at an at-grade rail to rail crossing), FRA Inspectors should be sure to include a description of that contributing condition in their inspection report.

133(b) Classes 3 through 5 track shall be equipped with rail anchoring through and on each side of track crossings and turnouts, to restrain rail movement affecting the position of switch points and frogs. For Class 3 track, this paragraph (b) is effective September 21, 1999.

133(c) Each flangeway at turnouts and track crossings must be at least 1½ inches wide.

Guidance. A turnout is a track arrangement consisting of a switch and frog extending from the point of the switch to the heel of the frog. This arrangement, allows engines and cars to pass from one track to another. Because of the operating or movable parts and lateral thrust, it is essential that fastenings be in place, tight, and in sound condition.

A track crossing (diamond) is a assembly used where two tracks intersect at grade permitting traffic on either track to cross the rails of the other. It may consist of four frogs connected by short rails, or a plant manufactured “diamond.” Because of the impact a crossing is subjected to, it is essential that fastenings be in place, tight, and in sound condition. Each switch, frog, and guard rail must be kept free of obstruction.

Anchors on each side of a turnout or crossing and through a turnout are required on Classes 4 through 5 track. For Class 3 track, this requirement is effective on September 21, 1999. In determining the adequacy of anchors at and on each side of a turnout or crossing and through turnouts, Inspectors should determine the capability of these devices to:

- Restrain rail;
- Assure proper fit of switch points; and
- Prevent line irregularities.

Ties and timbers at switches and crossings must be of sound condition, well-tamped, and the roadbed must be adequately drained.

Flangeways at turnouts and track crossings must be at least 1½ inches wide.

Turnouts and track crossings must be walked and measurements made before they can be included on the F 6180.96 form as a unit inspected.

§213.135 Switches

135(a) Each stock rail must be securely seated in switch plates, but care shall be used to avoid canting the rail by overtightening the rail braces.

Guidance. The TSS under §213.135 specifies the requirements for switch restraint, movement, and fit. Each stock rail must be securely seated in the switch plates. Various conditions, such as loose braces or hanging ties, can cause a stock rail to become unseated. In these situations, FRA Inspectors should cite the railroad with defect code 213.135.01. Alternatively, a stock rail can become unseated if the braces are overtightened during maintenance. In these situations, FRA Inspectors should cite the railroad with defect code 213.135.02.

135(b) Each switch point shall fit its stock rail properly, with the switch stand in either of its closed positions to allow wheels to pass the switch point. Lateral and vertical movement of a stock rail in the switch plates or of a switch plate in a tie shall not adversely affect the fit of the switch point to the stock rail. Broken or cracked switch point rails will be subject to the requirements of §213.113, except that where remedial actions C, D, or E require the use of joint bars, and joint bars cannot be placed due to the physical configuration of the switch, remedial action B will govern, taking into account any added safety provided by the presence of reinforcing bars on the switch points.

Guidance. This paragraph recognizes the existence of reinforcing bars or straps on switch points where joint bars cannot be applied to certain rail defects, as required under §213.113(a)(2), because of the physical configuration of the switch. In these instances, remedial action B will govern, and a person designated under §213.7(a), who has at least one year of supervisory experience in track maintenance, will limit train speed to that not exceeding 30 m.p.h. or the maximum allowable under §213.9(a) for the appropriate class of track, whichever is lower. Of course, the person may exercise the options under §213.5(a) when appropriate.

Sec. 213.135(b) addresses cracks in the switch rail (point) with reinforcing straps acting as surrogate joint bars. If the switch point rail is not cracked and only the straps are cracked, then it is not appropriate to cite §213.135(b), and FRA Inspectors should use the appropriate cite defects under §213.133(a) (Turnouts and track crossing generally). Normally minor cracks in a strap are not a major concern. However, if a strap is fully broken and causing other problems (e.g., loose switch clip, etc.), then §213.133 would be appropriate. If the straps and switch point rail are both broken, then there is an unprotected rail break and FRA Inspectors should cite the appropriate defect under §213.113.

Most industry standards call for a 4¾ inches opening between the switch point and the stock rail, measured at the No. 1 switch rod. As components wear, “lost motion” will result. When the problem of elongated switch clip and/or rod holes is encountered, the switch rods may be adjusted at the clip (e.g., adjustable side jaw clips, rocker clips, etc.). Adjustment may also be accomplished at the switch stand depending on the design of the assembly. In some cases, lost motion may be compensated by the addition of properly designed shims between the switch clip assembly and the switch rail.

When the opening is substantially less than the standard dimension, wheels can still pass through the switch as intended. However, the backs of wheels may contact the inside rail head of the open switch rail. This interaction can cause undesirable lateral pressure against the switch rail. This pressure can contribute to broken heel block bolts, cause cracked or broken switch clips, and broken switch crank cross pins. In extreme circumstances, the closed point can open under movement because of the transfer of lateral loads through the switch rods. In these circumstances, Inspectors should make an extra effort to determine the condition of all affected components. The amount of throw is one of the many factors that must be taken into consideration when determining the railroad's compliance with §§213.133 and 213.135.

Based on the above, make sure that switch points fit snugly against the rail when the switch is thrown in either position. As appropriate, request that the railroad representative operate the switch to test for lost motion and/or loose connections.

The Appendix to the American Railway Engineering and Maintenance of Way Association Portfolio of Trackwork Plans contains the following split switch terms:

> "Split Switch with Uniform Risers - A split switch in which the switch rails have a uniform elevation on riser plates for the entire length of the switch, and therefore not having a heel slope, the point rail rise being run off back of the switch in the closure rails."
>
> "Split Switch with Graduated Risers - A split switch in which the switch rails are gradually elevated by means of graduated riser plates until they reach the required height above the stock rail, and therefore having a heel slope."

The heel of the switch point is higher than the stock rail at the heel joint with the uniform riser layout while, on the graduated layout, the switch point is at the same elevation as the stock rail. The mixing of uniform riser and graduated riser plates in the same switch, while not specifically addressed in the TSS, can cause undesired stress in the switch rails and closure rails. Inspectors should make a note of the intermixing of switch plates in turnouts that have a high amount of traffic.

135(c) Each switch shall be maintained so that the outer edge of the wheel tread cannot contact the gage side of the stock rail.

Guidance. Inspectors are to examine the seating of stock rails in the switch plates to ensure that the outer tread of a wheel cannot engage the gage side of these rails. Grease lines or slight groves running at a slight angle on the tread of a stock rail can provide Inspectors with clues about the wheel/rail interface. These marks can be found in the area where wheel treads transition from the switch rail to the stock rail. When found, Inspectors should closely examine the gage side of the stock rail to make sure the outer

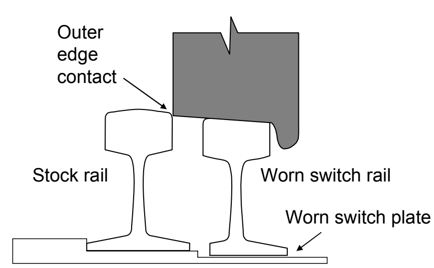


Figure 23

edge of wheel treads are not contacting the gage side of the stock rail. As shown in Figure 23, this type of defect can occur when a new stock rail is replaced with a worn switch rail and switch plates remaining in place. This causes the switch rail to drop down from the same level as its corresponding stock rail. The danger associated with this condition is the possibility that the outer edge of a wheel can contact the gage side of the stock rail during a trailing movement through a switch, thereby turning over the stock rail.

Other items that can cause a stock rail to be higher than a switch point include improper surfacing, crosstie conditions/defects, and loose rail braces.

135(d) The heel of each switch rail shall be secure and the bolts in each heel shall be kept tight.

Guidance. At least two tight bolts in each rail are required to ensure that the heel of each switch rail is "secure" for purposes of determining compliance with §213.135(d). Examine the heel block, its fastenings, and bars; or, in the absence of a heel block, (which is known as a floating heel block) examine that assembly.

If heel joints were considered to be a normal joint, only one bolt per rail end would be required in the heel for Class 1 track. However, the heel joint functions in a different manner than a normal track joint. The heel joint serves as the pivotal point for the rotation of the switch point. It helps maintain the proper horizontal, vertical, and longitudinal fit of the switch point against its stock rail. One bolt per rail end in Class 1 track at the heel joint does not provide redundancy. The loss of the single bolt in the rail end at the heel joint could have serious safety consequences.

Some railroad heel joints have as many as six bolts for the higher track classes. Typically, when railroads plan to field weld, they do not drill the middle two bolt holes in the rail of a six hole joint bar. This practice, which provides for at least two bolts in each rail end of the heel, satisfactorily secures the assembly.

The switch heel assembly with joint bars also performs the function of a joint. As such, where there is an improper joint bar at a heel block, an FRA Inspector should cite §213.121 (Rail joints). One example of an improper joint bar is the installation of a six hole joint bar where a five hole bar by design should be used. This would be a deviation of §213.121, because it is an improperly designed bar for that application, which may make it difficult to throw the switch or may cause gapping.

135(e) Each switch stand and connecting rod shall be securely fastened and operable without excessive lost motion.

Guidance. For hand-operated switch stands of virtually all types, rotary motion imparted to the vertical spindle within the stand by the person operating the hand lever is translated into (practically) linear movement of the connecting rod by the right angle combination of the end of the spindle beneath the stand and its attached crank. Unless cranks are integrated with the spindle by casting during manufacture, they are separate pieces that must be joined. Cranks are attached to spindles in one of two ways: (1) they may be turned into a threaded opening in the side of the spindle or (2) the crank may be fabricated to have a square or rectangular, smooth opening at one end which can be moved from below up onto a spindle having a similar cross-section to a position where it can be secured in place by a horizontally inserted cross pin that simultaneously engages the crank with the spindle. For ease of reference in this discussion, the first case will be referred to as Type A and the second case as Type B. An undesired decoupling of the connecting rod and the switch stand can occur in Type A if the bolt attaching a connecting rod to a threaded crank comes out and, in Type B, separation of the crank and the spindle can occur in the absence of the cross pin. Either instance could result in the gapping of the closed switch point under train movement, unless some other device is in place to physically restrain the points.

Type B switch stands may at times have a plate like arrangement of sheet metal suspended from the headblock timbers beneath the assembly. This device, generally a shallow "U" shape, is commonly referred to as a "safety plate." The function of the plate is twofold: (1) to restrict the downward movement of the crank on the spindle, should the cross pin be absent, so the crank does not completely separate from the spindle, and (2) to keep a vertically unrestrained crank from sliding down the spindle far enough to permit the connecting rod enough space below the bottom of the switch stand to move up off the lug of the crank. There have been cases where cross pins have fractured. The plate itself is deformed so that the downward displacement of the crank was sufficient to enable the connecting rod to clear the crank lug without contacting the base of the stand. This leads to decoupling of the switch stand and the connecting rod.

Track Inspectors must constantly bear in mind those aspects of switch stand performance that are crucial to functional safety. This discussion concentrates on that region of the mechanical linkage between the switch points and the switch stand that may be difficult to observe in the course of a turnout inspection.

There are several different styles of Type B switch stands that are in use on main tracks and yards in the railroad industry. These models differ in minor ways. Nevertheless, they rely on the cross pin restraint of the spindle/crank subassembly and they all share vulnerability to the uncoupling of the switch stand and connecting rod. A turnout inspection must include examination of these hard to see parts even.

135(f) Each throw lever shall be maintained so that it cannot be operated with the lock or keeper in place.

Guidance. Inspectors must examine each switch lock and keeper. Certain types of switch stands "internally toggle" when the handle is thrown all the way in either position to hold the switch point against its stock rail. These types of switch stands are used in other than main track and often are a "semi-automatic" design whereby a train trailing the turnout, with the switch in the incorrect position, will initially force the points over. The final throw is completed by the internal toggling action of the switch stand. By design and application preference, these switch stands might not have a lock or keeper for other than main track applications (see Figure 24).

There is a concern associated with this type of switch stand retrofitted with an "S" shaped strap, bolted and welded to one of the two flanges of the throw lever stop. The bolt has been proven to be ineffective in preventing rotation of the strap, and the bead weld, placed by the manufacturer at the top of the strap, cracks from repeated depression of the keeper. The strap rotates downward, altering the location of the lock shackle or keeper, allowing the throw of the switch lever without removal of the lock or keeper.

Figure 24

If the above types of switch stands are used at switches and derails not requiring securing, the soundness of the strap is not in question. However, if the track owner requires that the stand be secured by lock or keeper, a weld displaying cracks will call into question the soundness of the latch mechanism and defect code

213.135.09, throw lever (potentially) operable with switch-lock or keeper in place, should be cited without recommending a violation. If the track owner fails to aggressively address and correct the potential defect on the subject types of switch stands, consider recommending a violation to Chief Counsel.

135(g) Each switch position indicator shall be clearly visible at all times.

Guidance. Examine condition of switch position indicator and note any unnecessary obstruction to its visibility. This requirement does not mandate that every switch have a position indicator but merely requires such devices to be clearly visible when installed on a switch stand.

135(h) Unusually chipped or worn switch points shall be repaired or replaced. Metal flow shall be removed to insure proper closure.

Guidance. The rule does not provide for specific dimensions for determining when switch points are "unusually chipped or worn." The Accident/Incident database indicates that worn or broken switch points are the largest single cause of derailments within the general category of "Frogs, Switches, and Appliances." However, most of these derailments are related also to other causal factors such as wheel flange condition, truck stiffness, and train handling characteristics. Therefore, qualified individuals must use their experience to determine when switch points are "unusually chipped or worn."

135(i) Tongue & Plain Mate switches, which by design exceed Class 1 and excepted track maximum gage limits, are permitted in Class 1 and excepted track.

Guidance. This paragraph provides an exemption for this item of specialized track work, primarily used in pavement or street railroads, which by design does not conform to the maximum gage limits prescribed for Class 1 and excepted track. This type of special work is fabricated from "girder rail" which includes a tram (flangeway) rolled into the rail section. A "mate" is similar to a frog but located on the side of the switch that is equivalent to a straight stock rail. The switch, when in the open or curved position, guides wheels past the mate on the turnout (curved) side in a manner similar to a frog guard rail.

Guidance, General. In addition to considering the above criteria, Inspectors must perform the following when inspecting switches:

- Check alinement, gage, and surface;
- Examine condition as to wear of switch points and stock rails.
- See that all bolts, nuts, cotter pins, and other fastenings are in place, in good condition, and are properly tightened;
- See that switch points fit snugly against the rail when the switch is thrown in either position. Request that the railroad representative operate switches to test for lost motion and/or loose connections;
- If applicable, examine the rod and fastenings that connect the switch point to the switch circuit controller to ensure they are in place and in good condition;
- Examine the condition and support of spring and power switch machines and hand-thrown switch stands, including automatic or safety switch stands. Switch stand and machine fastenings to the head block ties must be tight to avoid any movement or play;
- Examine switch-lock, and keeper;

- Examine condition of switch position indicator and note any unnecessary obstruction to its visibility;
- Examine the heel block, its fastenings, and bars; or, in the absence of a heel block, examine the floating heel of the switch point;
- Examine the seating of stock rails in the switch plates to ensure that the outer tread of a wheel cannot engage the gage side of these rails and that chairs or braces do not cant these rails in. This defect is particularly a problem for travel in the direction from the frog to the switch (trailing movement). Grease lines or slight groves running at a slight angle on the tread of a stock rail can provide Inspectors with clues about the wheel/rail interface. These marks can be found in the area where the wheel tread transitions from the switch rail to the stock rail. When found, Inspectors should closely examine the gage side of the stock rail to make sure the outer edge of wheel treads are not contacting the gage side of the stock rail; and
- Examine the gage plates and switch rods.

§213.137 Frogs

137(a) The flangeway depth measured from a plane across the wheel-bearing area of a frog on Class 1 track may not be less than 1⅜ inches, or less than 1½ inches on Classes 2 through 5 track.

Guidance. The Association of American Railroads (AAR) Field Manual of Interchange Rules states that a wheel is condemnable when the flange height is "1½ inches or more above the approximate center line of the tread." The American Railway Engineering and Maintenance-of-way Association (AREMA) Portfolio of Trackwork Plans, Point and Flangeway Dimensions, provides a designed flangeway depth of at least 1¾ inches. Therefore, the amount of clearance between a worn wheel with a high flange and the bottom of a new frog's flangeway may be as little as ⅜ inch. At higher speeds, if a worn frog has a flangeway less than 1½ inches, the wheel flange could "bottom out" in the flangeway and result in severe damage to the frog.

Section 213.137(a) permits a flangeway depth of 1⅜ inches in Class 1 track. In such a condition, a wheel that is approaching condemning limits might contact the bottom of the flangeway. As such, it is possible to have evidence of wheel flangeway contact on the bottom of the flangeway caused by non-compliant wheels.

137(b) If a frog point is chipped, broken, or worn more than ⅝ inch down and six inches back, operating speed over that frog may not be more than 10 m.p.h.

Guidance. If a frog point is chipped, broken, or worn more than ⅝ inch down and 6 inches back, a collapse of the point area is possible after repeated wheel impacts. This parameter requires a defect to be more than ⅝ inch down from the original profile to a location 6 inches back toward the heel to be considered. For example, a frog point that is ⅞ inch below its original profile at the actual frog point and ⅞ inch below at a position 6 inches back toward the heel of the frog would be a defect.

Figure 25

For a severe condition that would not meet this criteria such as a breakout at a frog point that is only 4 inches in length and greater than ⅝ inch down, Inspectors may consider using the defect code 213.137.99. While this condition may not be a defect, it is a method to notify a railroad of a condition that the Inspector feels the structural integrity of the frog is in question. Please note that 213.137.99 does not link to a paragraph in the TSS and may only be used as an advisory to the railroad.

Another possible result of a severely worn frog point, especially when coupled with a worn or loose guard rail, is that a railroad wheel may "hit" the point and climb to the wrong side of the frog. Also see Figure 26 for information about "depressed point" designs that may influence the measurement of a worn or broken frog point.

137(c) If the tread portion of a frog casting is worn down more than ⅜ inch below the original contour, operating speed over that frog may not be more than 10 m.p.h.

Guidance. This paragraph specifically refers to the amount of tread wear from the original contour of the casting. The original contour can be determined in a variety of ways depending upon the frog design.

The tread of the frog is considered to be any portion that is contacted by the tread of the wheel except for portion of the frog from the actual point to a position 6 inches back towards the heel [this area is addressed by §213.137(b)]. As shown in Figure 26, the measurements of the portion of the tread further back than the 6 inch position may be taken by placing a straightedge positioned longitudinal or transverse.

Figure 26 shows a rail bound manganese frog design with an actual frog point that is $^{3}/_{16}$ inch lower than the tread portion. A frog built without manganese (e.g., a frog composed of Tee rails called a bolted rigid frog) will have a point with a similar profile. Called a depressed point, the tread will taper up to the top of the rail profile in the direction toward the frog heel in a distance equal to one-half the frog number in inches, but not less than 5 inches.

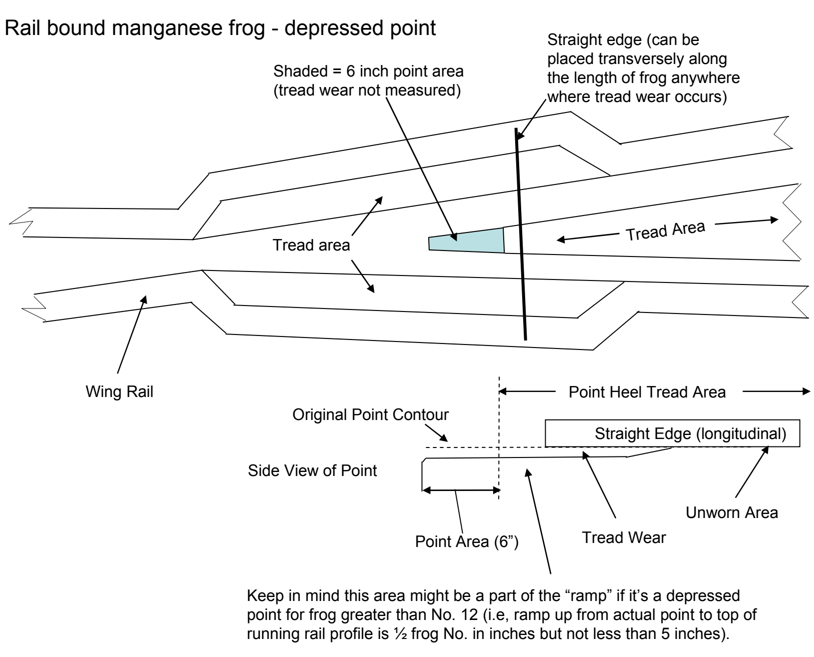


Figure 26

An alternate rail bound manganese or solid cast frog design includes a profile whereby the tread portion of the casting adjacent to a frog point is manufactured to a plane ⅛ inch above the top of the rail profile (wing wheel riser). See Figure 27. These design characteristics need to be considered when measuring tread wear as discussed below.

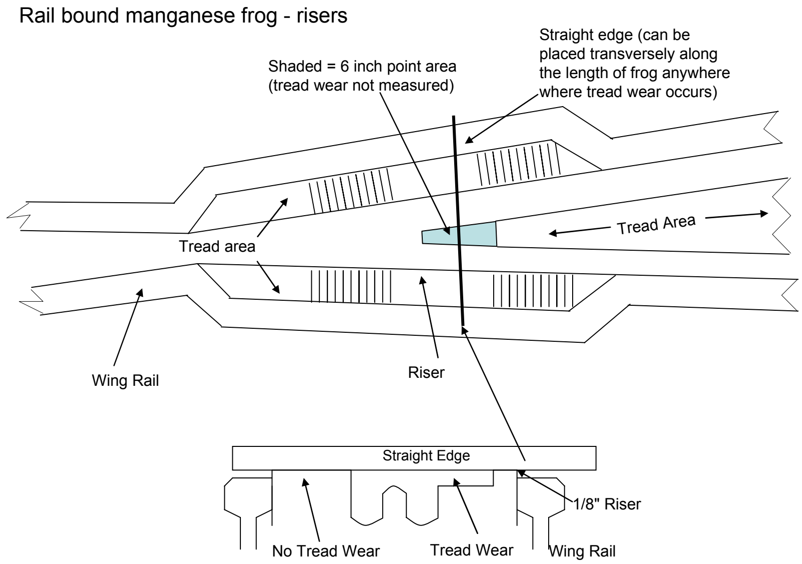


Figure 27

When measuring tread wear, the distance from the bottom of the straight edge to the worn tread at the riser is measured. Various types of gauges such as a folding leaf gauge with different degrees of taper or a wedge-type gauge may obtain this measurement. Tape measures are also frequently used to measure tread wear.

If the tread is worn more than ⅜ inch, the corresponding flangeway depth may also be reaching critical limits. Since the manganese insert is typically designed to be about 2 inches thick at the wall of the flangeway and about 1⅜ inches or less at the bottom of the flangeway, wear in this condemning range could result in structural failure of the frog.

Frogs frequently exhibit small spalling (pitting) in the tread. Usually, this type of spalling is not hazardous. Measurements of tread wear should be made over a length that is worn down due to abrasion or plastic flow of metal not at the bottom of small spalls. However, if the depression is of sufficient size to permit the tread of a wheel to follow that depression, tread wear should be measured at the depression.

To measure flangeway depth, place a straight edge across the frog at the area of concern. Measure the space between the underside of the straight edge to the bottom of the flangeway and the space between the underside of the straight edge and the tread. As shown in Figure 28, subtract the tread value from the flangeway value to obtain the actual flangeway depth.

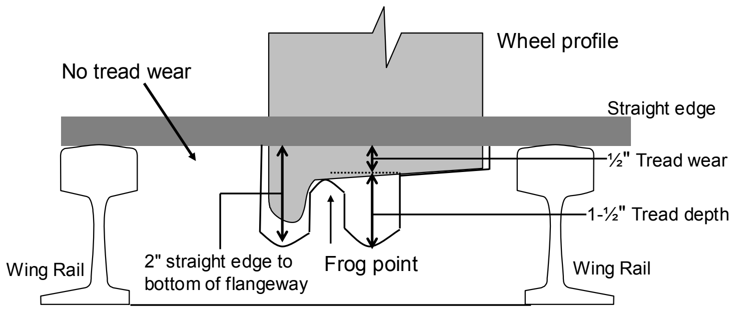


Figure 28

When a railroad wheel approaches the frog in the facing direction, the weight of the wheel is supported on the tread of the frog opposite the point until the wheel reaches the transition point, about 6 inches back from the actual point. At this location, the weight is transferred to the frog point.

137(d) Where frogs are designed as flange-bearing, flangeway depth may be less than that shown for Class 1 if operated at Class 1 speeds.

Guidance. This paragraph provides an exemption for an item of specialized track work that by design does not conform to the minimum flangeway depth requirements prescribed in paragraph (a) of this section. Called a flange-bearing frog, this technology is under consideration as a method of reducing impact loads at frogs. This design is a new concept for track above yard speeds but has been used extensively in light rail transit trackwork.

There are a number of frog designs in use throughout the industry and the most common types are rail bbound manganese and bolted rigid (stiff). The special attributes of spring frogs are covered under §213.139. Conventional moveable point frogs are found at flat angle track crossings and slip switches (Figure 29). This type of movable point frog is similar to a switch because of its movable points that fit against a knuckle rail, which is like a stock rail.

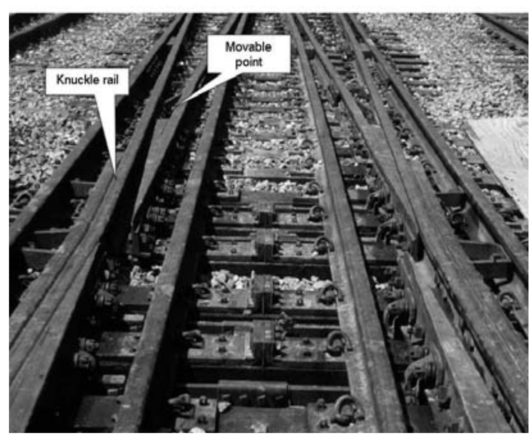


Figure 29

In recent decades new technology movable frogs have been introduced in the Nation and there are two types - "swing nose" (Figure 30) and movable wing (Figure 31). Conventional movable point frogs and swing nose frogs are virtual switches; therefore there are no guard rails. As such, it is appropriate to use the applicable elements of §213.135 (Switches) in an inspection report when encountering defects in these movable point frogs. For example, a movable point that does not fit its knuckle rail properly would be covered under §213.135 (b) (each switch point shall fit its stock rail properly).

The movable wing rail type frog is similar to a spring frog but both wing rails are moved remotely in synchronization with the switch points. It is appropriate to use the applicable elements of §213.139 (Spring rail frogs) in an inspection report when encountering defects. Like above, when using any of the 139 series defect codes it is necessary to include defect code 213.133.20 - Turnout or track crossing fastenings not intact or maintained.

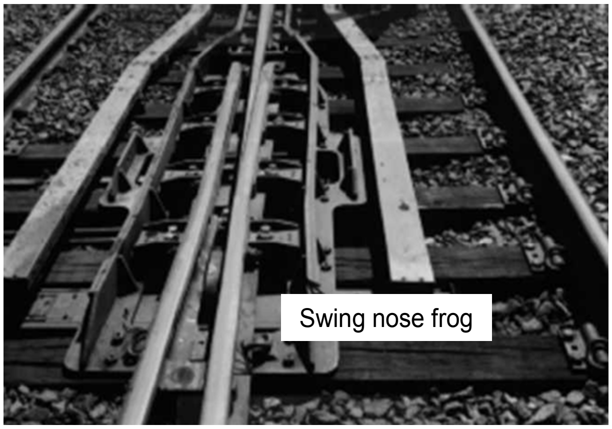


Figure 30

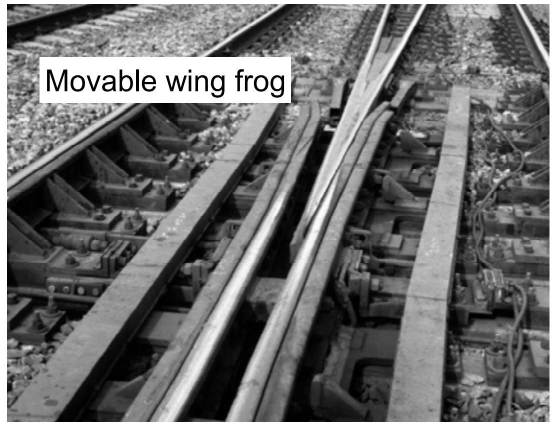


Figure 31

The following are the key elements to consider when inspecting new technology frogs:

- Bolting or fastener designs that fasten the movable point frog to concrete or timber switch ties are considered fasteners in the same manner as cut spikes. Fastenings are discussed under §213.127 of this manual. Bolts that connect movable frog components together are considered frog bolts and must be addressed by using defect code 213.133.12, Loose or missing frog bolts.
- Of paramount importance is a proper fit of the vee point rails against the wing rails on movable frogs. Inspectors must use their judgment to determine if the point fits the wing rail properly to allow wheels to pass the frog point. Movements of the wing rail must not adversely affect the fit of the frog point to the wing rail. When an Inspector encounters a condition on a movable frog which should be addressed on the inspection report and no existing code is available for that condition, defect code 213.137.99 will be acceptable with a full description of the condition in the inspection report.
- Unlike rail bound manganese frogs, the running surface of most, if not all, movable frogs are made of hardened rail. Inspectors must be aware that this rail may contain defects that require remedial action under §213.113. Asymmetrical rails found in some switch points and frogs must be closely examined during inspections, as this appears to be a potential weak spot where a crack or break could occur.
- When performing inspections, FRA Inspectors should discuss any concerns about an advanced turnout with appropriate railroad personnel. Inspectors should consult with the Regional Track Specialist to resolve any questions about the safety of these installations.

Guidance, General. The various types of frogs available for specific applications include bolted rigid, solid manganese, self-guarded, rail bound manganese, spring rail, movable point, cast, or swing nose. On rail bound manganese frogs, the normal wear pattern is in the manganese insert.

An Inspector, in addition to measurements described in the TSS, should see that a frog is supported throughout on well tamped and sound ties.

The requirements for flangeway depth in Paragraph (a) and the requirements for tread wear in Paragraph (c) also apply to crossing frogs. Since the designed flangeway depth is also 1⅞ inches, the safety concerns are therefore the same as excessive wear on the tread portion could result in a wheel flange striking the bottom of the flangeway and causing structural damage to the frog.

Inspectors must evaluate cracks or breaks in frog castings or rail defects in the non-running portion of wing rails in terms of their potential effect on the safe passage of rolling stock. In particular, when making the evaluation:

- The Inspector should determine if there is a loss or imminent loss of wheel guidance due to a loss of functional integrity.
- The Inspector should not consider cracks or breaks in a manganese frog casting that do not affect the safe passage of rolling stock to be a defective condition. If a severe crack, or a series of cracks, creates a condition where the breaking out of a piece of the casting is imminent, the use of defect code 213.137.99 should be considered. Cracks or wear that develop into a loss of functional integrity should be addressed by using defect code 213.137.02 or 213.137.03 which governs worn frog points and castings.
- Rail defects in the non-running portion of wing rails should be addressed by using defect code 213.137.99.

§213.139 Spring rail frogs

139(a) The outer edge of a wheel tread shall not contact the gage side of a spring wing rail.

Guidance. Inspectors must closely examine every spring rail frog encountered during an inspection. While spring rail frogs have been successfully used for many years, their unique design requires special maintenance attention to avoid derailment hazards to trailing point train movements on the main track. If a spring wing rail is higher than the top of a frog point, a hollow wheel (or false flange) of a wheel during a trailing move may push on the spring wing rail causing an extreme wide gage. While some spring frogs have a "relief" groove built into the frog for this purpose, Inspectors must be acutely aware of any signs of the gage side of a spring wing rail being struck by the outer edge of wheel treads.

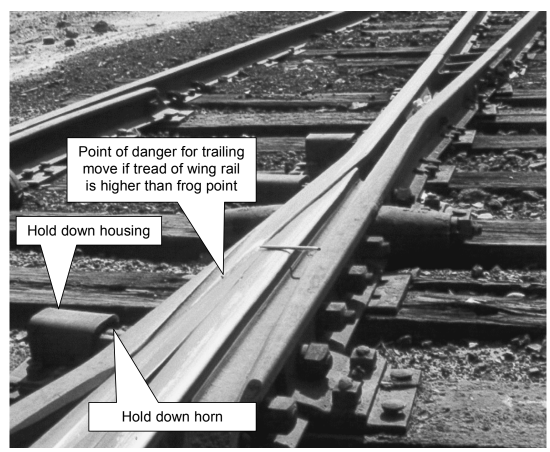


Figure 32

139(b) The toe of each wing rail shall be solidly tamped and fully and tightly bolted.

Guidance. The toe of each spring rail frog must be solidly supported, and proper hold-down housing clearance must be maintained to avoid excessive vertical movement of the wing rail. The first sign that this is occurring will be gouging on the gage corner of the wing rail behind the point of frog. Wheel gouging must not be confused with channeling in the spring wing rail that is incorporated at the time of manufacture to accommodate wheel tread transition.

If the toe is not solidly tamped and excessive horn and housing clearance exists, the wing rail may have vertical motion operating on the point rail in a trailing-point movement and the forces on the wing rail will cause the wing rail to move laterally, allowing the wheel to drop in at the throat of the frog.

139(c) Each frog with a bolt hole defect or head-web separation shall be replaced.

Guidance. Any bolt hole defect or head-web separation in a spring frog of any dimension constitutes a defect. This paragraph does not prescribe a corrective action other than "replacement."

139(d) Each spring shall have compression sufficient to hold the wing rail against the point rail.

Guidance. Typically, if a wing rail is up against the point it is an indication that the spring is holding it as intended. If there is a suspicion that there is insufficient compression in the spring, the railroad representative should determine its compliance.

139(e) The clearance between the hold-down housing and the horn shall not be more than ¼ inch.

Guidance. Since the spring wing rail is a movable part of a spring frog, it cannot be fastened down. The hold-down housing and a horn assembly prevents the wing rail from moving up higher than the top of the frog point. Figure 33 illustrates the proper method to determine if there is excessive space between the hold-down housing and the horn.

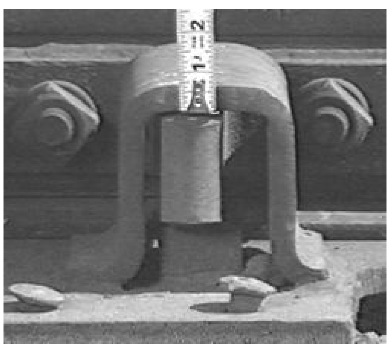


Figure 33

Guidance, General. Due to the unique design characteristics of spring frogs, turnouts with this type of appliance require special consideration in regard to guard rails. On the main track side of a turnout when trains are not "springing" the frog (by design) and operating on an unbroken path, an extra length guard rail assures a proper path for wheel sets.

A guard rail should be of sufficient length to cover the designed hinge length. This keeps wheels off the spring wing rail from the point where this rail is "hinged" through the frog throat and finally to the actual frog point.

While the TSS does not address this design concept, Inspectors should be aware of this attribute of spring frogs. If a guard rail is of insufficient length to cover the designed hinge length, any lateral wheel forces can cause significant problems. Specifically, the guard rail and other frog elements will quickly deteriorate, and in extreme circumstances, the wing rail can open while trains are moving through the main track side which can result in an unprotected wide gage. Inspectors should note on their inspection report any guard rail on a spring frog that is not of the proper length or installed in the improper position.

Another special consideration with regard to spring frogs is the longitudinal relationship between the spring wing rail and frog point. If a turnout has insufficient rail anchors to restrain longitudinal movement, the wing rail may not function properly. Evidence that longitudinal movement is occurring may be a gap between the wing rail and the frog point. Inspectors are reminded to refer to §213.133 (b) that requires Classes 3 through 5 track to be equipped with sufficient rail anchoring to restrict longitudinal rail movement. If longitudinal movement is observed because of insufficient anchors on Classes 1 and 2 track, Inspectors are encouraged to note this condition and inform the railroad.

Spring frogs are manufactured with a steel base plate. Attached to the base plate are clip plates, which are placed along the fixed side of the frog. The clip plates, which are shaped into a right angle, are attached to the base plate by bolts, welds, or both. Frog bolts are placed through the body of the frog and through the vertical portion of the clip plates and tightened. This holds the body of the frog to the clip plate assembly.

There are no gage holding fasteners along the movable side of the frog as they would interfere with the spring wing rail. Therefore, it can be seen that the frog bolts and clip plate assemblies acting together maintain alinement of the spring frog. Care should be taken to insure that frog bolts and clip plate bolts are in place and tight (defect code 213.133.12). Also check clip plates to see if welds are cracked or broken and check clip plates for cracks and breaks at the corner where the plate bends from horizontal to vertical. Where cracks or breaks in clip plates affect the fastening of the frog to the base plate use defect code 213.127.01 (insufficient fasteners).

In recent years, railroads have augmented the design of spring frog installations by the application of improved stops to limit the amount of movement of the spring rail. In addition, some frogs have been retrofitted with welded stops. Most stops are designed to allow the wing to open no more than 1⅞ to 2¼ inches. When stops are properly installed, the risk of trailing point derailments is reduced.

When spring frogs are equipped with the improved features such as relief grooves and stops, the Inspector should evaluate the condition of the components in order to ascertain that the improved features are functioning as intended.

When spring frog defects are found, the defective conditions must be repaired as soon as possible. Combinations of the defects are especially hazardous. The railroad must protect the movements over the frog with a speed restriction until the defects are repaired.

Spring frog defects are considered as non-class-specific defects (see §213.9) and, therefore, Inspectors must consider the circumstances involved in evaluating the remedial action taken by the railroad when spring frog defects are found. Inspectors should consider all spring frog defects as serious which must be repaired as soon as possible. In most circumstances, when it is evident that the outer edge of wheels are contacting the gage side of the wing rail or a combination of spring frog defects exist, Inspectors would expect that the railroad would implement a speed restriction.

Some spring frogs are equipped with retarders that reduce the impact of the wing on the point as the wing closes with each passing wheel in the diverging route. The retarders may hang, causing the wing to remain open. While the TSS does not address this design concept, Inspectors should still be aware of this attribute of spring frogs because it could lead to further degradation of frog components.

§213.141 Self-guarded frogs

141(a) The raised guard on a self-guarded frog may not be worn more than ⅜ of an inch.

Guidance. When examining self-guarded frogs, observe the condition of the frog point and where there is evidence of wear caused by wheel flanges contacting the frog point, take measurements to determine compliance with this section. To determine the amount of wear on a raised guard, measure the thickness at a portion where there is wear. Compare this measurement to a portion where there is no wear and the difference between the two is equivalent to the amount of wear.

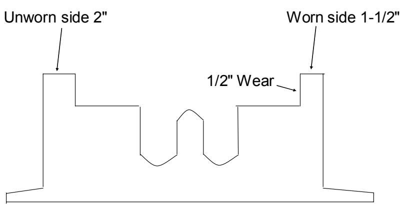


Figure 34

141(b) If repairs are made to a self-guarded frog without removing it from service, the guarding face must be restored before rebuilding the point.

Guidance. During repairs of a self-guarded frog, it is imperative that the raised guarding face is restored before the actual frog point. This precaution is necessary due to the potential for a wheel flange striking the frog point.

Self-guarded frogs are designed for use in low speed track and their use in tracks where speeds exceed 20 m.p.h. can result in excessive lateral forces such as wheels "kicking" or in extreme cases wheels climbing up the raised guard. The TSS does not prohibit the use of self-guarded frogs in any class of track; however, Inspectors are encouraged to inform a railroad of the potential for problems that may occur if a self-guarded frog is found in a track where speeds exceed 20 m.p.h.

§213.143 Frog guard rails and guard faces; gage

The guard check and guard face gages in frogs must be within the limits prescribed in the following table:

Class of track	*Guard check gage* *The distance between the gage line of a frog to the guard line [1] of its guard rail or guarding face, measured across the track at right angles to the gage line [2], may not be less than*	*Guard face gage* *The distance between guard lines [1], measured across the track at right angles to the gage line [2], may not be more than*
1	*4' 6⅛"*	*4' 5¼"*
2	*4' 6¼"*	*4' 5⅛"*
3 & 4	*4' 6⅜"*	*4' 5⅛"*
5	*4' 6½"*	*4' 5"*

[1] 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.

[2] A line ⅝ inch below the top of the centerline of the head of the running rail or corresponding location of the tread portion of the track structure.

Table 12

Guidance. A guard rail is installed parallel to the running rail opposite a frog to form a flangeway with the rail and to hold wheels of equipment to the proper alinement when passing through the frog.

A guard rail must be maintained in the proper relative position to the frog in order to accomplish its critical intended safety function. Inspectors should examine guard rails carefully to see that they are adequately fastened, and when measuring guard rail gage, fully consider any movement of guard rail or frog under traffic conditions.

This section clearly specifies allowable tolerances for guard check and guard face gage for various classes of track.

When measuring guard check gage, it is important to consider the path of wheels through the frog because the function of a guard rail is to keep wheel flanges from striking the actual frog point. As reference, standard check gage on a railroad wheel set is approximately 54½ inches (see Figure 35 for approximate design check gage values). While the TSS minimum guard check gage is less than wheel check gage in lower classes of track, the condition of the actual frog point in relation to the path of wheels through a frog is a good indicator of the effectiveness of a guard rail.

The critical area where guard check gage must be measured is at the actual point of frog. Inspectors must also consider any unusual wear that may exist at the actual frog point and position the track gauge or other measuring device accordingly.

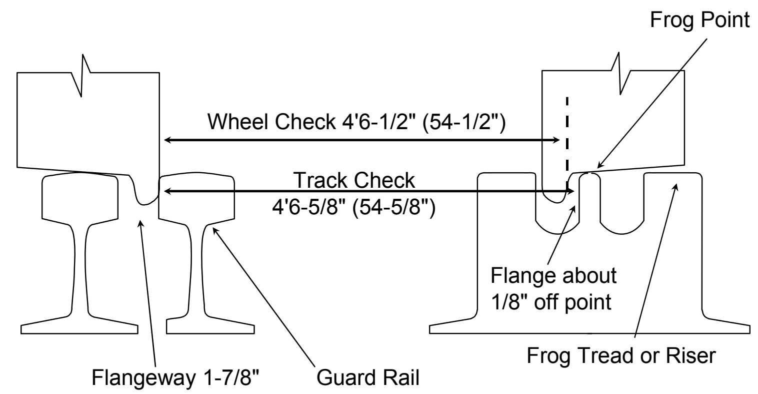


Figure 35

When measuring guard check gage, dynamic lateral movement of the guard rail and/or frog shall be considered. In the case of a frog that is moving laterally under train movement (floating), it is important to consider the most restrictive measurement. Specifically, if measuring guard check gage in a turnout where the frog can move toward the track being measured due to train movement on the other track, that dynamic frog position would be considered. See Figure 36.

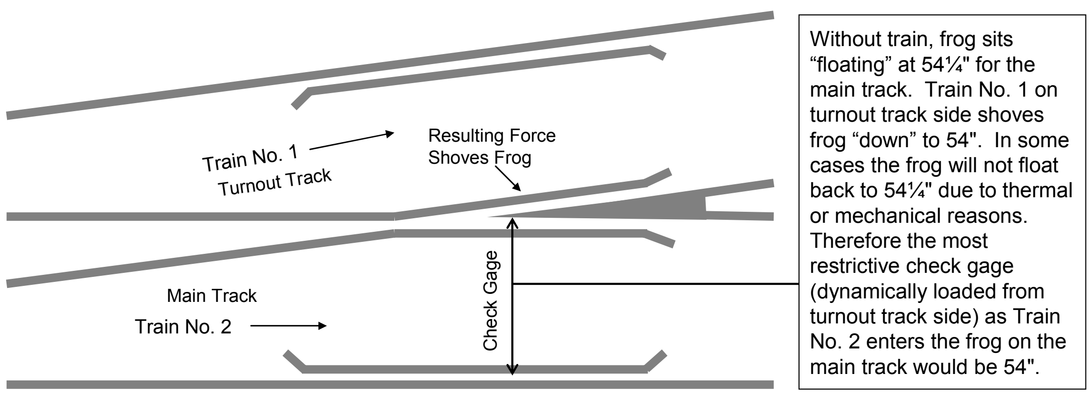


Figure 36

In severe cases where a frog is severely floating (moving laterality under load), and there is an accompanying condition (i.e., deteriorated crossties or ineffective fasteners), FRA Inspectors should cite the defect or recommend a civil penalty for the accompanying condition (i.e., §§213.109 (Crossties) or 213.127 (Rail fastenings)).

Face gage is a dimension that becomes critical when the distance between two opposing guard rails, or a guard rail and a frog wing rail, become larger than the distance between the back of wheel sets. This would occur by improper installation or a condition such as a severe alinement defect. Normally, face gage would be measured in the same vicinity as check gage. However, Inspectors should consider measuring face gage at other points in special trackwork where there may be an indication that wheels are being "pinched." For general reference, Figure 37 illustrates approximate design face gage values.

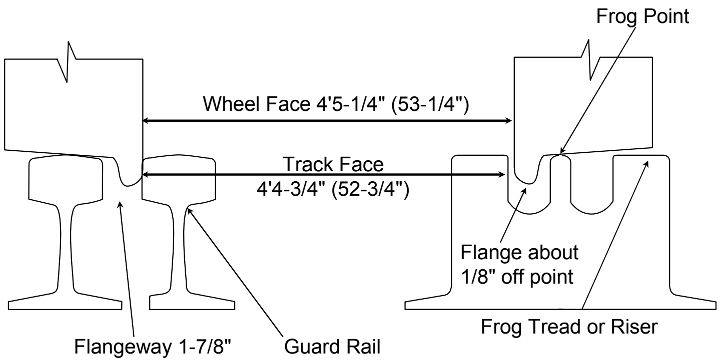


Figure 37

Broken guard rails occur infrequently, since they do not support the vertical wheel loads of passing trains. When evaluating a crack or break in a guard rail, the Inspector should be aware that cracks or breaks exist which do not affect the ability of the guard rail to function as intended. If the integrity of the guard rail is affected, the Inspector will cite the defect using defect code 213.143.03, Cracked or broken guard rail.

There are many different types and designs of frog guard rail designs. Some guard rail plates are recessed to seat the running rail while others are flat. Some guard rail plates are punched with spike hole slots; others are not. Other guard rails are bolted to the running rail. On some railroads, it is normal practice not to spike the gage side of the running rail through the guard rail area while some guard rail plates do not have holes punched for this purpose. FRA has no record of serious safety problems that have developed as a result of not spiking the running rail through the guard rail area.

If encountering a problem where the running rail has moved laterally to create an unsafe condition, the Inspector should use insufficient fasteners defect code 213.127.01. Inspectors should discuss unique situations with their Regional Track Specialist.

While not a requirement of the TSS, guard rails have a straight portion that guides wheels through the area from the "throat" to the actual frog point. If Inspectors find a guard rail where the straight portion does not encompass this area, Inspectors should bring this to the attention of the railroad. Figure 38 illustrates the proper measurement points to determine check/face gage compliance and shows the proper longitudinal relationship between a guard rail and frog point.

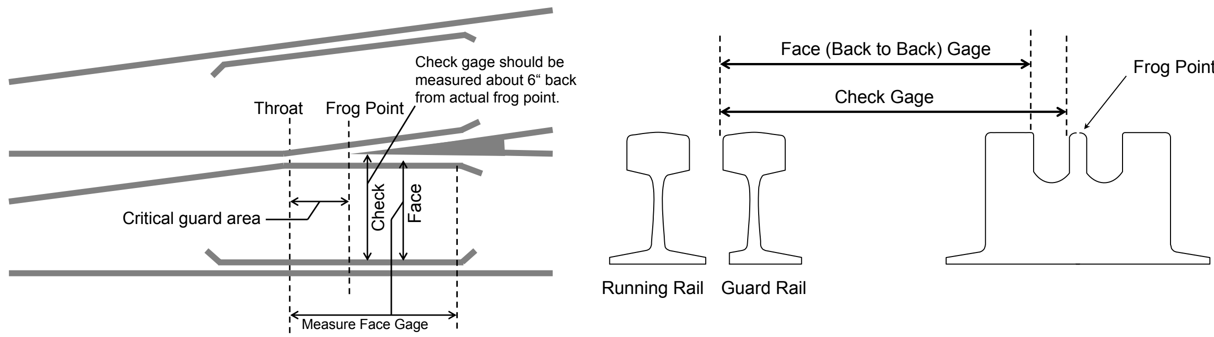

Check gage should be measured about 6" back from actual frog point.
Throat
Frog Point
Critical guard area
Check
Face
Measure Face Gage
Face (Back to Back) Gage
Check Gage
Frog Point
Running Rail
Guard Rail

Figure 38

Subpart E - Track Appliances and Track - Related Devices

§213.201 Scope

This subpart prescribes minimum requirements for track appliances and track-related devices.

§213.205 Derails

205(a) Each derail shall be clearly visible.

Guidance. The TSS requires derails to be clearly visible. While the TSS does not specify a color derails are to be painted, they must be visible to railroad employees, and a derail dark in color and obscured by vegetation would not be in compliance.

205(b) When in a locked position, a derail shall be free of lost motion which would prevent it from performing its intended function.

Guidance. Inspectors will need to determine the extent of movement due to worn parts or improper adjustment, if any, and determine if such movement renders the derail ineffective.

205(c) Each derail shall be maintained to function as intended.

Guidance. Derails are of various designs and may be of the following types: switch point, spring switch point, sliding, hinged, and portable.

Derails can be operated by various means: electrical, hand throw, lever, and mechanical rod from a point other than at the derail. They should be installed to derail rolling stock in a direction away from the track or facility to be protected.

In addition to the requirements of this section, a switch point type derail must also comply with the requirements of §213.133 [turnouts generally] and §213.135 [switches].

205(d) Each derail shall be properly installed for the rail to which it is applied. [This paragraph (d) is applicable September 21, 1999.]

Guidance. Derails must be the proper size for the rail to which it is applied. Derails are manufactured to “sizes” based on the rail section to which they are to be applied and should be installed according to the manufacturer’s instructions. Installation of a derail of incorrect size can make a derail ineffective. Inspectors may use derail manufacturer instructions as a guide to determine if a derail is properly installed (correct size for the rail to which it is applied).

Derails are made by “hand” (right or left) to derail equipment to a specific side of the track. In addition, “universal” derails will derail equipment in either direction. A derail that is installed to derail equipment toward a main track that should otherwise be protected would constitute an improperly installed derail. A “hand” derail placed in the wrong direction would also constitute an improperly installed derail.

Subpart F - Inspection

§213.231 Scope

This subpart prescribes requirements for the frequency and manner of inspecting track to detect deviations from the standards prescribed in this part.

§213.233 Track inspections

233(a) All track shall be inspected in accordance with the schedule prescribed in paragraph (c) of this section by a person designated under §213.7.

Guidance. Recognizing that proper inspection of track is essential to safe maintenance, Subpart F contains the minimum requirements for the frequency and manner of inspecting track. Inspectors should know that a track owner may exceed the TSS in the interest of good practice, but they cannot be less restrictive. FRA's track safety program success is dependent upon the adequacy of the railroad's inspection efforts and subsequent maintenance program. Monitoring and assessing a railroad's track condition, through regular inspections, is integral to our safety success.

233(b) Each inspection shall be made on foot or by riding over the track in a vehicle at a speed that allows the person making the inspection to visually inspect the track structure for compliance with this part. However, mechanical, electrical, and other track inspection devices may be used to supplement visual inspection. If a vehicle is used for visual inspection, the speed of the vehicle may not be more than 5 miles per hour when passing over track crossings and turnouts, otherwise, the inspection vehicle speed shall be at the sole discretion of the Inspector, based on track conditions and inspection requirements. When riding over the track in a vehicle, the inspection will be subject to the following conditions --

(1) One Inspector in a vehicle may inspect up to two tracks at one time provided that the Inspector's visibility remains unobstructed by any cause and that the second track is not centered more than 30 feet from the track upon which the Inspector is riding;

(2) Two Inspectors in one vehicle may inspect up to four tracks at a time provided that the Inspectors' visibility remains unobstructed by any cause and that each track being inspected is centered within 39 feet from the track upon which the Inspectors are riding;

(3) Each main track is actually traversed by the vehicle or inspected on foot at least once every two weeks, and each siding is actually traversed by the vehicle or inspected on foot at least once every month. On high density commuter railroad lines where track time does not permit an on track vehicle inspection, and where track centers are 15 foot or less, the requirements of this paragraph (b)(3) will not apply; and

(4) Track inspection records shall indicate which track(s) are traversed by the vehicle or inspected on foot as outlined in paragraph (b)(3) of this section.

Guidance. This paragraph specifies the number of additional tracks that can be inspected. Depending upon whether one or two qualified railroad inspectors are in the vehicle, and depending upon the distance between adjacent tracks (30 or 39 feet, measured between track centerlines), a track owner's railroad inspectors may inspect multiple tracks (up to four) from hi-rail vehicles. Tracks obstructed from their view by tunnels, differences in ground level, railroad rolling stock, etc., cannot be included in the inspection record. Section 213.233(b)(3) requires each main track to be traversed at least once every two weeks and a siding traversed at least once every month. Track inspection records, under §213.241, must indicate which track(s) are traversed in accordance with paragraph (b)(3).

233(c) Each track inspection shall be made in accordance with the following schedule:

Class of Track	Type of Track	Required Frequency
Excepted track and *Class 1, 2, and 3 track*	*Main track and sidings*	Weekly *with at least 3 calendar days interval between inspections, or* before use*, if the track is used less than once a week, or* twice weekly *with at least 1 calendar day interval between inspections, if the track carries passenger trains or more than 10 million gross tons of traffic during the preceding calendar year.*
Excepted track and *Class 1, 2, and 3 track*	*Other than main track and sidings*	Monthly *with at least 20 calendar days interval between inspections.*
Class 4 and 5 track	………	Twice weekly *with at least 1 calendar day interval between inspections.*

Table 13

Guidance. A geometry car inspection will not be considered acceptable for meeting the required inspection frequency specified by §213.233(c), unless a waiver allowing this substitution is in effect.

Section 213.233(c), specifies the minimum frequency at which inspections must be conducted. For purposes under §213.233(c) and outlined in the frequency schedule, “main track” is defined as “a track, other than an auxiliary track, extending through yards and between stations.” A siding is defined as “an auxiliary track for meeting or passing trains.” Section 213.233(c) also links inspection frequencies to the amount of annual tonnage, presence of passenger trains, and speed according to track class. A railroad’s change in the designation of a track to “other than main track” in its timetable and/or special instructions may not necessarily permit a railroad to reduce track inspection frequency. If the traffic remains essentially the same, the station designations remain, or if the method of operations continue the same, the track will be considered a main track with respect to the TSS. In addition, if any main track type operating rules or procedures are applicable to a track in question, FRA will consider such a track as a main track under the TSS. This would be the case even if the railroad uses the term such as spur, lead, running, etc. to describe the track in question. (Source: Letter dated July 10, 1991, from FRA Associate Administrator for Safety to Union Pacific Railroad.)

Each railroad inspection performed in accordance with the schedule prescribed in paragraph (c) must be made on foot or by riding over the track in a vehicle at a speed that allows the person making the inspections to visually inspect the track structure for compliance. An inspection made from a vehicle driven alongside the track does not constitute an inspection performed at the required frequency. The railroad may make additional inspections using other inspection methods provided that these inspections are not used to comply with frequency requirements prescribed in Section 213.233.

Inspecting after dark is in compliance with the requirements of §213.233, Track inspections, as long as the railroad inspector is capable of detecting defects. As an example, inspections are routinely made in tunnels with limited or no lighting, and maintenance requirements may require inspections after daylight hours. Appropriate artificial lighting is required for an inspector to conduct a valid inspection.

When FRA Inspectors are conducting inspections from a hi-rail vehicle, only the track occupied will be recorded on the F 6180.96 form [hi-rail main track (MTH) or hi-rail yard track (YTH)]. When conducting a walking inspection, multiple tracks may be inspected and counted as units on the F 6180.96 form. It is recognized that walking inspections reveal more defective conditions than hi-rail inspections. Therefore, FRA Inspectors may include multiple tracks while conducting walking inspections. Inspectors will use good judgment in insuring a high quality inspection while conducting walking inspections.

For the purposes of the application of inspection intervals, a week is defined as a period of seven days, Sunday through Saturday. This is the accepted standard definition and emphasized here to avoid confusion when the railroad changes the starting and ending days of a week from inspector to inspector or from territory to territory. Classes 1 through 3 track require a weekly inspection with at least three calendar days interval between inspections, or before use, if the track is used less than once a week; or twice weekly with at least one calendar day interval between inspections, if the track carries passenger trains or more than 10 million gross tons of traffic during the preceding calendar year.

When a railroad operates seasonal or irregular passenger service, it is expected that the twice weekly inspection will be conducted during those periods. A railroad will be considered to be in compliance if the twice weekly inspection occurs the week before and the week or weeks that the passenger trains are operated. If a one time infrequent or seasonal passenger train movement occurs only on one day of a week, the twice weekly inspection the prior week and one [*] inspection the week of the movement is adequate.

[*] If the scheduled passenger train is to operate on one day only, at an interval during the week that does not allow for the two required inspections prior to that movement, then the one inspection for the week must occur before the movement.

233(d) If the person making the inspection finds a deviation from the requirements of this part, the Inspector shall immediately initiate remedial action.

Note: to §213.233. Except as provided in paragraph (b) of this section, no part of this section will in any way be construed to limit the Inspector's discretion as it involves inspection speed and sight distance.

Guidance. To assure that railroads are providing proper inspections at the required frequency, Inspectors must periodically examine the railroad's inspection records (noting record keeping type defects under §213.241 only). By reviewing the track owner's inspection procedures and records, or through personal observations, Inspectors will determine the number of tracks being inspected, the number of railroad inspectors performing inspections, the specific tracks inspected, and whether the railroad inspector actually traversed the track by vehicle or on foot. As specified in this section of the TSS, the track owner must assure all tracks are inspected in accordance with the prescribed schedule. Failure of the owner to comply with this schedule may constitute a violation.

If a track owner's qualified person, designated under §213.7, finds a deviation from the TSS and fails to immediately initiate proper remedial action, the failure may constitute a violation. FRA track inspections do not constitute a required track inspection under the TSS. FRA inspections assess a railroad's compliance with Part 213. Inspectors will review a track owner's inspection records to learn if these records reflect the actual conditions of the track structure under train operations.

Turnouts and track crossings visually inspected from a vehicle must be accomplished at a speed not exceeding 5 m.p.h. A vehicle's speed will be at the sole discretion of the operator and is based upon track conditions, inspection requirements, operating rules, and other circumstances that may vary from day to day and location to location. Nothing in the TSS precludes an inspection from a train or engine as long as the overall effectiveness of the inspection is not compromised and the person is able to visually inspect the track structure for compliance with this part. However, examining track while simultaneously operating a locomotive shall not be considered as an inspection under the TSS. The person must have the ability to stop movements to make a close examination of any possible track defect.

Deviations found under §213.233 are those observed in the field as opposed to the §213.241 record keeping requirements, which are normally reviewed at a track owner's corporate or division offices. Inspectors may also monitor other railroad records such as dispatcher or control operator's record of track authorities conveyed and speed restrictions placed to confirm that inspections were made and proper remedial actions were taken.

Classes 1 through 3 track require a weekly inspection with at least three calendar days interval between inspections, or before use, if the track is used less than once a week; or twice weekly with at least one calendar day interval between inspections if the track carries passenger trains or more than 10 million gross tons of traffic during the preceding calendar year.

§213.235 Inspection of switches, track crossings, and lift rail assemblies or other transition devices on moveable bridges

235(a) Except as provided in paragraph (c) of this section, each switch, turnout, track crossing, and moveable bridge lift rail assembly of other transition device shall be inspected on foot at least monthly.

Guidance. Paragraph (a) prescribes the frequency and method of inspection for switches, turnouts, track crossings, and moveable bridge lift rail assemblies or other transition devices by a track owner's qualified persons. By examining records and conducting field investigations, FRA Inspectors can confirm the track owner's on foot inspection of each switch, turnout, track crossing, and movable lift bridge rail assembly at least monthly.

235(b) Each switch in Classes 3 through 5 track that is held in position only by the operating mechanism and one connecting rod shall be operated to all of its positions during one inspection in every three month period.

Guidance. Each switch, in Classes 3 through 5 track, that is held in normal or reverse position by only one connecting rod is required to be operated (thrown) in all its positions during one track inspection by the track owner in every three month period. An example of a switch that has more than one connecting rod is a switch that also has a lock rod. A rod connecting a switch to a switch circuit controller (point detector) is not considered to be a rod that holds a switch in position. This requirement is designed to emphasize the importance of these non-redundant mechanisms. Thorough inspection is best accomplished by operating the switch mechanism to allow for a comprehensive inspection of these components. Inspectors should observe the various switch components, determine their functional design, and assess missing components that are integral to safe operation. If the proper operation of the points is in doubt Inspectors should use the appropriate codes under §213.133. The phrase "all positions" is intended to cover slip and lap (three-way) switches.

235(c) In the case of track that is used less than once a month, each switch, turnout, track crossing, and moveable bridge lift rail assembly or other transition device shall be inspected on foot before it is used.

Guidance. "Lift Rails" have unique properties and functions. This discussion will focus on cast manganese alloy types of lift rail assemblies that provide a transition between a fixed span and a movable span on lift bridges, swing bridges, and bascules. Lift rails are made of three pieces for swing bridges: a section on the fixed span, a section on the movable span, and the rocker.

Figure 39

Analogous to a rail in some respects, a manganese lift rail provides a running surface and it is also similar to a rail joint in that it joins rails at the ends of bridge spans. It is made of manganese alloy, and it has the appearance of a frog.

Manganese lift rails have tapered sections to reduce shock. The design provides for the transfer of wheels to take place on one span, rather than between spans. Track and bridge maintenance personnel familiar with manganese steel lift rails point out that cracks generally progress slowly.

Railroad maintenance officials advocate proper maintenance to prevent or reduce cracking of manganese lift rails. Because there is deformation of manganese over time, they recommend that metal flow be ground at the wheel contact point to reduce or prevent cracks. Railroad maintenance personnel also emphasize that the bridge itself can aggravate wear and deterioration of manganese steel lift rails when the bridge needs to be adjusted or repaired. The condition of the bridge ties, for example, is an important factor in the maintenance of these of such assemblies.

Policies regarding speeds on manganese lift rails are set by each railroad. Some railroads require a 25 m.p.h. maximum speed on all lift rails regardless of condition. Further reductions of train speeds should be placed when the lift rails deteriorate to prohibitive levels. In deciding to place a speed restriction or remove a lift rail from service, railroads consider a wide range of factors including the amount of traffic, bridge condition, and the condition of the lift rail itself.

Conclusions:

- When evaluating the safety of a manganese lift rail assembly, Inspectors must consider that crakes in manganese casting are known to propagate slowly. Although cracks are known to propagate slowly, cracks can be more hazardous under certain bridge conditions, such as a deteriorated deck. Inspectors are cautioned against citing §213.113 (Defective rails), to describe cracks in the manganese casting running surface of the manganese lift rail appliance.
- Specific concerns about the safety of a manganese steel lift rails must be immediately brought to the attention of an appropriate railroad manager and discussed with the Regional Track Specialist.

Guidance, General. Inspections conducted from a vehicle are not considered sufficient to determine compliance. Therefore, each switch, turnout, track crossing, and lift rail assembly or other transition device on moveable bridges will be inspected by a walking inspection before FRA Inspectors can consider a unit (activity) inspected, as outlined in Chapter 2 of this manual.

§213.237 Inspection of rail

*237(a) In addition to the track inspections required by §213.233, a continuous search for internal defects shall be made of all rail in Classes 4 through 5 track, and Class 3 track over which passenger trains operate, at least once every 40 million gross tons (mgt) or once a year, whichever interval is shorter. On Class 3 track over which passenger trains do not operate such a search shall be made at least once every 30 mgt or once a year, whichever interval is longer. ** [This paragraph (a) is effective January 1, 1999.]*

Guidance. The inspection frequency requirements stated in this paragraph consider both the passage of time and the accumulated tonnage since the last inspection. Several methods are employed by railroads to estimate tonnage, but they are only estimates and cannot be considered as precisely accurate. In addition, scheduling of rail detection cars is influenced by many factors such as the availability of equipment if the service is contracted, equipment failures or various other scheduling problems, which may arise.

For Class 3 track over which only freight operations are conducted the date of the most recent inspection will define the beginning of a new inspection cycle and before the expiration of time or tonnage limits, whichever is longer, an inspection for internal rail defects must be conducted. For Classes 4 and 5 track, and Class 3 track over which passenger trains operate, the date of the most recent inspection will define the beginning of a new inspection cycle and before the expiration of time or tonnage limits, whichever is shorter, an inspection for internal rail defects must be conducted.

Language in §213.237(a) refers to §213.233 (Track inspection) indicating that many rail, defects as well as conditions caused by wear or damage, cannot be visually discovered. These require an internal search by a detector car or other specialized detection equipment.

Some railroads have elected to perform more internal rail inspections than required under the TSS, with intervals between tests typically ranging from 20 to 30 MGTs or between 20 and 30 days. These typical intervals define a good baseline for generally accepted maintenance practices, and the industry's rail quality managers consider these limits as points of departure for adjustment of test schedules to account for the effects of specific track characteristics, maintenance, traffic, and weather.

The annual test requirement for Classes 4 and 5 track and Class 3 track over which passenger trains operate is based on risk factors associated with freight train speeds and passenger train operations.

Selecting an appropriate frequency of rail testing is a complex task involving many different factors which include but not limited to, temperature differential, curvature, residual stresses, rail sections, cumulative tonnage, and past rail test results. Taking into consideration all of the above factors, FRA's research suggests that 40 MGTs is the maximum tonnage that should be hauled between rail tests and still allow a safe window of opportunity for detection of an internal rail flaw before it propagates in size to a service failure. Furthermore, FRA's Accident/Incident data points to a need for inclusion of all Class 3 trackage in a railroad's rail testing program. The requirement states that Class 3 track, over which passenger trains do not operate, should be tested once a year or once every 30 MGTs, whichever is longer.

237(b) Inspection equipment shall be capable of detecting defects between joint bars, in the area enclosed by joint bars.

Guidance. The equipment used must be capable of detecting defects in the joint area as well as in the body of the rail. Two separate systems may be used to meet this requirement provided that each is used before the expiration of the time or tonnage limits as required by this section.

237(c) Each defective rail shall be marked with a highly visible marking on both sides of the web and base.

Guidance. Each defective rail must be marked with a highly visible marking on both sides of the web and base to prevent reuse of the rail. A defect's identity and control numbers are not required on the web and base, but may be used by a railroad for inventory purposes. Inspectors should be aware that rail with certain defects, such as a bolt hole crack, may have the defective portion "cropped" and the remaining portion placed back in service. The track owner may remove defect markings from the non-defective portion of such rail.

*237(d) If the person assigned to operate the rail defect detection equipment being used determines that, due to rail surface conditions, a valid search for internal defects could not be made over a particular length of track, the test on that particular length of track cannot be considered as a search for internal defects under §213.237(a). ** (This paragraph (d) is not retroactive to tests performed prior to September 21, 1998).*

Guidance. This paragraph and paragraph (e) address a situation where a valid search for internal rail defects could not be made because of rail surface conditions. Several types of technologies are presently employed to continuously search for internal rail defects, some with varying means of displaying and monitoring search signals. A continuous search is intended to mean an uninterrupted search by whatever technology is being used, so that there are no segments of rail that are not tested. If the test is interrupted (e.g., as a result of rail surface conditions that inhibit the transmission or return of the signal) then the test over that segment of rail is not valid because it was not continuous. Therefore, a non-test is not defined in absolute technical terms. Rather, the provision leaves this determination to the rail test equipment operator who is uniquely qualified on that equipment. Paragraph (d) is not retroactive to tests performed prior to September 21, 1998.

237(e) If a valid search for internal defects cannot be conducted for reasons described in paragraph (d) of this section, the track owner shall, before the expiration of time or tonnage limits;

(1) Conduct a valid search for internal defects;

(2) Reduce operating speed to a maximum of 25 miles per hour until such time as a valid search for internal defects can be made; or

(3) Remove the rail from service.

Guidance. This paragraph specifies the three options available to a railroad following a non-test due to rail surface conditions. These options must be exercised prior to the expiration of time or tonnage limits specified in the paragraph (a) of this section. If doubts exist concerning a defective rail's disposition, Inspectors should review the track owner's records, under §213.241(c). When conducting a records inspection, Inspectors will determine that the requirements of §§213.113(a)(2) and 213.237(e), are in compliance and have determined that valid inspections have occurred. The expiration of time and tonnage must be determined before any compliance action is taken.

Broken rails continue to be one of the leading causes of train accidents. Inspectors should examine records to assure railroad internal rail inspection frequency compliance and should be alert during track inspections to any rail that is marked as defective. During accident investigations where a broken rail is a factor, Inspectors should provide complete information on type of defects, results of last rail inspection, type of inspection equipment used, track usage since last inspection, and accumulated tonnage on that rail. See the guidance under §213.237(d) for a discussion of the situation where a valid search for internal rail defects could not be made because of rail surface conditions.

§213.239 Special inspections

In the event of fire, flood, severe storm, or other occurrence which might have damaged track structure, a special inspection shall be made of the track involved as soon as possible after the occurrence and, if possible, before the operation of any train over that track.

Guidance. This section is general in nature because it is not practical to specify all the conditions that could trigger a special inspection, nor the specific manner and timing. This section is not meant to imply that train operations must necessarily stop until the special inspection is made. However, all special inspections should be conducted for the primary purpose of determining whether the track structure is safe for the continued operation of trains. Inspectors are directed to review the significant impacts to railroad operations in regard to storms as discussed in any applicable safety advisory.

Because a number of train derailments have been caused by unexpected track damage from moving water in the past, the FRA deemed it appropriate to issue Safety Advisory 97-1 which recommends procedures that reflect best industry practice for special track inspections. The procedures consist of:

(1) Prompt notification to dispatchers of expected bad weather;

(2) Limits on train speed on all track subject to flood damage, following the issuance of a flash flood warning, until a special inspection can be performed;

(3) Identification of bridges carrying Class 4 or higher track that are vulnerable to flooding and over which passenger trains operate;

(4) Availability of information about each bridge, such as identifying marks, for those who may be called to perform a special inspection;

(5) Training programs and refresher training for those who perform special inspections; and

(6) Availability of a bridge maintenance or engineering employee to evaluate the railroad track inspector's findings.

Although the advisory contains a sample list of sudden events that routinely occur in nature, this provision is not limited to only the occurrences listed or to only natural disasters. Section 213.239 addresses the need to inspect after "other occurrences" which include such natural phenomena as temperature extremes, as well as unexpected events that are human caused (e.g., a vehicle that falls on the tracks from an overhead bridge, a water main break that floods a track roadbed, or terrorist activity that damages track). This interpretation is not new; FRA has always viewed this section to encompass sudden events of all kinds that affect the safety and integrity of track.

Inspectors should determine the procedures that have been established by the railroad to comply with §213.239, mindful that advisory procedures are not mandatory. Procedures should include the method employed by the railroad to receive information on severe weather (e.g., who receives the information and what is done with that information). When the railroad is notified of a possible track damaging occurrence, a special inspection must be made. A track owner may designate any official to be responsible for making a determination on whether a special inspection, under §213.239, is required. The designation is not limited to any certain craft, but the official must be trained and qualified to assure a proper inspection was conducted. The TSS do not require railroads to keep written records of special inspections, and so FRA Inspectors will not have any such records to determine railroad compliance with this section. As a result, FRA Inspectors should look to other sources (e.g., train dispatcher hi-rail occupancy records) to determine compliance.

§213.241 Inspection records

241(a) Each owner of track to which this part applies shall keep a record of each inspection required to be performed on that track under this subpart.

Guidance. Each track owner is required to keep a record of each inspection according to the requirements under §§213.4, 213.119, 213.233, and 213.235. Each inspection report under these sections must be prepared on the day of inspection and signed by the person making the inspection.

The track owner may develop any form that meets the requirements of the TSS. If the owner requires inspections at more frequent intervals than specified by §213.233(c), then the only requirement is to prepare and maintain an inspection record to comply with the minimum inspection frequency. This section is explicit concerning the required information contained in the inspection records. They must specify the track inspected [including the provisions under §213.233(b)(3)], date of inspection, location and nature of any defect, and the remedial action taken by the person making the inspection. Railroad inspection reports are required to reflect the actual conditions, as they exist in the track structure. The railroad inspector must include the specific measurement of the track parameter, whenever appropriate, when describing the nature of the defect per §213.241(b). For example: "wide gage exceeds allowable for Class 4 track - 58 inches - track slow ordered to 10 m.p.h." When defects are discovered, the track owner's inspectors and immediately initiate remedial action, in accordance with §213.5. If a speed restriction is used as remedial action, the reduced speed should be shown in the inspection records.

Railroad track inspectors are required to list all deviations from the TSS on their inspection record. FRA Inspectors should review railroad inspection records to determine if the reported data accurately reflects the track conditions, as they exist in the field. Railroad inspectors are not limited to recording deviations from the TSS (e.g., railroad maintenance items). FRA Inspectors should compare the defects they find with the railroad inspectors reports to determine the level of compliance with the railroad's inspection program. If multiple tracks are being inspected, the records must designate the track(s) traversed, and any tracks not inspected due to visibility obstruction or excessive distance as required under §213.233.

When two qualified persons inspect multiple tracks in accordance with §213.233(b), one report or two reports may be optionally prepared. If one report is used, the report must include a notation such as signature, initials or printed name of the second inspector.

Rail inspection records must be maintained by the track owner for at least two years after the inspection and for one year after the last remedial action is taken. The record must specify the location and nature of any rail defects found through internal inspection and the remedial action taken and the date thereof. This record may consist of log sheets combined with a standard rail defect and change out report, computer records, or other data kept by the track owner and containing all the required information.

The rail inspection records must specify the locations of any rail that, due to rail surface conditions, prohibit the railroad from conducting a valid search for internal defects at the required frequency. If a valid search cannot be conducted before the time or tonnage frequency expires, the remedial action and date of remedial action must be recorded on the inspection records.

241(b) Each record of an inspection under §213.4 [excepted track], §213.233 [inspections], and §213.235 [switch & crossing inspections] shall be prepared on the day the inspection is made and signed by the person making the inspection. Records shall specify the track inspected, date of inspection, location and nature of any deviation from the requirements of this part, and the remedial action taken by the person making the inspection. The owner shall designate the location(s) where each original record shall be maintained for at least one year after the inspection covered by the record. The owner shall also designate one location, within 100 miles of each state in which they conduct operations, where copies of records which apply to those operations are either maintained or can be viewed following 10 days notice by the Federal Railroad Administration.

Guidance. In reviewing compliance with this section, Inspectors should determine if the track owner is properly recording the location and date when each switch that is held in position only by the operating mechanism and a connecting rod are operated in every three month period [(§213.235(c)]. In addition, the record should reflect when each siding was actually traversed by a vehicle or on foot at the required frequency [§213.233(c)].

The regulation allows railroads to designate a location within 100 miles of each state (designated locations) where Inspectors can view records. Inspectors are required to give 10 days advance notice before conducting the record keeping inspection of designated locations. The regulation does not require the railroads to maintain the records at these designated locations, only to be able to provide viewing of them at the locations within 10 days after notification. The TSS stipulates locations within 100 miles of each state, rather than locations in each state, to accommodate those railroads whose operations may cross a state's line by only a few miles. In those cases, the railroad could designate a location in a neighboring state, provided the location is within 100 miles of that state's border. Records must be kept for at least one year after the inspection covered by the report. It is appropriate for the Inspector to expect all records will be available for inspection up to the date of notification.

241(c) Rail inspection records shall specify the date of inspection, the location and nature of any internal defects found, the remedial action taken and the date thereof, and the location of any intervals of track not tested per §213.237(d). The owner shall retain a rail inspection record for at least two years after the inspection and for one year after remedial action is taken.

Guidance. This paragraph requires a track owner to record any locations where a proper rail inspection cannot be performed because of rail surface conditions. Section §213.237(d), specifies that if rail surface conditions prohibit the railroad from conducting a proper search for rail defects, a test of that rail does not fulfill the requirements of §213.237(a) which requires a search for internal defects at specific intervals. Subsection (c) requires a record keeping of those instances.

(d) Each owner required to keep inspection records under this section shall make those records available for inspection and copying by the Federal Railroad Administration.

(e) For purposes of compliance with the requirements of this section, an owner of track may maintain and transfer records through electronic transmission, storage, and retrieval provided that;

(1) The electronic system be designed so that the integrity of each record is maintained through appropriate levels of security such as recognition of an electronic signature, or other means, which uniquely identify the initiating person as the author of that record. No two persons shall have the same electronic identity;

(2) The electronic storage of each record shall be initiated by the person making the inspection within 24 hours following the completion of that inspection;

(3) The electronic system shall ensure that each record cannot be modified in any way, or replaced, once the record is transmitted and stored;

(4) Any amendment to a record shall be electronically stored apart from the record which it amends. Each amendment to a record shall be uniquely identified as to the person making the amendment;

(5) The electronic system shall provide for the maintenance of inspection records as originally submitted without corruption or loss of data;

(6) Paper copies of electronic records and amendments to those records, that may be necessary to document compliance with this part shall be made available for inspection and copying by the Federal Railroad Administration at the locations specified in paragraph (b) of this section; and

(7) Track inspection records shall be kept available to persons who performed the inspections and to persons performing subsequent inspections.

Guidance. This paragraph contains requirements for maintaining and retrieving electronic records of track inspections. This allows each railroad to design its own electronic system as long as the system meets the specified criteria to safeguard the integrity and authenticity of each record. The provision also requires that railroads make available paper copies of electronic records, when needed, by the FRA Inspector or by railroad track inspectors.

A track owner may elect to maintain and transfer records through electronic transmission, storage, and retrieval procedures. Each record must have sufficient security to maintain the integrity of the record. Levels of security must identify the person making the inspection as the author of the record. No two individuals will have or share the same electronic signature or identity. If individuals use an electronic signature or identity other than their own, violations or personal liability action should be considered for all parties involved. The integrity of electronic inspection record systems is an extremely sensitive issue. Should the system integrity be compromised, an Inspector should immediately contact the appropriate Regional Track Specialist. Should the Regional Track Specialist be unavailable the Inspector will notify the appropriate Regional Administrator. Headquarters Track Division will also be notified.

The system must ensure that no record can be replaced, deleted, or modified in any way, once the record has been transmitted and stored. Each amendment to a record shall be stored separately from the record it amends. Each amendment must identify the person making the amendment and have sufficient security to maintain the integrity of the amendment.

For electronic records, inspection records must be completed the day of the inspection either on computer or temporarily on paper. The electronic record must then be uploaded to the permanent electronic storage system where the record will be maintained for one year. The uploading of each inspection record must be completed within 24 hours following the completion of the inspection.

An advantage of an electronic system is the associated reduction in paperwork. Therefore, Inspectors must rely on viewing records on a terminal or monitor screen whenever it is made available for viewing by the railroad. Although printouts of records must be made available to FRA Inspectors, Inspectors are discouraged from requesting paper copies of electronic records unless necessary to document non-compliance. A paper copy of an electronic record may be marked “original” and included in the documentation necessary for a violation report when recommending civil penalties.

The railroad inspection records will be furnished upon request at the location specified by the railroad as required in paragraph (b) of this section. A paper copy of any electronic inspection record or amendment will be made available to the railroad inspector or any subsequent railroad inspectors performing inspections of the same territory upon request.

Appendix

Appendix A - Superelevation in Inches/Speed MPH

Curve	Table A1 – Elevation Inches – Three Inches Unbalance												
Degree	0	½	1	1½	2	2½	3	3½	4	4½	5	5½	6
0º30'	93	100	107	113	120	125	131	136	141	146	151	156	160
0º40'	80	87	93	98	103	109	113	118	122	127	131	135	139
0º50'	72	78	83	88	93	97	101	106	110	113	117	121	124
1º00'	66	71	76	80	85	89	93	96	100	104	107	110	113
1º15'	59	63	68	72	76	79	83	86	89	93	96	99	101
1º30'	54	58	62	66	69	72	76	79	82	85	87	90	93
1º45'	50	54	57	61	64	67	70	73	76	78	81	83	86
2º00'	46	50	54	57	60	63	66	68	71	73	76	78	80
2º15'	44	47	50	54	56	59	62	64	67	69	71	74	76
2º30'	41	45	48	51	54	56	59	61	63	66	68	70	72
2º45'	40	43	46	48	51	54	56	58	60	62	65	66	68
3º00'	38	41	44	46	49	51	54	56	58	60	62	64	66
3º15'	36	39	42	45	47	49	51	54	56	57	59	61	63
3º30'	35	38	40	43	45	47	50	52	54	55	57	59	61
3º45'	34	37	39	41	44	46	48	50	52	54	55	57	59
4º00'	33	35	38	40	42	44	46	48	50	52	54	55	57
4º30'	31	33	36	38	40	42	44	45	47	49	50	52	54
5º00'	29	32	34	36	38	40	41	43	45	46	48	49	51
5º30'	28	30	32	34	36	38	40	41	43	44	46	47	48
6º00'	27	29	31	33	35	36	38	39	41	42	44	45	46
6º30'	26	28	30	31	33	35	36	38	39	41	42	43	45
7º00'	25	27	29	30	32	34	35	36	38	39	40	42	43
8º00'	23	25	27	28	30	31	33	34	35	37	38	39	40
9º00'	22	24	25	27	28	30	31	32	33	35	36	37	38
10º00'	21	22	24	25	27	28	29	31	32	33	34	35	36
11º00'	20	21	23	24	26	27	28	29	30	31	32	33	34
12º00'	19	20	22	23	24	26	27	28	29	30	31	32	33

Curve	Table A2 - Elevation Inches – Four Inches Unbalance												
Degree	0	½	1	1½	2	2½	3	3½	4	4½	5	5½	6
0º30'	107	113	120	125	131	136	141	146	151	156	160	165	169
0º40'	93	98	104	109	113	118	122	127	131	135	139	143	146
0º50'	83	88	93	97	101	106	110	113	117	121	124	128	131
1º00'	76	80	85	89	93	96	100	104	107	110	113	116	120
1º15'	68	72	76	79	83	86	89	93	96	99	101	104	107
1º30'	62	65	69	72	76	79	82	85	87	90	93	95	98
1º45'	57	61	64	67	70	73	76	78	81	83	86	88	90
2º00'	53	57	60	63	65	68	71	73	76	78	80	82	85
2º15'	50	53	56	59	62	64	67	69	71	73	76	78	80
2º30'	48	51	53	56	59	61	63	65	68	70	72	74	76
2º45'	46	48	51	53	56	58	60	62	64	66	68	70	72
3º00'	44	46	49	51	53	56	58	60	62	64	65	67	69
3º15'	42	44	47	49	51	53	55	57	59	61	63	65	66
3º30'	40	43	45	47	49	52	53	55	57	59	61	62	64
3º45'	39	41	44	46	48	50	52	53	55	57	59	60	62
4º00'	38	40	42	44	46	48	50	52	53	55	57	58	60
4º30'	36	38	40	42	44	45	47	49	50	52	53	55	56
5º00'	34	36	38	40	41	43	45	46	48	49	51	52	53
5º30'	32	34	36	38	39	41	43	44	46	47	48	50	51
6º00'	31	33	35	36	38	39	41	42	44	45	46	48	49
6º30'	30	31	33	35	36	38	39	41	42	43	44	46	47
7º00'	29	30	32	34	35	36	38	39	40	42	43	44	45
8º00'	27	28	30	31	33	34	35	37	38	39	40	41	42
9º00'	25	27	28	30	31	32	33	35	36	37	38	39	40
10º00'	24	25	27	28	29	30	32	33	34	35	36	37	38
11º00'	23	24	25	27	28	29	30	31	32	33	34	35	36
12º00'	22	23	24	26	27	28	29	30	31	32	33	34	35

Appendix B - Defect Code/Penalty Schedule

Defect Description (sorted by paragraph)	Code (unsorted)	Violation	Willful Violation
Subpart A General			
213.4 Excepted track			
(a) Excepted track segment not identified in appropriate record	4.01	2,500	5,000
(b) Excepted track segment located within 30 feet of an adjacent track subject to simultaneous operation at speeds in excess of 10 mph	4.02	2,500	5,000
(c) Excepted track not inspected in accordance with §213.233(c) and 213.235 as specified for Class 1 track	4.03	2,500	5,000
(d) Train with a car required to be placarded by 49 CFR Part 172 operated over excepted track within 100 feet of a bridge or in a public street or highway	4.07	2,500	5,000
(e) Excepted track operations			
(1) Train speed exceeds 10 mph on excepted track	4.04	5,000	7,500
(2) Occupied passenger train operated on excepted track	4.05	7,000	10,000
(3) Freight train operated on excepted track with more than five cars required to be placarded in accordance with 49 CFR Part 172	4.06	7,000	10,000
(4) The gage on excepted track exceeds 4'10¼ inches [use 213.53.05]		5,000	7,500
(f) Failure to notify FRA of removal of trackage from excepted status	4.08	2,000	4,000
213.7 Designation of qualified persons to supervise certain renewals and inspect track			
(a) Failure of track owner to designate qualified persons to supervise restorations & renewals	7.02	1,000	2,000
(b) Failure of track owner to designate qualified persons to inspect track for defects	7.06	1,000	2,000
(c) Failure to use qualified person to pass trains over broken rails or pull aparts	7.03	1,000	2,000

Defect Description (sorted by paragraph)	Code (unsorted)	Violation	Willful Violation
(c) Train speed exceeds 10 m.p.h. over broken rails or pull aparts	7.04	1,000	2,000
(c) Failure to promptly notify and dispatch person fully qualified under §213.7 to the location of the broken rail or pull apart	7.05	1,000	2,000
(d) Failure of track owner to properly maintain written records of designation.	7.07	1,000	2,000
213.9 Classes of track: Operating speed limits			
(a) Class of track table [reference only]			
(b) Failure to restore other than excepted track to compliance with Class 1 standards within 30 days after a person designated under §213.7(a) has determined that operations may safely continue over defect(s) not meeting Class 1 or excepted track standards	9.01	2,500	2,500
(b) Failure of track owner to enforce, over Class 1 defects, the limiting conditions imposed by person designated under §213.7(a)	9.02	2,500	2,500
213.11 Restoration or renewal of track under traffic conditions			
Proper qualified supervision not provided at work site during work hours when track is being restored or renewed under traffic conditions	11.01	2,500	2,500
213.13 Measuring track not under load			
Failure to add dynamic movement to static measurement	13.01	1,000	2,000
Subpart B Roadbed			
213.33 Drainage			
Drainage or water-carrying facility not maintained	33.01	2,500	5,000
Drainage or water-carrying facility obstructed by debris	33.02	2,500	5,000
Drainage or water-carrying facility collapsed	33.03	2,500	5,000
Drainage or water-carrying facility obstructed by vegetation	33.04	2,500	5,000

Defect Description (sorted by paragraph)	Code (unsorted)	Violation	Willful Violation
Drainage or water-carrying facility obstructed by silt	33.05	2,500	5,000
Drainage or water-carrying facility deteriorated to allow subgrade saturation	33.06	2,500	5,000
Uncontrolled water undercutting track structure or embankment	33.07	2,500	5,000
213.37 Vegetation			
(a) Combustible vegetation around track-carrying structures	37.01	1,000	2,000
(b) Vegetation obstructs visibility of railroad signs and fixed signals	37.02	1,000	2,000
(b)(2) Vegetation obstructs visibility of grade crossing warning signs and signals by the traveling public	37.10	1,000	2,000
(c) Vegetation obstructs passing of day and night signals by railroad employees	37.03	1,000	2,000
(c) Vegetation interferes with railroad employees performing normal trackside duties	37.04	1,000	2,000
(c) Excessive vegetation in toepaths and around switches that interferes with employees performing normal trackside duties.	37.08	1,000	2,000
(d) Vegetation prevents proper functioning of signal and/or communication lines	37.05	1,000	2,000
(e) Excessive vegetation at train order office, depot, interlocking plant, a carman's building, etc., prevents employees on duty from visually inspecting moving equipment when their duties so require	37.06	1,000	2,000
(e) Excessive vegetation at train meeting points prevents proper inspection of moving equipment by railroad employees	37.07	1,000	2,000
(e) Vegetation brushing sides of rolling stock that prevents employees from visually inspecting moving equipment from their normal duty stations	37.09	1,000	2,000

Subpart C Track Geometry			
213.53 Gage			
(a) Gage is measured between the heads of the rails at right angles to the rails in a plane five-eighths of an inch below the top of the rail head [reference only]			
(b) Gage dimension exceeds allowable on tangent track	53.01	5,000	7,500
(b) Gage dimension is less than allowable on tangent track	53.02	5,000	7,500
(b) Gage dimension exceeds allowable on curved track	53.03	5,000	7,500
(b) Gage dimension is less than allowable on curved track	53.04	5,000	7,500
(b) Gage dimension exceeds allowable for excepted track	53.05	5,000	7,500
213.55 Alinement			
Alinement deviation of tangent track exceeds allowable	55.01	5,000	7,500
Alinement deviation of curved track exceeds allowable for a 62-foot chord	55.02	5,000	7,500
Alinement deviation of curved track exceeds allowable for a 31-foot chord	55.03	5,000	7,500
213.57 Curves; elevation and speed limitations			
Reserved	57.01		
(a) Maximum crosslevel on curve exceeds allowable	57.06	2,500	5,000
(b) Operating speed exceeds allowable for 3 inches of unbalance, based on curvature and elevation	57.02	2,500	5,000
(c) Operating speed exceeds allowable for 4 inches of unbalance, based on curvature and elevation	57.03	2,500	5,000
(d) Qualification of equipment for (c) above [reference only]			
(e) A track owner, or an operator of a passenger or commuter service, who provides passenger or commuter service over trackage of more than one track owner… [reference only]			

(f) Equipment presently operating at curving speeds allowed under the formula in paragraph (c) of this section… [reference only]			
(g) Operating speed exceeds allowable for a FRA approved unbalance based on curvature and elevation approved for track contiguous to high speed track	57.04	2,500	5,000
Reserved	57.05		
(a) Maximum crosslevel on curve exceeds allowable	57.06	2,500	5,000
213.59 Elevation of curved track; runoff		2,500	2,500
(a) If a curve is elevated, the full elevation must be provided throughout the curve… [reference only]			
213.63 Track surface			
Runoff in any 31-feet of rail at end of raise exceeds allowable	63.01	5,000	7,500
Deviation from uniform profile on either rail exceeds allowable	63.02	5,000	7,500
Reserved	63.03		
Reserved	63.04		
Deviation from zero crosslevel at any point on tangent exceeds allowable	63.05	5,000	7,500
Reserved	63.06		
Difference in crosslevel between any two points less than 62-feet apart on tangents exceeds allowable.	63.07	5,000	7,500
Difference in crosslevel between any two points less than 62-feet apart on curves between spirals exceeds allowable	63.08	5,000	7,500
Difference in crosslevel between any two points less than 62-feet apart on spirals exceeds allowable	63.09	5,000	7,500
Reverse elevation on curve exceeds allowable	63.10	5,000	7,500
Variation in crosslevel per 31-feet exceeds allowable on restricted length spiral	63.11	5,000	7,500

Difference in crosslevel within 62-feet between a point on a curve that equals or exceeds 6 inches and a point with greater elevation exceed allowable	63.12	5,000	7,500
Crosslevel differences for six or more consecutive pairs of staggered joints exceeds allowable	63.13	5,000	7,500
Subpart D -- Track Structure			
213.103 Ballast; general			
(a)-(d) Insufficient Ballast	103.01	2,500	5,000
(a)-(d) Fouled Ballast	103.02	2,500	5,000
213.109 Crossties			
(a) Crossties made of unsound material	109.01	1,000	2,000
(b) Crossties not effectively distributed to support a 39-foot segment of track	109.03	2,500	5,000
(c) Sufficient number of nondefective ties [Paragraph (c) has been superseded by (d) which became effective on September 21, 2000]			
(d) Fewer than minimum allowable number of non-defective ties per 39 feet for tangent and curved track less than 2 degrees	109.04	1,000	2,000
(d) Fewer than minimum allowable number of non-defective ties per 39 feet for turnouts and curved track over 2 degrees	109.05	1,000	2,000
(e) Crossties counted to satisfy the requirements set forth in the table in paragraph (d) of this section shall not be... [reference only]			
(f) No effective support ties within the prescribed distance from a joint	109.02	2,500	5,000
(g) Track constructed without crossties does not effectively support track structure.	109.06	2,500	5,000
213.110 Gage Restraint Measurement Systems			
(a) Failure to notify FRA at least 30 days prior to the designation of a GRMS line segment	110.01	2,500	5,000
(a) Failure to notify FRA at least 10 days prior to the removal of a line segment from GRMS designation	110.02	2,500	5,000

(b) Failure to provide required information identifying a GRMS line segment	110.03	2,500	5,000
(c) Failure to provide sufficient technical data to establish compliance with minimum GRMS design requirements	110.04	2,500	5,000
(c) Failure to maintain and operate GRMS within minimum design requirements over designated GRMS line segments	110.05	2,500	5,000
(d)-(f) GRMS calculations [reference only]			
(g) Failure of GRMS to provide analog trace of specified parameters	110.06	2,500	5,000
(h) Failure of GRMS to provide exception report listing of specified parameters	110.07	2,500	5,000
(i) Failure to provide exception report listing to §213.7 individual prior to next inspection required under §213.233	110.08	2,500	5,000
(j) Failure to maintain and make available documented calibration procedures on GRMS vehicle	110.09	2,500	5,000
(j) Failure to initiate a daily instrument verification procedure	110.10	2,500	5,000
(j) Failure to maintain PTLF accuracy within five-percent of 4,000-pound reading	110.11	2,500	5,000
(j) Failure to make available GRMS training program	110.12	2,500	5,000
(k) Failure of GRMS training program to meet minimum requirements	110.13	2,500	5,000
(k) Failure to provide GRMS training to §213.7 individual whose territory is subject to requirements of §213.110	110.14	2,000	4,000
(l) Failure to initiate required remedial action for exceptions listed on GRMS record of lateral restraint	110.15	5,000	7,500
(l) Gage widening exceeds allowable measured with PTLF	110.16	5,000	7,500
(m) Failure to provide functional PTLF to §213.7 individual whose territory is subject to requirements of §213.110	110.17	5,000	7,500
(m) Failure to restore contact between rail and lateral rail restraint components	110.18	5,000	7,500
(n) Failure to keep GRMS records as required	110.19	2,000	4,000

(o) Failure to conduct GRMS inspections at required frequency	110.20	5,000	7,500
213.113 Defective rails			
(a) Transverse fissure	113.01	5,000	7,500
(a) Compound fissure	113.02	5,000	7,500
(a) Horizontal split head	113.03	5,000	7,500
(a) Vertical split head	113.04	5,000	7,500
(a) Split web	113.05	5,000	7,500
(a) Piped rail	113.06	5,000	7,500
(a) Bolt hole crack	113.07	5,000	7,500
(a) Head web separation	113.08	5,000	7,500
(a) Broken base	113.09	5,000	7,500
(a) Detail fracture	113.10	5,000	7,500
(a) Engine burn fracture	113.11	5,000	7,500
(a) Ordinary break	113.12	5,000	7,500
(a) Broken or defective weld	113.13	5,000	7,500
(a) Damaged rail	113.14	5,000	7,500
(a) Flattened rail	113.15	5,000	7,500
(a) Rail defect originating from bond wire attachment [Where a defect results from a bond wire attachment, FRA inspectors must cite this defect code and also include a description of the applicable rail defect as described in §213.113]	113.16		
213.115 Rail end mismatch			
Rail-end mismatch on tread of rail exceeds allowable (jointed track)	115.01	2,500	5,000
Rail-end mismatch on gage side of rail exceeds allowable (jointed track)	115.02	2,500	5,000

Rail-end mismatch on tread of rail exceeds allowable (CWR)	115.03	2,500	5,000
Rail-end mismatch on gage side of rail exceeds allowable (CWR)	115.04	2,500	5,000
213.119 Continuous welded rail			
Failure of track owner to develop and implement written CWR procedures	119.01	5,000	7,500
(a) Failure to comply with written CWR procedures	119.02	5,000	7,500
(b) Failure to comply with written CWR procedures - anchoring requirements	119.10	5,000	7,500
(c) Failure to comply with written CWR procedures - rail neutral temperature	119.11	5,000	7,500
(d) Failure to comply with written CWR procedures - monitoring procedures	119.12	5,000	7,500
(e) Failure to comply with written CWR procedures - train speed	119.13	5,000	7,500
(f) Failure to comply with written CWR procedures - inspection procedures	119.14	5,000	7,500
(g) Failure of track owner to institute required provisions for inspecting joints in CWR	119.05	5,000	7,500
(g)(2) Failure to record the location of, conditions of, and remedial action for joints in CWR, as required	119.06	5,000	7,500
(g)(2)(v)Failure to inspect joints in CWR at required frequency	119.07	5,000	7,500
(g)(3) Railroad using alternate methods to inspect joints in CWR without seeking approval from FRA	119.08	5,000	7,500
(g)(3)(ii) Railroad using alternate methods to inspect joints in CWR before approval has been granted	119.09	5,000	7,500
(h) Failure of track owner to develop a training program for the implementation of their written CWR procedures	119.03	5,000	7,500
(i) Failure to keep CWR records as required	119.04	5,000	7,500
213.121 Rail joints			
(a) Rail joint not of structurally sound design and dimension (jointed track)	121.01	2,500	5,000
(a) Rail joint not of structurally sound design and dimension (CWR)	121.11	2,500	5,000

(b) Cracked or broken joint bar in Classes 3 through 5 track (other than center-break) (jointed track)	121.02	2,500	5,000
(b) Cracked or broken joint bar in Classes 3 through 5 track (other than centerbreak) (CWR)	121.12	2,500	5,000
(b) Cracked or broken insulated joint bar in Classes 3 through 5 track (other than centerbreak) (CWR)	121.07	2,500	5,000
(b) Worn joint bar allows excessive vertical movement of rail in joint in Classes 3 through 5 track (jointed track)	121.04	2,500	5,000
(b)Worn joint bar allows excessive vertical movement of rail in joint in Classes 3 through 5 track (CWR)	121.14	2,500	5,000
(c) Center cracked or broken joint bar (jointed track)	121.03	5,000	7,500
(c) Center cracked or broken joint bar (CWR)	121.13	5,000	7,500
(c) Center cracked or broken insulated joint bar (CWR)	121.15	5,000	7,500
(d) Less than 2 bolts per rail at each joint for conventional jointed rail in Classes 2 through 5 track	121.05	2,500	5,000
(d) Less than 1 bolt per rail at each joint for conventional jointed rail in Class 1 track	121.06	2,500	5,000
(e) Less than two bolts per rail at any joint in continuous welded rail	121.17	2,500	5,000
(f) Loose joint bars (jointed track)	121.08	2,500	5,000
(f) Loose joint bars (CWR)	121.18	2,500	5,000
(g) Torch-cut or burned-bolt hole in rail in Classes 2 through 5 track (jointed track)	121.09	2,500	5,000
(g) Torch-cut or burned-bolt hole in rail in Classes 2 through 5 track (CWR)	121.19	2,500	5,000
(h) Joint bar reconfigured by torch cutting in Classes 3 through 5 track (jointed track)	121.10	5,000	7,500
(h) Joint bar reconfigured by torch cutting in Classes 3 through 5 track (CWR)	121.20	5,000	7,500
Reserved	121.16		

213.122 Torch cut rail			
(a) Torch cut rail applied in Class 3 through 5 track for other than emergency	122.01	2,500	5,000
(a) Failure to remove torch cut rails within specified time frame	122.02	2,500	5,000
(b) Failure to remove non-inventoried torch cut rail within 30 days of discovery	122.03	2,500	5,000
(b) Train speed exceeds allowable over non-inventoried torch cut rail	122.04	2,500	5,000
213.123 Tie plates			
(a) Insufficient tie plates in Class 3 through 5 track	123.01	1,000	2,000
(b) Object between base of rail and the bearing surface of the tie plate causing concentrated load	123.02	1,000	2,000
213.127 Rail fastenings			
Insufficient fasteners in a 39-foot track segment	127.01	2,500	5,000
Fasteners in a 39-foot track segment not effectively maintaining gage	127.02	2,500	5,000
213.133 Turnouts and track crossings, generally			
(a) Loose, worn, or missing switch clips	133.01	1,000	1,000
(a) Loose, worn, or missing clip bolts (transit, side jaw, eccentric, vertical).	133.02	1,000	1,000
(a) Loose, worn, or defective connecting rod	133.03	1,000	1,000
(a) Loose, worn, or defective connecting rod fastening	133.04	1,000	1,000
(a) Loose, worn, or defective switch rod	133.05	1,000	1,000
(a) Loose, worn, or missing switch rod bolt	133.06	1,000	1,000
(a) Worn or missing cotter pins	133.07	1,000	1,000
(a) Loose or missing rigid rail braces	133.08	1,000	1,000
(a) Loose or missing adjustable rail braces	133.09	1,000	1,000

(a) Missing switch, frog, or guard rail plates	133.10	1,000	1,000
(a) Loose or missing switch point stops	133.11	1,000	1,000
(a) Loose, worn, or missing frog bolts	133.12	1,000	1,000
(a) Loose, worn, or missing guard rail bolts	133.13	1,000	1,000
(a) Loose, worn or missing guard rail clamps, wedge, separator block, or end block	133.14	1,000	1,000
(a) Obstruction between switch point and stock rail	133.15	1,000	1,000
(a) Obstruction in flangeway of frog	133.16	1,000	1,000
(a) Obstruction in flangeway of guard rail	133.17	1,000	1,000
(a) Turnout or track crossing fastenings not intact or maintained	133.20	1,000	1,000
(b) Insufficient anchorage to restrain rail movement	133.18	1,000	1,000
(c) Flangeway less than 1½ inches wide	133.19	1,000	1,000
213.135 Switches			
(a) Stock rail not securely seated in switch plates	135.01	2,500	5,000
(a) Stock rail canted by overtightening rail braces	135.02	2,500	5,000
(b) Improper fit between switch point and stock rail	135.03	2,500	5,000
(b) Excessive lateral or vertical movement of switch point	135.05	2,500	5,000
(c) Outer edge of wheel contacting gage side of stock rail	135.04	2,500	5,000
(d) Heel of switch insecure	135.06	2,500	5,000
(e) Insecure switch stand or switch machine	135.07	2,500	5,000
(e) Insecure connecting rod	135.08	2,500	5,000
(f) Throw lever operable with switch lock or keeper in place	135.09	2,500	5,000
(g) Switch position indicator not clearly visible	135.10	2,500	5,000

(h) Unusually chipped or worn switch point	135.11	5,000	7,500
(h) Improper switch closure due to metal flow	135.12	5,000	7,500
(i) Use of tongue and plane mate where speeds exceed class one	135.13		
213.137 Frogs			
(a) Insufficient flangeway depth	137.01	2,500	5,000
(b) Frog point chipped, broken, or worn in excess of allowable	137.02	2,500	5,000
(c) Tread portion of frog worn in excess of allowable	137.03	2,500	5,000
(d) Use of flange bearing frog where speed exceeds that permitted by Class 1	137.04	2,500	5,000
Frog condition not otherwise provided [This code is intended for advisory purposes only, not for citing defects]	137.99		
213.139 Spring rail frogs			
(a) Outer edge of wheel contacting side of spring wing rail	139.01	2,500	5,000
(b) Toe of wing rail not fully bolted and tight	139.02	2,500	5,000
(b) Ties under or wing rail not solidly tamped	139.03	2,500	5,000
(c) Bolt hole defect in frog	139.04	2,500	5,000
(c) Head and web separation in frog	139.05	2,500	5,000
(d) Insufficient tension in spring to hold wing rail against point rail	139.06	2,500	5,000
(e) Excessive clearance between hold-down housing and horn	139.07	2,500	5,000
213.141 Self-guarded frogs			
(a) Raised guard worn excessively	141.01	2,500	5,000
(b) Frog point rebuilt before restoring guarding face	141.02	2,500	5,000
213.143 Frog guard rails and guard faces; gage			
Guard check gage less than allowable	143.01	2,500	5,000

Guard face gage exceeds allowable	143.02	2,500	5,000
Cracked or broken guard rail	143.03	2,500	5,000
Subpart E – Track appliances and track-related devices			
213.205 Derails			
(a) Derail not clearly visible	205.01	2,500	5,000
(b) Derail operable when locked	205.02	2,500	5,000
(c) Improperly installed derail	205.05	2,500	5,000
(c) Loose, worn, or defective parts of derail	205.06	2,500	5,000
(d) Improper size derail	205.04	2,500	5,000
Reserved	205.03		
Subpart F – Inspection			
213.233 Track inspections			
(a) Track inspected by other than qualified designated individual	233.01	2,000	4,000
(b) Track being inspected at excessive speed	233.02	2,000	4,000
(b) One Inspector inspecting more than two tracks	233.05	2,000	4,000
(b) Two Inspectors inspecting more than four tracks	233.06	2,000	4,000
(b)(3) Inspection performed on track outside of maximum allowable track center distances	233.07	2,000	4,000
(b)(3) Main track not traversed within the required frequency	233.08	2,000	4,000
(b)(3) Siding track not traversed within the required frequency	233.09	2,000	4,000
(c) Failure to inspect at required frequency	233.03	2,000	4,000
(d) Failure to initiate remedial action for deviations found	233.04	2,000	4,000

213.235 Switches, crossings, transition devices			
(a) Failure to inspect turnouts at required frequency	235.01	2,000	4,000
(a) Failure to inspect track crossings at required frequency	235.02	2,000	4,000
(a) Failure to inspect lift rail assemblies or other transition devices on moveable bridges at required frequency	235.03	2,000	4,000
(b) Failure to operate specified switches in Classes 3 through 5	235.04	2,000	4,000
213.237 Inspection of rail			
(a) Failure to inspect rail for internal defects at required frequency	237.01	2,500	5,000
(b) Failure of equipment to inspect rail at joints	237.02	2,500	5,000
(c) Defective rail not marked properly	237.03	2,500	5,000
(d) Invalid test due to rail surface conditions track cannot be considered as a search for internal defects under §213.237(a)			
(e) Failure to reduce operating speed until valid rail inspection is performed	237.04	2,500	5,000
213.239 Special inspections			
Failure to conduct special inspections when required	239.01	2,500	5,000
213.241 Inspection records			
(a) Failure to keep records as required	241.01	1,000	1,000
(b) Failure of Inspector to complete report at time of inspection	241.02	1,000	1,000
(b) Failure of inspector to sign report	241.03	1,000	1,000
(b) Failure of Inspector to provide required information	241.04	1,000	1,000
(b) Failure to record required CWR joint inspection	241.15	1,000	1,000
(c) Failure of rail inspection record to provide required information	241.05	1,000	1,000

(d) Failure to make records available for copying and inspection	241.06	1,000	1,000
(e)(1) Electronic system does not maintain the integrity of each record	241.07	1,000	1,000
(e)(2) Electronic storage not initiated within 24 hours	241.14	1,000	1,000
(e)(3) Electronic system allows record or amendments to be modified	241.08	1,000	1,000
(e)(4) Electronic amendments not stored separately from record	241.09	1,000	1,000
(e)(4) Person making electronic amendment not identified	241.10	1,000	1,000
(e)(5) Electronic system corrupts or losses data	241.11	1,000	1,000
(e)(6) Paper copies of records not made available for inspection and copying	241.12	1,000	1,000
(e)(7) Inspection reports not available to Inspector or subsequent Inspectors	241.13	1,000	1,000

Note – defect code descriptions are not regulatory language. They are analytical instruments only and are subject to change as needed.

Appendix C - Rail Mill Branding and Key Dimensions

Weight	Type	Rail Mill/Branding Designations														
		U.S. Steel	Bethlehem	Illinois	Old Illinois	Carnegie	Tennessee	Lackawanna	Midvale	Colorado	Inland	Cambria	MD/PA	Dominion	Algoma	Sydney
70	ARA-A			7020		7020	7020	7031								
70	ARA-B		174	7030		7030	7030	7032								
70	ASCE	7040	70AS	7040	7010	7040	7040	700	532	701			237			
70	Bangor Aroostook		70-BA					703					97			
70	Chicago & Alton				7002											
70	Pennsylvania			7033	7005	7033	7033		504				57			
72	CP Sandberg															
72	Chicago NW	7250	72NP	7250	7201	7250	7250		581							
72	Spokane							722								
74	MD/PA												146			
75	ASCE	7540	75AS	7540	7506	7540	7540	750	529	753			214			
75	Boston & Maine		92					752					92			
75	Lackawanna		75-C					753								
75	Int. Great Northern			7551		7551	7551									
75	Miscellaneous															
75	Missouri Pacific	7550	75MP	7550	7512	7550	7550	754	528							
75	Nat. Ry. Mexico		128													
75	NYC. (Dudley)															
75	MD/PA												87			
75	Seaboard (Dudley)		75DY	7522		7522	7522						221			
75	Union Pacific		75-B	7523	7513	7523	7523			754			249			
75	Union Pacific	7524	75SP	7524		7524	7524			757						
76	MD/PA												216			
78	Great Northern				77501			775								
78	Old Colony		78-OC										98			
79	MD/PA												76			
80	Frictionless		79.5-C													
80	ARA-A	8020	80-RA	8020		8020	8020	8031		801						
80	ARA-B	8030	80-RB	8030		8030	8030	8032	569	802						

Weight	Type	Rail Mill/Branding Designations														
		U.S. Steel	Bethlehem	Illinois	Old Illinois	Carnegie	Tennessee	Lackawanna	Midvale	Colorado	Inland	Cambria	MD/PA	Dominion	Algoma	Sydney
80	ASCE	8040	80AS	8040		8040	8040	800	530	800	8040		251			
80	Canadian Northern		804	8010		8010	8010	804								
80	DUDLEY	8022	80DY	8022		8022	8022						220			
80	Frictionless		80-MC-F													
80	Great Northern				8009			802								
80	Hocking Valley								540							
80	New York Central		220	8022	8008	8022	8022	801	543							
85	Asce	8540	85AS	8540	8504	8540	8540	850	531	851	8540		235			
85	C.B. & Q.	8543	85-CB	8543	8506	8543	8543	855		852						
85	Canadian Pacific	8524	85CP	8524		8524	8524	856			8524			8501	113	
85	Head Free – CP													8504	137	
85	Denver & RG									850						
85	D. & R.G. / C & S									853						
85	Great Northern		854	8553	8509	8553	8553	854								
85	Missouri Pacific	8550	853	8550	8507	8550	8550									
85	N.Y.C. & Stl. / Kcs		85-NK	8521		8521	8521	8531			8521					
85	Pennsylvania	8531	85PS	8531	8530	8531	8531	8530	559		8531					
85	Pennsylvania		85-PR	8533	8503	8533	8533	852	500				67			
85	Seaboard (Dudley)		85DY	8522		8522	8522	851					261			
85	Soo Line	8520		8520		8520	8520									
85	Western Pacific															
90	ARA-A	9020	90RA	9020		9020	9020	9031	563	902	9020					
90	ARA-B	9030	90RB	9030		9030	9030	9032	561	905	9030					
90	ASCE	9040	90AS	9040	9002	9040	9040	900	535		9040		245			
90	A.T. & SF	9021	90SF	9021		9021	9021	9033		903	9021					
90	Chicago NW	9035	90OM	9035		9035	9035	904								
90	Denver Rio Grande									906						
90	Frictionless			9039		9039	9039									
90	Frictionless			9029		9029	9029									
90	Great Northern	9024	90GH	9024		9024	9024			908	9024					
90	Great Northern			9036		9036										
90	Great Northern		90-GN	9034	9010	9034	9034	9030	560	904						

Weight	Type	Rail Mill/Branding Designations														
		U.S. Steel	Bethlehem	Illinois	Old Illinois	Carnegie	Tennessee	Lackawanna	Midvale	Colorado	Inland	Cambria	MD/PA	Dominion	Algoma	Sydney
90	Head Free - R.A.	9027	90RA-T	9027		9027	9027			TC1013						
90	Interborough R. T.	9050	90RT	9050		9050	9050	902					77			
90	Lehigh Valley															
90	N.Y.C. (Dudley)		90DY					901								
90	Union Pacific	9023		9023	9003	9023	9023			901						
91	Lackawanna		91- DL	9133		9133	9133	911								
92	Frictionless		304													
93	Frictionless		93-NH-F					932								
95	ASCE							950					267			
95	Boston & Albany															
95	W & H Ry. (Dudley)		95-DY					951								
97	Frictionless		97-CO-F													
98	Frictionless		98-PS-F													
100	ARA-A	10020	100RA	10020		10020	10020	10031	565	1003	10020					
100	ARA-B	10030	100RB	10030		10030	10030	10032	564	1002	10030					
100	AREA	10025	100RE	10025		10025	10025			10025	10025					
100	ASCED	10040	100 AS	10040	10001	10040	10040	1000	536				247			
100	Canadian Pacific															100CP-RE
100	Chicago NW	10035	100-OM	10035		10035	10035	1006			10035					
100	Elgin Joliet & East.			10050		10050	10050									
100	Great Northern	10036	100GN	10036		10036	10036	1008								
100	Head Free - R.A.		100RA-T											10004	136	
100	Head Free - R.E.		100RE-T													
100	Interborough R. T.	10005	100RT	10005		10005	10005	1005								
100	N.Y., N.H. & H.	10034	100NH	10034	10004	10034	10034	1002					100			
100	New York Central		100-DY	10022	10003	10022	10022	1001								
100	Pennsylvania	10031	100PS	10031		10031	10031	10030	558		10031					
100	Pennsylvania	10033	100PR	10033	10002	10033	10033	1003	520				96			
100	Reading	10032	100RG	10032		10032	10032	1007								
100	R.W. Hunt.															
101	Lackawanna	10133	101DL	10133		10133	10133	10130								
105	Lackawanna	10533	105DL	10533		10533	10533	1052								

Weight	Type	Rail Mill/Branding Designations														
		U.S. Steel	Bethlehem	Illinois	Old Illinois	Carnegie	Tennessee	Lackawanna	Midvale	Colorado	Inland	Cambria	MD/PA	Dominion	Algoma	Sydney
105	Dudley	10524	105DY	10524		10524	10524				10524					
105	New York Central		105-B	10522		10522	10522	1051								
106	Miscellaneous.									1060						
107	N.Y., N.H. & H.	10734	107NH	10734		10734	10734	1072								
110	AREA	11025	110RE	11025		11025	11025			1100	11025					
110	ASCE												268			
110	C.T.A.	11050														
110	Great Northern	11036	110GN	11036		11036	11036				11036					
110	Head Free - AREA	11027	110RE-T	11027		11027	11027				11027					
110	Lehigh Valley	11033	110LV	11033		11033	11033									
112	AREA	11228	112RE	11228		11228	11228			1121	11228					
112	Head Free – R.E.	11227	112RE-T	11227		11227	11227				11227HF					
112	CB & Q – TR	11229		11229		11229	11229			1122						
113	Head Free – SP	11327	113RE-T	11327		11327	11327			1130						
115	AREA	11525	115RE	11525		11525	11525			1150	11525					
115	D.R.G.W.									1155						
115	Dudley	11522/23	115DY	11523		11523	11523									
115	Miscellaneous.															
118	Lackawanna		118DL-M													
119	Area	11937								1190	11937					
120	Area			12025		12025	12025									
120	Mfg. Std.		120-MS													
120	New York Central		120-DY					1201								
122	CB (B&O)		122-CB													
125	Pennsylvania		308	12531		12531	12531	12530	584							
126	Frictionless		125.5-PSF													
127	Dudley	12723	127DYM								12723					
127	New York Central		127-DY	12722		12722	12722				12722					
129	CB & Q – TR	12929		12929		12929	12929				12929					
130	AREA	13025	130RE	13025		13025	13025			1300	13025					
130	Head Free – P.S.		130PS-T													
130	Head Free – R.E.	13027	130RE-T	13027		13027	13027				13027			13001	138	

Weight	Type	Rail Mill/Branding Designations														
		U.S. Steel	Bethlehem	Illinois	Old Illinois	Carnegie	Tennessee	Lackawanna	Midvale	Colorado	Inland	Cambria	MD/PA	Dominion	Algoma	Sydney
130	Phil. & Reading		130RG													
130	Pennsylvania	13031	130PS	13031		13031	13031	13030	589	1302	13031					
131	Area	13128	131RE	13128		13128	13128			1311	13128					
131	Head Free – R.E.	13127														
132	Area	13225	132RE	13225		13225	13225			1321	13225					
132	Head Free – S.P.	13227	132RE-T	13227		13227	13227			1320						
133	Area	13331	133RE	13331		13331	13331			1330	13331					
135	Central of NJ		135CR													
136	AREA	13637	136RE							1360						
136	Lehigh Valley	13633	136LV	13633		13633	13633									
136	Lehigh Valley		136-LV													
136	Lehigh Valley		136-LV-M													
136	New York Central		136NYC													
140	AREA/PS	14031	140RE	14031		14031	14031									
141	AREA		141RE													
152	Pennsylvania	15222	152PS	15224		15224	15224									
155	Pennsylvania	15531	155PS	15531		15531	15531									

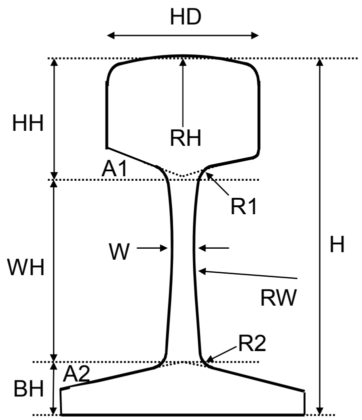
		Key Rail Dimensions											
		Rail Height	Head Width	Web Thickness	Head Height	Web Height Fishing	Base Height	Head Radius	Web Radius	Top Fillet Radius	Bottom Fillet Radius	Head Bottom Angle	Base Angle
Weight	Type	H	HD	W	HH	WH	BH	RH	RW	R1	R2	A1	A2
70	ARA-A	4 ¾	2 3/8	1/2	1 11/32	2 1/2	29/32	14	14	0.375	0.375	1 to 4	1 to 4
70	ARA-B	4 35/64	2 3/8	33/64	1 23/64	2 17/64	59/64	12	12	0.3125	0.3125	13 deg.	13 deg.
70	ASCE	4 5/8	2 7/16	33/64	1 11/32	2 15/32	13/16	12	12	0.25	0.25	13 deg.	13 deg.
70	Bangor Aroostook	4 ¾	2 7/16	1/2	1 13/32	2 19/32	3/4	12	12	0.25	0.25	12 deg.	12 deg.
70	Chicago & Alton	4 3/8	2 23/64	35/64	1 45/64	1 59/64	3/4					12 deg.	12 deg.
70	Pennsylvania	4 ½	2 7/16	1/2	1 19/32	2 1/8	25/32	10	8	0.25	0.25	13 deg.	13 deg.
72	CP (Sandberg)	4 15/16	2 1/4	1/2	1 5/8	2 25/64	59/64	6	VERT.	0.375	0.375	15 deg.	15 deg.
72	Chicago NW	4 ¾	2 3/8	9/16	1 13/32	2 1/2	27/32					14 deg.	14 deg.
72	Spokane Int'l. Ry.	4 45/64	2 7/16	33/64	1 27/64	2 15/32	13/16	12	12	0.25	0.25	13 deg.	13 deg.
74	MD/PA	4 11/16	2 7/16	9/16	1 3/4	2 3/16	3/4	15	15	0.3125	0.3125	17 deg.	13 deg.
75	ASCE	4 13/16	2 15/32	17/32	1 27/64	2 35/64	27/32	12	12	0.25	0.25	13 deg.	13 deg.
75	Boston & Maine	5	2 1/2	9/16	1 7/16	2 47/64	53/64	12	STR.	0.25	0.25	13 deg.	13 deg.
75	Lackawanna	4 11/16	2 1/2	1/2	1 43/64	2 13/64	13/16	10.5	10	0.3125	0.3125	18 deg.	12° 45'
75	Int. & Grt. Nor	4 ¾	2 1/2	9/16	1 7/16	2 15/32	27/32					13 deg.	13 deg.
75	Miscellaneous	4 ¾	2 1/2	1/2	1 27/32	2 1/8	25/32					13 deg.	13 deg.
75	Missouri Pacific	4 ¾	2 9/16	9/16	1 7/16	2 15/32	27/32	12	30	0.25	0.25	13 deg.	13 deg.
75	Nat. Ry. Mex.	5	2 3/4	1/2	1 3/8	2 7/8	3/4					12 deg.	12 deg.
75	N.Y.C. (Dudley)	5	2 5/8	17/32	1 3/8	2 3/4	7/8	14	14	0.5	0.3125	14 deg.	14 deg.
75	MD/PA	4 3/4	2 1/2	9/16	1 1/2	2 7/16	13/16	12	VERT.	0.25	0.25	13 deg.	13 deg.
75	Seaboard (Dudley)	5	2 9/16	1/2	1 3/8	2 3/4	7/8	14	14	0.5	0.3125	14 deg.	14 deg.
75	Union Pacific	5	2 9/16	33/64	1 3/8	2 13/16	13/16	12	12	0.25	0.25	13 deg.	13 deg.
75	Union Pacific	4 15/16	2 7/16	33/64	1 3/8	2 5/8	15/16	14	14	0.375	0.375	1 to 4	1 to 4
76	MD/PA	4 3/4	2 1/2	1/2	1 11/16	2 1/4	13/16	20	VERT.	0.3125	0.3125	14° 30'	12 deg.
78	Great Northern	5	2 3/8	5/8	1 11/16	2 1/2	13/16					14 deg.	14 deg.
78	Old Colony	4 3/4	2 1/2	17/32	1 3/4	2 7/32	25/32	12	12	0.4375	0.4375	14 deg.	12° 15'
79	MD/PA	4 3/4	2 5/8	5/8	1 5/8	2 11/32	25/32	12	9	0.25	0.25	13 deg.	13 deg.
80	Frictionless	5 3/16	1 15/16	9/16	2 1/32	2 9/32	7/8					13 deg.	13 deg.
80	ARA-A	5 1/8	2 1/2	33/64	1 7/16	2 23/32	31/32	14	14	0.375	0.375	1 to 4	1 to 4
80	ARA-B	4 15/16	2 7/16	35/64	1 15/32	2 15/32	1	12	12	0.3125	0.3125	13 deg.	13 deg.
80	ASCE	5	2 1/2	35/64	1 1/2	2 5/8	7/8	12	12	0.25	0.25	13 deg.	13 deg.
80	Canadian Northern	5	2 9/16	35/64	1 13/32	2 11/16	29/32					13 deg.	13 deg.

		Key Rail Dimensions											
		Rail Height	Head Width	Web Thickness	Head Height	Web Height Fishing	Base Height	Head Radius	Web Radius	Top Fillet Radius	Bottom Fillet Radius	Head Bottom Angle	Base Angle
Weight	Type	H	HD	W	HH	WH	BH	RH	RW	R1	R2	A1	A2
80	Dudley	5 1/8	2 21/32	17/32	1 1/2	2 3/4	7/8	14	14	0.5	0.3125	1 to 4	1 to 4
80	Frictionless	5 3/16	1 15/16	9/16	2 1/32	2 9/32	7/8					13 deg.	13 deg.
80	Great Northern	5	2 13/32	5/8	1 5/8	2 1/2	7/8					14 deg.	14 deg.
80	Hocking Valley	5	2 31/64	29/64	1 3/4	2 25/64	7/8					13 deg.	13 deg.
80	New York Central	5 1/8	2 21/32	17/32	1 1/2	2 3/4	7/8	14	14	0.5	0.3125	1 to 4	1 to 4
85	ASCE	5 3/16	2 9/16	9/16	1 35/64	2 3/4	57/64	12	12	0.25	0.25	13 deg.	13 deg.
85	C.B. & Q.	5 3/16	2 21/32	9/16	1 35/64	2 3/4	57/64					13 deg.	13 deg.
85	Canadian Pacific	5 1/8	2 1/2	9/16	1 7/16	2 11/16	1	8	8	0.375	0.375	1 to 4	1 to 4
85	Head Free – CP	5 1/4	2 29/64	9/16	1 9/16	2 11/16	1	8	8	0.375	0.375	1 to 4	1 to 4
85	Denver & RG	5 1/4	2 1/2	9/16	1 3/4	2 5/8	7/8					13 deg.	13 deg.
85	D. & R.G. / C & S	5 3/8	2 1/2	9/16	1 15/32	2 29/32	1					1 to 4	1 to 4
85	Great Northern	5	2 21/32	21/32	1 19/32	2 1/2	29/32					14 deg.	14 deg.
85	Missouri Pacific	5 7/32	2 15/32	19/32	1 3/4	2 39/64	55/64					13 deg.	13 deg.
85	N.Y.C. & Stl. / Kcs	5 3/8	2 17/32	17/32	1 29/64	2 15/16	63/64	14	14	0.375	0.375	1 to 4	1 to 4
85	Pennsylvania	5 1/8	2 1/2	17/32	1 21/32	2 15/32	1	10	10	0.25	0.25	15 deg.	13 deg.
85	Pennsylvania	5	2 9/16	17/32	1 3/4	2 3/8	7/8	10	8	0.25	0.25	13 deg.	13 deg.
85	Seaboard (Dudley)	5 1/4	2 11/16	17/32	1 5/8	2 3/4	7/8	14	14	0.5	0.3125	1 to 4	1 to 4
85	Soo Line	5 3/8	2 1/2	9/16	1 15/32	2 29/32	1					14° 2' 11"	14° 2' 11"
85	Western Pacific	5 1/4	2 1/2	9/16	1 3/4	2 5/8	7/8	10	VERT.	0.3125	0.3125	13 deg.	13 deg.
90	ARA-A	5 5/8	2 9/16	9/16	1 15/32	3 5/32	1	14	14	0.375	0.375	1 to 4	1 to 4
90	ARA-B	5 17/64	2 9/16	9/16	1 39/64	2 5/8	1 1/32	12	12	0.3125	0.3125	13 deg.	13 deg.
90	ASCE	5 3/8	2 5/8	9/16	1 19/32	2 55/64	59/64	12	12	0.25	0.25	13 deg.	13 deg.
90	AT & SF	5 5/8	2 9/16	9/16	1 15/32	3 5/32	1					1 to 4	1 to 4
90	Chicago NW	5 17/32	2 1/2	1/2	1 17/32	2 31/32	1 1/32	12	12	0.3125	0.3125	13 deg.	13 deg.
90	Denver & RG	5 1/2	2 9/16	9/16	1 5/8	2 7/8	1					14 deg.	14 deg.
90	Frictionless	5 5/8	2 1/4	9/16	2	2 5/8	1					13 deg.	13 deg.
90	Frictionless	6 3/32	1 59/64	9/16	1 15/16	3 5/32	1					1 to 4	1 to 4
90	Great Northern	5 3/8	2 5/8	9/16	1 15/32	2 7/8	1 1/32	12	14	0.4375	0.625	13 deg.	13 deg.
90	Great Northern	5 3/8	2 5/8	19/32	1 15/32	2 7/8	1 1/32					13 deg.	13 deg.
90	Great Northern	5 3/8	2 5/8	5/8	1 1/2	2 7/8	1	14	14	0.375	0.375	13 deg.	13 deg.
90	Head Free - R.A.	5 25/32	2 31/64	9/16	1 5/8	3 5/32	1	14	14	0.375		1 to 4; U = 54°	1 to 4
90	Interborough R.T.	5	2 7/8	11/16	1 25/32	2 11/32	7/8	12	9	0.25	0.25	13 deg.	13 deg.
90	Lehigh Valley	5	2 3/4	5/8	1 53/64	2 15/64	15/16	12	9	0.25	0.25	14 deg.	14 deg.

		Key Rail Dimensions											
		Rail Height	Head Width	Web Thickness	Head Height	Web Height Fishing	Base Height	Head Radius	Web Radius	Top Fillet Radius	Bottom Fillet Radius	Head Bottom Angle	Base Angle
Weight	Type	H	HD	W	HH	WH	BH	RH	RW	R1	R2	A1	A2
90	N.Y.C. (Dudley)	5 1/2	2 21/32	9/16	1 1/2	3 1/32	31/32	14	14	0.5	1	1 to 4	1 to 4
90	Union Pacific	5 3/4	2 3/4	17/32	1 1/2	3 3/8	7/8					13 deg.	13 deg.
91	Lackawanna	5 1/4	2 5/8	5/8	1 41/64	2 11/16	59/64	10	8	0.25	0.25	13 deg.	13 deg.
92	Frictionless	5 7/16	1 15/16	5/8	2 3/32	2 5/16	1 1/32					13 deg.	13 deg.
93	Frictionless	6 1/8	2 1/8	19/32	1 13/16	3 3/8	15/16					13 deg.	13 deg.
95	ASCE	5 9/16	2 11/16	9/16	1 41/64	2 63/64	15/16	12	12	0.25	0.25	13 deg.	13 deg.
95	Boston & Albany	5 1/32	3	5/8	1 9/16	2 15/32	1	14	14	0.5	0.3125	14 deg.	14 deg.
95	W & H Ry. (Dudley)	5 1/32	3	5/8	1 9/16	2 15/32	1	14	14	0.5	0.3125	1 to 4	1 to 4
97	Frictionless	5 7/8	2 1/4	9/16	1 15/16	2 55/64	1 5/64					13 deg.	13 deg.
98	Frictionless	5 27/32	2 1/2	9/16	1 31/32	2 25/32	1 3/32					15 deg.	13 deg.
100	ARA-A	6	2 3/4	9/16	1 9/16	3 3/8	1 1/16	14	14	0.375	0.375	1 to 4	1 to 4
100	ARA-B	5 41/64	2 21/32	9/16	1 45/64	2 55/64	1 5/64	12	12	0.3125	0.3125	13 deg.	13 deg.
100	AREA	6	2 11/16	9/16	1 21/32	3 9/32	1 1/16	14	14	0.375	0.625	1 to 4	1 to 4
100	ASCE	5 3/4	2 3/4	9/16	1 45/64	3 5/64	31/32	12	12	0.25	0.25	13 deg.	13 deg.
100	Canadian Pacific	6 1/16	2 11/16	9/16	1 23/32	3 9/32	1 1/16	14	14	0.375	0.625	1 to 4	1 to 4
100	Chicago NW	5 45/64	2 9/16	9/16	1 39/64	2 61/64	1 9/64	12	12	0.3125	0.3125	13 deg.	13 deg.
100	Elgin Joliet & East.	5 9/16	2 21/32	9/16	1 37/64	2 51/64	1 3/16					1 to 4	1 to 4
100	Great Northern	5 3/4	2 3/4	9/16	1 5/8	3	1 1/8					1 to 4	1 to 4
100	Head Free - R.A.	6 5/32	2 11/16	9/16	1 23/32	3 3/8	1 1/16	14	14	0.375		1 to 4; U = 49°	1 to 4
100	Head Free - R.E.	6 1/16	2 39/64	9/16	1 23/32	3 9/32	1 1/16					1 to 4; U = 57°	1 to 4
100	Interborough R. T.	5 3/4	2 7/8	9/16	1 45/64	3 5/64	31/32	12	12	0.25	0.25	13 deg.	13 deg.
100	N.Y., N.H. & H.	6	2 3/4	19/32	1 23/32	3 11/32	15/16	12	12	0.25	0.25	13 deg.	13 deg.
100	New York Central	6	3	19/32	1 5/8	3 13/32	31/32	14	14	0.5	0.3125	1 to 4	1 to 4
100	Pennsylvania	5 11/16	2 43/64	9/16	1 13/16	2 25/32	1 3/32	10	10	0.3125	0.3125	15 deg.	13 deg.
100	Pennsylvania	5 1/2	2 13/16	5/8	1 7/8	2 11/16	15/16	10	8	0.25	0.25	13 deg.	13 deg.
100	Reading	5 5/8	2 21/32	9/16	1 45/64	2 55/64	1 1/16	12	12	0.3125	0.3125	13 deg.	13 deg.
100	R.W. Hunt.	6	2 9/16	9/16	1 19/32	3 21/64	1 5/64	12	12	0.375	0.375	14 deg.	14 deg.
101	Lackawanna	5 7/16	2 3/4	5/8	1 23/32	2 11/16	1 1/32	10	8	0.25	0.25	13 deg.	13 deg.
105	Lackawanna	6	2 3/4	5/8	1 23/32	3 1/4	1 1/32	10	8	0.25	0.25	13 deg.	13 deg.
105	Dudley	6	3	5/8	1 5/8	3 13/32	31/32	14	14	0.5	0.75	1 to 4	1 to 4
105	New York Central	6	3	5/8	1 5/8	3 13/32	31/32	14	14	0.5	1	1 to 4	1 to 4
106	Misc.	6 3/16	2 21/32	19/32	1 3/4	3 3/8	1 1/16					1 to 4	1 to 4
107	N.Y., N.H. & H.	6 1/8	2 3/4	19/32	1 23/32	3 11/32	1 1/16	12	12	0.25	0.25	13 deg.	13 deg.

		Key Rail Dimensions											
		Rail Height	Head Width	Web Thickness	Head Height	Web Height Fishing	Base Height	Head Radius	Web Radius	Top Fillet Radius	Bottom Fillet Radius	Head Bottom Angle	Base Angle
Weight	Type	H	HD	W	HH	WH	BH	RH	RW	R1	R2	A1	A2
110	AREA	6 1/4	2 25/32	19/32	1 23/32	3 13/32	1 1/8	14	14	0.375	0.625	1 to 4	1 to 4
110	ASCE	6 1/8	2 7/8	37/64	1 25/32	3 11/32	1	12	12	0.25	0.25	13 deg.	13 deg.
110	C.T.A.	7	2 3/4	9/16	1 7/8	4 5/16	13/16					14 deg.	9 deg.
110	Great Northern	6 1/2	2 3/4	19/32	1 5/8	3 3/4	1 1/8	14	14	0.5	0.625	1 to 4	1 to 4
110	Head Free - AREA	6 7/16	2 11/16	19/32	1 29/32	3 13/32	1 1/8	14	14	0.375		1 to 4; U = 55° 30'	1 to 4
110	Lehigh Valley	6	2 7/8	19/32	1 7/8	3 1/16	1 1/16					1 to 4	1 to 4
112	AREA	6 5/8	2 23/32	19/32	1 11/16	3 13/16	1 1/8	24	10 & 23	0.375	0.625	1 to 4	1 to 4
112	Head Free - R.E.	6 3/4	2 11/16	19/32	1 13/16	3 13/16	1 1/8	14	10 & 23	0.375		1 to 4; U = 58°	1 to 4
112	CB & Q – TR	6 3/4	2 1/2	5/8	1 3/4	3 7/8	1 1/8					1 to 4; U = 77° 45'	1 to 4
113	Head Free – SP	6 13/16	2 11/16	19/32	1 7/8	3 13/16	1 1/8	14	10 & 23	0.375		1 to 4; U = 58°	1 to 4
115	AREA	6 5/8	2 23/32	5/8	1 11/16	3 13/16	1 1/8	10	3 & 14	0.75	0.75	1 to 4	1 to 4
115	D.R.G.W.	6 5/8	2 23/32	3/4	1 11/16	3 13/16	1 1/8					13 deg.	13 deg.
115	Dudley	6 1/2	3	5/8	1 11/16	3 3/4	1 1/16	14	14	0.5	0.75	1 to 4	1 to 4
115	Miscellaneous	6	2 15/16	21/32	1 7/8	3 1/16	1 1/16					1 to 4	1 to 4
118	Lackawanna	6 1/2	2 7/8	5/8	1 29/32	3 1/2	1 3/32					13 deg.	13 deg.
119	AREA	6 13/16	2 21/32	5/8	1 7/8	3 13/16	1 1/8	14	3 & 14	0.75	0.75	1 to 4	1 to 4
120	AREA	6 1/2	2 7/8	5/8	1 25/32	3 17/32	1 3/16					1 to 4	1 to 4
120	Mfg. Std.	6 1/4	2 7/8	5/8	1 29/32	3 5/32	1 3/16	12	12	0.375	0.375	14 deg.	14 deg.
120	New York Central	7	3	21/32	1 5/8	4 5/16	1 1/16	14	20	0.5	1	1 to 4	1 to 4
122	CB (B&O)	6 25/32	2 15/16	21/32	1 15/16	3 39/64	1 15/64	10	3 & 14	0.75	0.75	1 to 2 3/4	1 to 2 3/4, 1 to 13.7
125	Pennsylvania	6 1/2	3	21/32	1 7/8	3 13/32	1 7/32	12	16	0.5	0.75	18 deg.	14 deg.
126	Frictionless	7	1 13/16	11/16	2 3/8	3 13/32	1 7/32					18 deg.	14 deg.
127	Dudley	7	3	21/32	1 11/16	4 5/32	1 5/32					1 to 4	1 to 4
127	New York Central	7	3	21/32	1 11/16	4 5/32	1 5/32	14	18	0.5	0.75	1 to 4	1 to 4
129	CB & Q – TR	7 5/16	2 5/8	21/32	1 27/32	4 9/32	1 3/16					1 to 4	1 to 4
130	AREA	6 3/4	2 15/16	21/32	1 27/32	3 11/16	1 7/32	14	14	0.5	0.75	1 to 4	1 to 4
130	Head Free - P.S.	6 13/16	3	21/32	2 3/16	3 3/8	1 7/32					18°; U = 58° 30'	14 deg.
130	Head Free - R.E.	6 13/16	2 27/32	21/32	2 1/32	3 11/16	1 7/32	14	14	0.5		1 to 4; U = 61°	1 to 4
130	Phil. & Reading	6 27/32	2 15/16	21/32	1 15/16	3 11/16	1 7/32					1 to 4	1 to 4
130	Pennsylvania	6 5/8	3	11/16	2	3 13/32	1 7/32	12	16	0.5	0.75	18 deg.	14 deg.
131	AREA	7 1/8	3	21/32	1 3/4	4 3/16	1 3/16	24	10 & 23	0.5	0.75	1 to 4	1 to 4
131	Head Free - R.E.	7 1/4	2 31/32	21/32	1 7/8	4 3/16	1 3/16	14	10 & 23	0.5		1 to 4; U = 60° 30'	1 to 4
132	AREA	7 1/8	3	21/32	1 3/4	4 3/16	1 3/16	10	8 & 16	3/4 & 5/16	0.875	1 to 4	1 to 4

		Key Rail Dimensions											
		Rail Height	Head Width	Web Thickness	Head Height	Web Height Fishing	Base Height	Head Radius	Web Radius	Top Fillet Radius	Bottom Fillet Radius	Head Bottom Angle	Base Angle
Weight	Type	H	HD	W	HH	WH	BH	RH	RW	R1	R2	A1	A2
132	Head Free – S.P.	7 5/16	2 31/32	21/32	1 15/16	4 3/16	1 3/16	14	10 & 23	0.5		1 to 4; U = 60° 30'	1 to 4
133	AREA	7 1/16	3	11/16	1 15/16	3 15/16	1 3/16	10	8 & 16	3/4 & 7/16	0.75	1 to 3	1 to 4.011
135	Central of NJ	6 1/2	3 5/32	3/4	2	3 9/32	1 7/32					14 deg.	14 deg.
136	AREA	7 5/16	2 15/16	11/16	1 15/16	4 3/16	1 3/16	14	8 & 20	3/4 & 5/16	0.75	1 to 4	1 to 4
136	Lehigh Valley	7	2 15/16	21/32	1 7/8	3 7/8	1 1/4					1 to 4	1 to 4
136	Lehigh Valley	7 3/8	2 15/16	11/16	1 25/32	4 3/8	1 7/32					1 to 4	1 to 4
136	Lehigh Valley	7	2 15/16	11/16	1 7/8	3 7/8	1 1/4					1 to 4	1 to 4
136	New York Central	7 9/32	2 15/16	11/16	1 7/8	4 5/32							
140	AREA/PS	7 5/16	3	3/4	2 1/16	4 1/16	1 3/16	10	8 & 27	3/4 & 7/16	0.75	1 to 3	1 to 4
141	AREA	7 7/16	3 1/16	11/16	2 5/32	4 3/32	1 3/16		19 31/32	¾	3/4	18.4 deg.	14 deg.
152	Pennsylvania	8	3	11/16	1 27/32	4 7/8	1 9/32	24	6&30	0.5	0.75	14 deg.	14 deg.
155	Pennsylvania	8	3	3/4	2 1/16	4 21/32	1 9/32					18° 26' 10"	14 deg.



Appendix D - Source/Activity Codes

Activity Codes		Source Codes																
		Reg Insp	Complaint	Accident	Special Assessment	Waiver	Asist Other Fed Agencey	Other	Nuclear Route	ATIP	ATIP Follow Up	Inspect from Train	Regular STRACNET	Special STRACNET	ATIP STRACNET	Reinspect	Manut. Facility	Focused Inspection
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	R	V	W
Remedial Action	209							x										
Camp Car	218C	x	x	x	x	x	x	x	x				x	x		x		x
FRA Geometry	ATIP									x	x				x			
Barrier Plan	BAP	x	x	x	x	x	x	x	x				x	x		x		x
Bridge Worker	BWK	x	x	x	x	x	x	x	x				x	x		x		x
CWR Plans	CWRP	x	x	x	x	x	x	x	x				x	x		x		x
Derail	DER	x	x	x	x	x	x	x	x		x		x	x		x		x
GRMS - Govt	GRMG		x		x		x	x	x									x
GRMS - Railroad	GRMS	x	x	x	x	x	x	x					x	x		x		
Highway Rail Vegetation	HGCT	x	x	x	x	x	x	x	x				x	x		x		x
Lift Rail	LRA	x	x	x	x	x	x	x	x		x		x	x		x		x
Bridge Inspection	MSB	x	x	x	x		x	x	x				x	x		x		x
Main Track Hi Rail	MTH	x	x	x	x	x	x	x	x		x		x	x		x		x
Main Track Walk	MTW	x	x	x	x	x	x	x	x		x		x	x		x		x
Noise	NOIS	x	x	x	x	x	x	x					x	x		x		x
Qualification Test Plan	QTP	x	x	x	x	x	x	x	x				x	x		x		x

Activity Codes		Source Codes																
		Reg Insp	Complaint	Accident	Special Assessment	Waiver	Asist Other Fed Agencey	Other	Nuclear Route	ATIP	ATIP Follow Up	Inspect from Train	Regular STRACNET	Special STRACNET	ATIP STRACNET	Reinspect	Manut. Facility	Focused Inspection
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	R	V	W
Vehicle Qualification Test	QVT	x	x	x	x	x	x	x	x				x	x		x		x
Rail Mill Facility	RMI				x	x	x	x	x							x	x	x
Roadway Maintenance Machine	RMM	x	x	x	x	x	x	x	x		X	x	x	x		x		x
Right of Way Plan	RWOP	x	x	x	x	x	x	x	x				x	x		x		x
Roadway Worker Protection	RWP	x	x	x	x	x	x	x	x		X	x	x	x		x		x
Rail Crossing Main	RXM	x	x	x	x	x	x	x	x		X		x	x		x		x
Rail Crossing Yard	RXY	x	x	x	x	x	x	x	x		x		x	x		x		x
Speed (Radar)	SPCL	x	x	x	x		x	x	x				x	x		x		x
Railroad Geometry Car	TGMS	x	x	x	x	x	x	x	x				x	x		x		
Turnout Main	TOM	x	x	x	x	x	x	x	x		x		x	x		x		x
Turnout Yard	TOY	x	x	x	x	x	x	x	x		x		x	x		x		x
Track Inspection Records	TREC	x	x	x	x	x	x	x	x				x	x		x		x
Inspect From Train	TRM	x	x	x	x	x	x	x	x			x	x	x		x		x
Yard Track Hi Rail	YTH	x	x	x	x	x	x	x	x		x		x	x		x		x
Yard Track Walk	YTW	x	x	x	x	x	x	x	x		x		x	x		x		x
Vehicle/Track Interaction	VTI	x	x		x	x	x	x	x				x	x		x		x
Welding Plant	WPI		x	x	x	x	x	x								x	x	x

Activity and source codes are analytical instruments only for use with FRA's Railroad Inspection System for the PC (RISPC) software program. These codes are specific to the track discipline only and use additional codes for other activities as appropriate.

Appendix E – Use of portable track-loading fixture (PTLF) in non-GRMS territory

Note – The use of the PTLF for compliance purposes outside GRMS territory has been temporality suspended.