CHAPTER 6

Track Safety Standards Classes 6 through 9

Subpart G General

§213.301 Scope of subpart

This subpart applies to all track used for the operation of trains at a speed greater than 90 m.p.h. for passenger equipment and greater than 80 m.p.h. for freight equipment.

Application

Subpart G applies to track required to support the passage of passenger and freight equipment in specific speed ranges higher than those permitted over Class 5 track. For those speeds above Class 5, the track and the vehicles operated on the track must be considered as an integral system. This subpart does not apply to technologies such as magnetic levitation that do not use flanged wheel equipment. Subpart G begins at a speed greater than 90 m.p.h. for qualified passenger equipment and a speed greater than 80 m.p.h. for qualified freight equipment.

The safety requirements for high speed track classes are contained in Subpart G of the Track Safety Standards (TSS) which covers track Classes 6 through 9. As are the standards for the lower track classes, the rules prescribed herein are minimum requirements for safety and the high speed railroad is encouraged and expected to maintain higher standards.

This subpart is intended to function as “stand alone” regulations governing any track belonging to one of these higher track classes. In other words, the track owner needs to refer only to Subpart G for compliance with the TSS for track over which railroads operate trains at the speeds associated with the high speed track classes. However, if that same track does not meet the requirements in Subpart G at any time, the other subparts (A through F) apply.

These requirements constitute only one of several components comprising a regulatory program permitting trains to travel at high speeds. The FRA may also address high speed issues in regulations outside of Part 213, such as emergency preparedness, wheel conditions, braking systems, and grade crossings. The TSS are an integral part of that larger regulatory scheme.

This Subpart provides the necessary information for FRA and State personnel to properly interpret and enforce the TSS for the higher track classes. It is not

to be construed as a modification, alteration, or revision of the TSS as published.

The Inspector should refer to this manual as often as necessary to understand the intent of any particular standard. The requirements prescribed in this part apply to specific track and vehicle/track interaction conditions. As in the lower classes, 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.

The high speed TSS is based on the fundamental principle that vehicles in the high speed regime must demonstrate that they will not exceed minimum vehicle/track performance safety limits when operating on specified track. Specific requirements are included for the qualification of persons engaged in the inspection and maintenance of high speed track, high speed track geometry, track structure, and both automated and visual inspections.

The high speed standards address conditions that exist alone and combinations of track and vehicle/track interaction which, while individually not in violation of any standard, could nonetheless present a hazard to the safe movement of trains. As in the inspection of the lower classes, if the inspector should encounter a rare event the Inspector should 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 unable, using professional experience, to convince the railroad to initiate some action, the Inspector should apply to the Regional Track Specialist for assistance. It is unlikely to find railroad resistance in the removal of recognized safety hazards.

§213.303 Responsibility for compliance

(a) Any owner of track to which this subpart applies who knows or has notice that the track does not comply with the requirements of this subpart, shall --

(1) Bring the track into compliance; or

(2) Halt operations over that track.

(b) If an owner of track to which this subpart applies assigns responsibility for the track to another person (by lease or otherwise), 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 subpart;

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

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

Application

This section describes the action that must be taken by the track owner once the owner knows 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; or

(2) Remove the track from service.

Only two response options are available under this paragraph. Track owners who know or have notice of non-compliance with this subpart may either bring the track into compliance with the subpart or halt operations over that track. This section does not offer the railroad the option of operating under this subpart with the supervision of a qualified person, as in the standards for track Classes 1 through 5. Such an option would permit too much potential for human error. Under this subpart, if a track does not comply with the requirements of its class, it must be repaired immediately or train speeds must be reduced to the maximum speed for the track class with which the track complies. It may be necessary on occasion for the track owner to reduce the

class of track to Class 5 or below. When this occurs, the requirements for the lower classes (1-5) will apply.

This section also provides that the party responsible for compliance can be someone other than the actual owner. The 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.

This section 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 prior to the assignment of the responsibility.

Inspectors must determine the responsible party when recommending civil penalties for non-compliance and alert Chief Counsel when violation reports involve parties other than the track owner.

For class specific defects, it is explicitly apparent to the track owner that they have the option of reclassifying the track to a lower class to bring the track into compliance. For example, §213.351, Rail Joints, states that "if a joint bar is cracked, broken, or because of wear allows vertical movement of either rail when all bolts are tight, it must be replaced." Obviously, one of the remedial actions available to the carrier would be to place a speed restriction and reclassify the track to class 1 or 2. For other defects in the standards, specific classes or remedial actions are not printed in the appropriate section.

Track owners often have questions regarding the remedial actions available when inspectors discover and record turnout defects such as missing or loose frog bolts. The carrier will not find the required remedial action in §213.353. Because turnouts are designed with certain redundancies, some maintenance personnel suggest that loose or missing components should not always be considered defects unless they present an immediate hazard. However, it is also recognized that these conditions will only deteriorate if left un-repaired.

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.

Consider the example of loose or missing rail braces. 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.

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 carrier and FRA inspectors to record these defects so that they will not be left un-repaired. In summary:

(1) FRA inspectors should 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) The FRA inspectors should 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 which 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 institute 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 the 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 §213.365(d). The remedial action taken by the railroad inspector must be recorded in accordance with §213.369(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 the vegetation is scheduled to be cut by a weed mower by a specific date within 30 days may be appropriate. The 30-day period represents only a maximum period that FRA would expect that all non-class specific defects are repaired or other appropriate action taken and is not intended to create a 30-day "grace period" for all defects.

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 are repaired as quickly as possible. However, a qualified railroad representative under §213.305 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.

§213.305 Designation of qualified individuals; general qualifications

Each track owner to which this subpart applies shall designate qualified individuals responsible for the maintenance and inspection of track in compliance with the safety requirements prescribed in this subpart. Each individual, including a contractor or an employee of a contractor who is not a railroad employee, designated to:

(a) Supervise restorations and renewals of track shall meet the following minimum requirements:

(1) At least;

(i) Five years of responsible supervisory experience in railroad track maintenance in track Class 4 or higher and the successful completion of a course offered by the employer or by a college

level engineering program, supplemented by special on the job training emphasizing the techniques to be employed in the supervision, restoration, and renewal of high speed track; or

(ii) A combination of at least one year of responsible supervisory experience in track maintenance in Class 4 or higher and the successful completion of a minimum of 80 hours of specialized training in the maintenance of high speed track provided by the employer or by a college level engineering program, supplemented by special on the job training provided by the employer with emphasis on the maintenance of high speed track; or

(iii) A combination of at least two years of experience in track maintenance in track Class 4 or higher and the successful completion of a minimum of 120 hours of specialized training in the maintenance of high speed track provided by the employer or by a college level engineering program supplemented by special on the job training provided by the employer with emphasis on the maintenance of high speed track.

(2) Demonstrate to the track owner that the individual:

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

(ii) Can detect deviations from those requirements; and

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

(3) Be authorized in writing by the track owner to prescribe remedial actions to correct or safely compensate for deviations from the requirements of this subpart and successful completion of a recorded examination on this subpart as part of the qualification process.

(b) Inspecting track for defects shall meet the following minimum qualifications:

(1) At least:

(i) Five years of responsible experience inspecting track in Class 4 or above and the successful completion of a course offered by the employer or by a college level engineering program, supplemented by special on the job training emphasizing the

techniques to be employed in the inspection of high speed track; or

(ii) A combination of at least one year of responsible experience in track inspection in Class 4 or above and the successful completion of a minimum of 80 hours of specialized training in the inspection of high speed track provided by the employer or by a college level engineering program, supplemented by special on the job training provided by the employer with emphasis on the inspection of high speed track; or

(iii) A combination of at least two years of experience in track maintenance in Class 4 or above and the successful completion of a minimum of 120 hours of specialized training in the inspection of high speed track provided by the employer or from a college level engineering program, supplemented by special on the job training provided by the employer with emphasis on the inspection of high speed track.

(2) Demonstrate to the track owner that the individual:

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

(ii) Can detect deviations from those requirements; and

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

(3) Be authorized in writing by the track owner to prescribe remedial actions to correct or safely compensate for deviations from the requirements in this subpart and successful completion of a recorded examination on this subpart as part of the qualification process.

(c) Individuals designated under paragraphs (a) or (b) of this section that inspect continuous welded rail (CWR) track or supervise the installation, adjustment, and maintenance of CWR in accordance with the written procedures established by the track owner shall have:

(1) Current qualifications under either paragraph (a) or (b) of this section;

(2) Successfully completed a training course of at least eight hours duration specifically developed for the application of written CWR procedures issued by the track owner; and

(3) Demonstrated to the track owner that the individual:

(i) Knows and understands the requirements of those written CWR procedures;

(ii) Can detect deviations from those requirements; and

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

(4) Written authorization from the track owner to prescribe remedial actions to correct or safely compensate for deviations from the requirements in those procedures and successful completion of a recorded examination on those procedures as part of the qualification process. The recorded examination may be written, or it may be a computer file with the results of an interactive training course.

(d) Persons not fully qualified to supervise certain renewals and inspect track as outlined in paragraphs (a), (b) and (c) 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 § 213.305 of this subpart are notified and dispatched to the location as soon as practicable for the purpose of authorizing movements and effectuating temporary or permanent repairs.

(e) With respect to designations under paragraphs (a), (b), (c) and (d) of this section, each track owner shall maintain written records of:

(1) Each designation in effect;

(2) The basis for each designation, including but not limited to:

(i) The exact nature of any training courses attended and the dates thereof;

(ii) The manner in which the track owner has determined a successful completion of that training course, including test scores or other qualifying results;

(3) Track inspections made by each individual as required by §213.369. These records shall be made available for inspection and copying by the Federal Railroad Administration during regular business hours.

Application

Work on or about a track structure supporting qualified high speed passenger trains demands the employees be fully aware of the need to perform work properly.

A person may be qualified to perform restorations and renewals under this subpart in three ways. First, the person may combine five or more years of supervisory experience in track maintenance for Class 4 or higher and the successful completion of a course offered by the employer or by a college level engineering program, supplemented by special on-the-job training. Second, a person may be qualified by a combination of at least one year of supervisory experience in track maintenance of Class 4 or higher, 80 hours of specialized training or in a college level program, supplemented with on-the-job training. Under the third option, a railroad employee with at least two years of experience in maintenance of high speed track can achieve qualification status by completing 120 hours of specialized training in maintenance of high speed track, provided by the employer or by a college level engineering program, supplemented by special on-the-job training. For the third option, all or part of the experience required may be non-supervisory.

Similarly, a person may be qualified to perform track inspections in Classes 6, 7, 8 and 9 by attaining five or more years of experience in inspection in track Class 4 or higher and by completing a course taught by the employer or by a college level engineering program, supplemented by special on-the-job training. Or, the person may be qualified by attaining a combination of at least one year

of experience in track inspection in Class 4 and higher and by successfully completing 80 hours of specialized training in the inspection of high speed track provided by the employer or by a college level engineering program, supplemented with on-the-job training. Finally, a person may be qualified by attaining two years of experience in track maintenance in Class 4 and above and by successfully completing 120 hours of specialized training in the inspection of high speed track provided by the employer or by a college level engineering program, supplemented by special on-the-job training provided by the employer with emphasis on the inspection of high speed track. For the third option, all or part of the experience required may be non-supervisory. The third option is primarily intended to provide a way for employees with two years of experience in the maintenance of high speed track to gain the necessary training to be qualified to inspect track.

This section also includes specific requirements for qualifications of persons charged with maintaining and inspecting CWR. Training of employees in CWR procedures is essential for high speed operations. Each person inspecting and maintaining CWR must understand how CWR behaves and how to prevent track buckles and other adverse track reactions to thermal and dynamic loading.

Paragraph (d) 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 §213.305 must be notified and dispatched to the location promptly to assume responsibility for authorizing train movements and effecting repairs. The word "promptly" is meant to provide the railroad with some flexibility in the event that 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 §213.305(d) to authorize multiple train movements over such conditions for an extended period of time.

Inspectors may request of an owner, verification of the experience and qualifications of his supervisory and track inspection personnel and those supervisory and track personnel who inspect and maintain CWR and those qualified to pass trains over broken rails or pull aparts. Each Inspector shall maintain an up-to-date list of the owner's qualified personnel to determine the effectiveness of their inspection or work. 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. Specific names of individuals should be made available in writing by the owner.

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 require 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 condition, question can be raised as to the competence and/or qualifications of the person(s) establishing the record.

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

Failure of the owner to have and maintain written records designating employees or 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, those supervisors and inspectors qualified on CWR, and those partially qualified to pass trains over broken rails and pull aparts.

Defect Codes	
305.01	No written record of names of qualified persons to supervise restorations and renewals of track under traffic and/or to inspect track for defects, or to pass trains over broken rails or pull-aparts, or to maintain or inspect CWR.
305.02	Failure of track owner to provide written authorization to qualified designated individuals.
305.03	Failure to use qualified person to pass trains over broken rails or pull aparts.
305.04	Train speed exceeds 10 m.p.h. over broken rails or pull aparts.
305.05	Failure to promptly notify and dispatch person fully qualified under §213.305 to the location of the broken rail or pull apart.

§213.307 Class of track; operating speed limits

(a) Except as provided in paragraph (b) of this section and §§213.329, 213.337(a) and 213.345(c), the following maximum allowable operating speeds apply:

Over track that meets all of the requirements prescribed in this subpart for	The maximum allowable operating speed for trains [1] is
Class 6 track	110 m.p.h.
Class 7 track	125 m.p.h.
Class 8 track	160 m.p.h[2]
Class 9 track	200 m.p.h.

[1] Freight may be transported at passenger train speeds if the following conditions are met:

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

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

(3) No carrier may accept or transport a hazardous material, as defined at 49 CFR 171.8, except as provided in Column 9A of the Hazardous Materials Table (49 CFR 172.101) for movement in the same train as

a passenger-carrying vehicle or in Column 9B of the Table for movement in a train with no passenger-carrying vehicles.

[2] Operating speeds in excess of 150 m.p.h. are authorized by this part only in conjunction with a rule of particular applicability addressing other safety issues presented by the system.

(b) If a segment of track does not meet all of the requirements for its intended class, it is to be reclassified to the next lower class of track for which it does meet all of the requirements of this subpart. If a segment does not meet all of the requirements for Class 6, the requirements for Classes 1 through 5 apply.

Application

As in the lower classes, the high speed standards classify track solely on the basis of authorized speeds of freight and passenger trains, irrespective of traffic density, axle loads, trailing tonnage, curvature, grades, or rail weight. Tolerances are specified in the TSS for each class of track. A deviation beyond the limiting tolerances requires repair, or reduction of speeds to the appropriate class. If the condition does not meet the requirements for track Classes 6 through 9, the owner may reduce the speed to comply with the requirements for Classes 1 through 5.

The exceptions for the maximum allowable operating speeds for each class of track parallels the standards for the lower classes, including the maximum operating curving speed required under §213.329 and rail defects under §213.337, except that a speed of 10 m.p.h. over the maximum intended operating speeds is permitted during the qualification phase per §213.345.

All equipment, whether used for passenger or freight, must demonstrate the same vehicle/track performance and be qualified on the high speed track. Hazardous materials, except for limited and small quantities, may not move in bulk on trains operated at high speeds.

Operating speeds in excess of 150 m.p.h. are authorized only in conjunction with a Rule of Particular Applicability addressing other safety issues presented by the system, except that a speed of 160 m.p.h. is authorized during the qualification of the vehicle/track system per §213.345.

Defect Codes	
307.01	Train speed exceeds 200 m.p.h. without FRA approval.
307.02	Freight transported at passenger train speeds in unqualified vehicles.
307.03	Load distribution & securement in the freight vehicle adversely affects the dynamic performance of the vehicle or the axle loading pattern is not uniform & exceeds the passenger locomotive axle loadings in passenger trains at the same maximum speed.
307.04	Carrier accepted or transported a hazardous material defined in 49 CFR Part 171.8 which is not acceptable for movement.
307.05	Trains operated in excess of 150 m.p.h. not in conjunction with a Rule of Particular Applicability addressing other safety issues presented by the system.

§213.309 Restoration or renewal of track under traffic conditions

(a) Restoration or renewal of track under traffic conditions is limited to the replacement of worn, broken, or missing components or fastenings that do not affect the safe passage of trains.

(b) The following activities are expressly prohibited under traffic conditions:

(1) Any work that interrupts rail continuity, e.g., as in joint bar replacement or rail replacement;

(2) Any work that adversely affects the lateral or vertical stability of the track with the exception of spot tamping an isolated condition where not more than 15 lineal feet of track are involved at any one time and the ambient air temperature is not above 95 degrees Fahrenheit; and

(3) Removal and replacement of the rail fastenings on more than one tie at a time within 15 feet.

Application

The term “restoration and renewal” in this section does not have the same meaning as in the context of §213.11, restoration or renewal of track under traffic conditions, in the low speed standards. The essential difference between this section and §213.11 is that the options for a qualified person to authorize movements over a work area at a speed determined by that person are severely restricted. Under §213.11, a qualified person may determine that it is safe to permit a train to pass through a work area at any speed up to the permanent speed on the track. Under §213.309, these options are further

limited because of the potential for human error and the speeds involved. Options available in the lower classes for a designated person to perform general restorations under traffic and set train speeds is not available under this section. Any restoration under traffic conditions beyond the replacement of worn, broken or missing components or fastenings or minor levels of spot surfacing is prohibited or a speed restriction must be imposed to place the track below Class 6 where the requirements for track Classes 1 through 5 apply. The section does not limit any restoration work while the track is "out-of-service" and then restored to service.

This section addresses two elements of concern: 1) that the stability of the track structure is significantly degraded; and 2) that roadway worker safety is compromised.

Defect Codes	
309.01	Reserved
309.02	Work performed during a period of restoration and renewal under traffic conditions which interrupts rail continuity.
309.03	Work performed during a period of restoration and renewal under traffic conditions which adversely affects track stability.
309.04	Removal and replacement of the rail fastenings on more than one tie at a time within 15 feet during a period of restoration and renewal under traffic conditions.

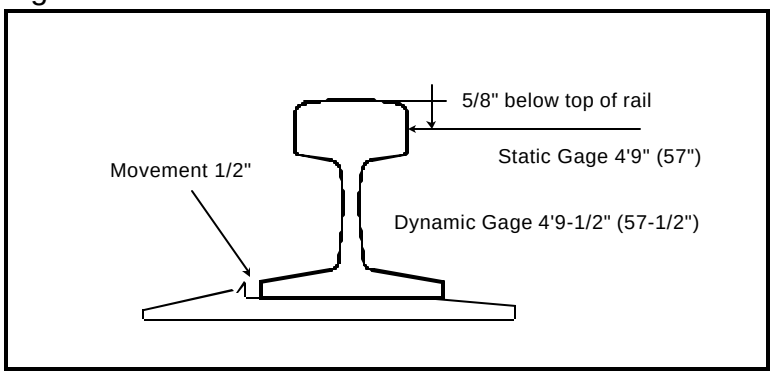
§213.311 Measuring track not under load

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

Application

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 must be added. Each deflection under the running rails must be measured and properly considered when computing the collective deviations under a load. It is very important that consideration be given to both rails when measuring these deflections. Figure 6-1 illustrates this concept in relation to lateral rail movement in a tie plate.

Figure 6-1



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; at bridge abutments and over culverts where the subgrade has settled; or where incipient geometry conditions exist. The word “incipient” means “beginning to appear.”

§213.317 Waivers

(a) Any owner of track to which this subpart applies may petition the Federal Railroad Administrator for a waiver from any or all requirements prescribed in this subpart.

(b) Each petition for a waiver under this section shall be filed in the manner and contain the information required by §§211.7 and 211.9 of this chapter.

(c) If the Administrator finds that a waiver is in the public interest and is consistent with railroad safety, the Administrator may grant the waiver 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.

Application

Inspectors have no authority to grant waivers from the TSS.

Any petition for waiver must be filed by the owner with the Docket Clerk, Office of Chief Counsel, in Washington, D.C. Refer to Chapter 3 of this manual for more information regarding Waiver procedures.

§213.319 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.

Application

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

The TSS specifies that each drainage structure is maintained and the Inspector should observe conditions that would affect the integrity of the structure such as culvert pull-apart or separations, crushing or uneven settlement due to failure of or lack of head walls, coupled 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 to be 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 Track Specialist should be consulted.

The Inspector must take note of the conditions of:

- Right-of-way ditches;
- Culvert, 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;
- Filling in of passageways from silting, sand wash, or debris.

Inspectors must call to the attention of the track owner any drainage condition deemed hazardous or potentially hazardous to the safety of train operations over the track and subgrade.

Defect Codes	
319.01	Drainage or water-carrying facility not maintained.
319.02	Drainage or water-carrying facility obstructed by debris.
319.03	Drainage or water-carrying facility collapsed.
319.04	Drainage or water-carrying facility obstructed by vegetation.
319.05	Drainage or water-carrying facility obstructed by silting.
319.06	Drainage or water-carrying facility deteriorated to allow subgrade saturation.
319.07	Uncontrolled water undercutting track structure or embankment.

§213.321 Vegetation

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

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

(b) Obstruct visibility of railroad signs and signals:

(1) Along the right of way, and

(2) At highway-rail crossings;

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

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

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

Application

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.

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.

- Paragraph (b) 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 intends only to cover the clearing of vegetation at highway-rail grade crossings on railroad property to provide adequate visibility to the traveling public of railroad signs and signals. It is not intended to cover or preempt state or local requirements for the clearing of vegetation on railroad rights-of-way at highway-rail grade crossings.

- 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.

- Before citing the railroad for vegetation interfering with signal or communication lines, the Inspector must confirm that the line is active. Occasionally, however, Inspectors may observe vegetation in lines that appear to be no longer functioning. 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 with regard to vegetation and the signal lines, joint inspections by track and signal personnel are encouraged. Violation reports, if necessary, will be executed by the Track Inspector with concurrence of the Signal Inspector.

- Judgment must be exercised by the Inspector in determining whether or not vegetation will prevent railroad employees from visually inspecting rolling stock from their normal duty stations.

Defect Codes	
321.01	Combustible vegetation around track-carrying structures.
321.02	Vegetation obstructs visibility of railroad signs and fixed signals.
321.03	Vegetation obstructs passing of day and night signals by railroad employees.
321.04	Vegetation interferes with railroad employees performing normal trackside duties.
321.05	Vegetation prevents proper functioning of signal and/or communication lines.
321.06	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.
321.07	Excessive vegetation at train meeting points prevents proper inspection of moving equipment by railroad employees.
321.08	Excessive vegetation in toepaths and around switches where employees are performing normal trackside duties.
321.09	Vegetation brushing sides of rolling stock.
321.10	Vegetation obstructs visibility of grade crossing warning signs and signals by the traveling public.

§213.323 Track 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.

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

Class of track	The gage must be at least	But not more than	The change of gage within 31 feet must not be greater than
6	4' 8"	4' 9-1/4"	1/2"
7	4' 8"	4' 9-1/4"	1/2"
8	4' 8"	4' 9-1/4"	1/2"
9	4' 8-1/4"	4' 9-1/4"	1/2"

Application

This rule established the minimum and maximum limits for gage, and the variation in gage differs with the authorized speed. An abrupt change in gage can produce significant wheel forces at high speeds. The minimum and maximum limits for gage values, Classes 6, 7, 8, and 9, were set to minimize the onset of truck hunting.

- Inspectors will make measurements at sufficient intervals to assure that track is being maintained within the prescribed limits.

- Particular attention will be given to gage in turnouts or where high lateral train forces would be expected.

- Gage should be measured where line or surface irregularities are observed by the Inspector. Remember to observe evidence of lateral rail movement.

- An accurate standard track gage or a ruler graduated in inches is an acceptable measuring device. Gage not within the specified limits of the TSS is a defect.

- FRA Inspectors may use a Portable Track Loading Fixture (PTLF) described in §213.110 for the purposes of measuring loaded gage.

Defect Codes	
323.01	Gage dimension exceeds allowable on tangent track.
323.02	Gage dimension is less than allowable on tangent track.
323.03	Gage dimension exceeds allowable on curved track.
323.04	Gage dimension is less than allowable on curved track.
323.05	Reserved
323.06	Gage variation within 31 feet exceeds allowable.

§213.327 Alinement

(a) Uniformity at any point along the track is established by averaging the measured mid-chord offset values for nine consecutive points centered around that point and which are spaced according to the following table:

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

(b) For a single deviation, alinement may not deviate from uniformity more than the amount prescribed in the following table:

Class of track	The deviation from uniformity of the mid-chord offset for a 31-foot chord may not be more than	The deviation from uniformity of the mid-chord offset for a 62-foot chord may not be more than	The deviation from uniformity of the mid-chord offset for a 124-foot chord may not be more than
6	1/2"	3/4"	1-1/2"
7	1/2"	1/2"	1-1/4"
8	1/2"	1/2"	3/4"
9	1/2"	1/2"	3/4"

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

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

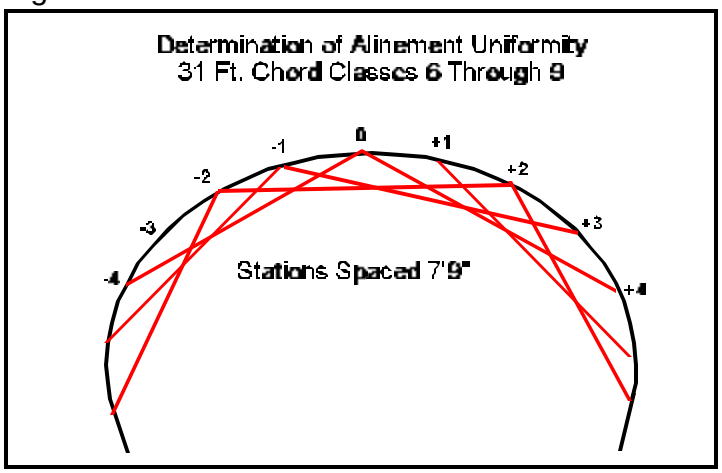
Application

In some cases, particularly for repeating noncomplying alinement anomalies, the alinement condition may be difficult to locate without the aid of a qualified geometry car. However, Inspectors have the responsibility to identify non-complying geometry conditions whenever possible. Whether located through visual or automated means, the condition must be field verified using conventional methods. Inspectors must be aware that, in addition to the

geometry car, other automated inspections will identify geometry anomalies that contribute to degraded vehicle/track interaction.

Uniformity at any point along the track is established by averaging the measured mid-chord offset (MCO) values for nine consecutive points centered around that point, and which are spaced according to the table in this section. For example, to establish uniformity for the 31-foot chord the Inspector should mark the point of concern plus four stations in each direction for a total of nine stations. Stations for the 31-foot chord are set at 7-foot 9 inch intervals. The MCO values are then obtained at each station and averaged. It is difficult to determine compliance with the 124-foot chord in the field using conventional manual methods. The method of determining uniformity is determined in this manner for tangents, spirals, and curves. Figure 6-2 illustrates the method to determine uniformity for the 31-foot chord measurement.

Figure 6-2

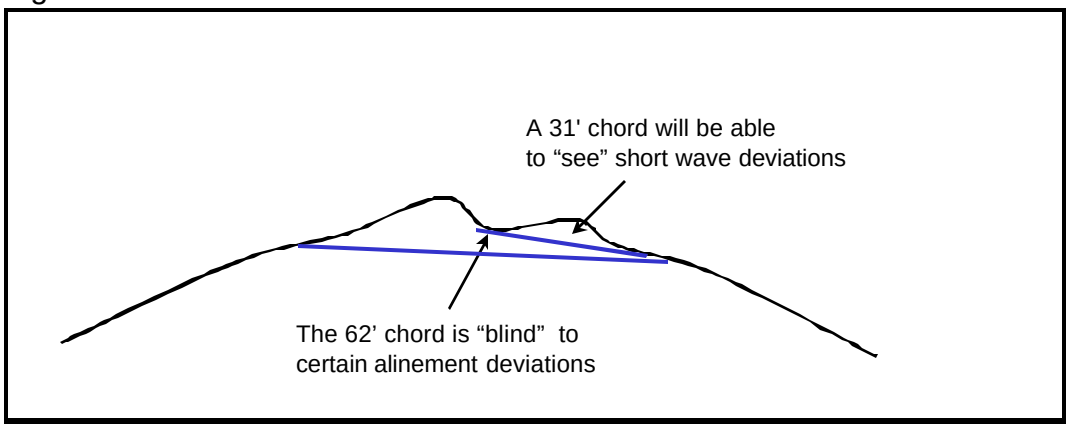


The TSS establishes maximum limits for alinement for track in Classes 6 through 9, tangent and curved track (including spirals), as measured with three chords, 31-foot, 61-foot and 124-foot. An alinement deviation may be present for any one or more of the chords. If an anomaly of uniformity exists for more than one chord, it shall be reported as a single defect line with a note describing other deviations in noncompliance with another chord. For example, “5/8-inch deviation from uniformity for a 31-foot chord. Note: defect is also a 3/4-inch deviation from uniformity for a 62-foot chord.”

The point of greatest alinement deviation can usually be detected visually and marked as the point where mid-offset will be required. However, Inspectors should use the locations identified by the automated inspection methods whenever possible to identify the location of deviation, and then visually verify the location.

For curves in Classes 6 through 9, an alinement condition may be in noncompliance with either the maximum limits for the 31-foot chord, or the 62-foot chord, or the 124-foot chord. As shown in Figure 6-3, certain alinement defects may be "blind" to some chords and "visible" to others. For example, the 31-foot chord is particularly necessary for the determination of short alinement deviations, and the 124-foot chord is useful for locating long wavelengths.

Figure 6-3



The line will be held taut against the rail 5/8-inch below the rail head using offset blocks if necessary. Methods establishing a line with laser or similar methods may also be used.

Paragraph (c) establishes alinement requirements for repeated deviations (three or more non-overlapping deviations) which occur within a distance equal to five times the specified chord length. Each occurrence of three or more deviations within a distance of five times the chord length, each of which exceeds the limit in the table, is considered one defective condition.

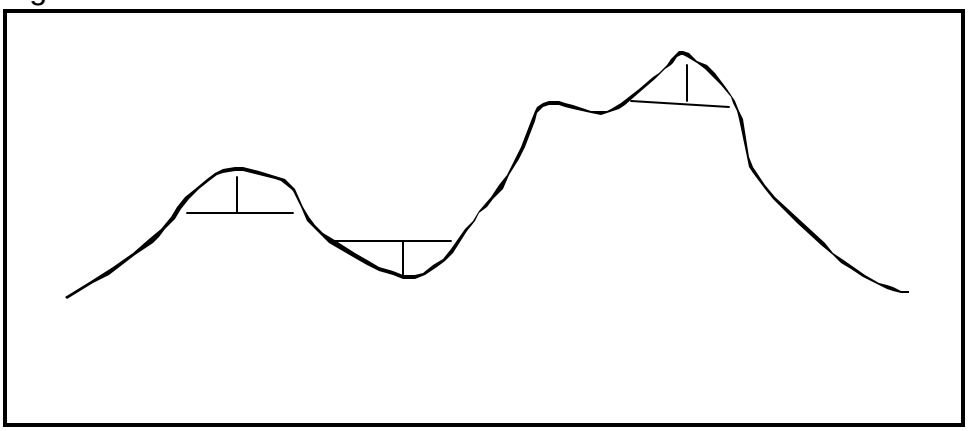
Repeated alinement deviations may excite a vehicle's natural resonance and cause adverse vehicle reaction. Although repeated alinement deviations are rare they are usually identified by automated inspections. However, the Inspector must be aware of their significance.

Repeated alinement defects are specific to one rail at a time. If an Inspector believes that a geometry condition on the opposite rail within the same area may contribute to the excitation, the Inspector should inform the railroad representative and note the condition on the inspection report.

The term "non-overlapping" is a common term but clarifies the concept in relation to track geometry inspection vehicles. Within one alinement "swing," normally several midchord offset measurements will exceed the specified

threshold. However, for an alinement deviation to be considered as a repeating defect, the chords themselves must not overlap. Figure 6-4 illustrates three repeating alinement deviations.

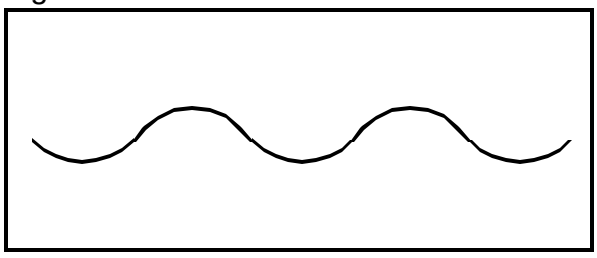
Figure 6-4



The concept is that one “swing” is not counted more than once.

Multiple alinement deviations may excite harmonic motion in the vehicle. Multiple deviations are three or more non-overlapping deviations from uniformity in track profile occurring within a distance equal to five times the specified chord length. The repeated condition, not each alinement deviation, is considered one defect. However, in the rare case where deviations repeat beyond the distance of five times the specified chord length, the Inspector shall consider all the sets of deviations as one exception. However, the total length the repeating condition occurs in feet must be reported along with the number of repeating deviations and the magnitude of each deviation.

Figure 6-5



Defect Codes	
327.01	Reserved
327.02	Reserved
327.03	Reserved
327.04	The alinement of track exceeds the allowable deviation for a 31-foot chord for a single deviation.
327.05	The alinement of track exceeds the allowable deviation for a 62-foot chord for a single deviation.
327.06	The alinement of track exceeds the allowable deviation for a 124-foot chord for a single deviation.
327.07	The alinement of track exceeds the allowable deviation for a 31-foot chord for three or more deviations.
327.08	The alinement of track exceeds the allowable deviation for a 62-foot chord for three or more deviations.
327.09	The alinement of track exceeds the allowable deviation for a 124-foot chord for three or more deviations.

§213.329 Curves, elevation and speed limitations

(a) The maximum crosslevel on the outside rail of a curve may not be more than 7 inches. The outside rail of a curve may not be more than 1/2 inch lower than the inside rail.

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

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

where --

V_{max} = Maximum allowable operating speed (m.p.h.).
E_a = Actual elevation of the outside rail (inches)[1].
D = Degree of curvature (degrees)[2].
3 = 3 inches of unbalance.

Appendix A includes tables showing maximum allowable operating speeds computed in accordance with this formula for various elevations and degrees of curvature for track speeds greater than 90 m.p.h.

(c) 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:

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

where --

V_{max} = Maximum allowable operating speed (m.p.h.).
E_a = Actual elevation of the outside rail (inches)[1].
D = Degree of curvature (degrees)[2].
E_u = Unbalanced elevation (inches).

[1] *Actual elevation for each 155 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. If E_u exceeds 4 inches, the Vmax formula applies to the spirals on both ends of the curve.*

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

(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 uniform superelevation, E_a, reflecting the intended target cant deficiency, E_u, no wheel of the equipment unloads to a value of 60 percent or less of its static value on perfectly level track and, for passenger-carrying equipment, the roll angle between the floor of the vehicle and the horizontal does not exceed 5.7 degrees.

(2) When positioned on a track with a uniform 7-inch superelevation, no wheel unloads to a value less than 60% of its static value on perfectly level track and, for passenger-carrying equipment, the angle, measured about the roll axis, between the floor of the vehicle and the horizontal does not exceed 8.6 degrees.

(e) The track owner shall notify the Federal Railroad Administrator no less than thirty calendar days prior to any proposed implementation of the higher curving speeds allowed when the "E_u" term, above, will exceed three inches. This

notification shall be in writing and shall contain, at a minimum, the following information:

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

(2) A complete description of the test procedure[1] and instrumentation used to qualify the equipment and the maximum values for wheel unloading and roll angles which were observed during testing;

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

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

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

(f) 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.

Application

Paragraph (a) does not imply that more than six 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 seven inches. 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.

The Associate Administrator for Safety shall reach a decision regarding the railroad's request for approval of a level of cant deficiency for specific equipment types based on the staff's review of the engineering information submitted by the railroad. When requested by Headquarters and Regional

Track Specialists, the Inspector may be asked to provide a memorandum containing recommendations concerning the railroad's request.

Paragraph (b) prescribes the formula to be used when determining the maximum train velocity in curves based on actual limiting curve alinement, in degrees, and the superelevation at the same point. 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.

The formula in paragraph (b) for calculating maximum allowable operating speed is commonly referred to as the three-inch unbalance formula since it permits three inches less superelevation than would be required for equilibrium conditions at the same speed. Actual elevation and actual curvature for each 155-foot track segment in the body of the curve are determined by averaging the measurements for 10 points through the segment at 15-foot six inches spacing.

Paragraph (c) permits a railroad to operate at higher levels of cant deficiency provided that the railroad submits required engineering information (static lean test, etc.) and the FRA Associate Administrator for Safety approves the level of cant deficiency.

To determine the basic vehicle performance in curves, FRA rules require a "static lean" test as an indicator of the behavior of the vehicle suspension components. The car or locomotive is placed so that the entire vehicle stands on a track with one rail uniformly higher than the other, causing the vehicle to lean toward the lower rail. The vehicle s response to this situation is determined by its weight distribution and by the presence of free play and the stiffness of its overall suspension system.

Equipment with tilting capability can use the tilting mechanism to reduce the roll angle at high levels of cant deficiency. On a track with a given elevation, a "top-heavy" vehicle or a vehicle with a high center of gravity, and a very flexible (soft) suspension system will lean at a much greater angle than a vehicle with a lower center of gravity and a very stiff suspension system. This static behavior mimics the vehicle's response to the forces encountered in passing through track curves at a cant deficiency. This particular test was selected because it is very straightforward and practical to perform and requires only very basic measurement capabilities. Nevertheless, it provides very useful information about the vehicle performance when in motion on curves.

The requirements for roll angle measurements in a static condition, in effect limit the steady state carbody acceleration on a smooth curve to no more than 0.1g at the maximum intended cant deficiency which is consistent with § 238.427 of

the Passenger Equipment Standards. This steady state acceleration is directly proportional to the centrifugal force experience by passengers when the equipment is going around a curve. Too many "g's" can result in a safety hazard to the occupants of the high speed passenger equipment.

Inspectors should compute allowable speeds through curves to determine compliance with this section and report defects when train speed exceeds the allowable based on this formula.

Speed becomes more critical if surface conditions have deteriorated or curvature has increased due to misalignment near the point of limiting speed and Inspectors need to determine compliance with the surface standard in §213.331 or the alinement standard in §213.327, which in some cases will be more restrictive.

Where railroads have not initiated remedial action to bring the surface and alinement of track into agreement with the operating speed based on the standard for three inches of unbalance, Inspectors will consider violation work when train speed exceeds four inches of cant deficiency. When train operation has been approved by the FRA for curving speeds producing more than three inches of unbalance (cant deficiency), Inspectors should only consider recommending a violation when the cant deficiency exceeds the approved level by more than a marginal amount. For example, if the FRA approved five inches of cant deficiency for specific equipment, Inspectors would not recommend a violation for marginal level of 5.2 or 5.4 inches of cant deficiency. On the other hand, violations should be considered at higher levels. The following formula should be used to calculate unbalance based on field measurements and known maximum authorized speed.

$$E_u = V_{max}^2(.0007D) - E_a$$

Normally, curves exist in high speed track are designed. However, it is possible that a curve may be introduced as a result of maintenance or geometry degradation. In either case, superelevation may or may not be present and trains may experience an unbalanced condition. The deviations from uniform profile and uniform alinement, as outlined in §§213.331 and 213.327, will not preclude longer wavelength misalinements on the order of 200 feet or greater that resemble the characteristics of a curve from being treated as curves for which the unbalance formula defined in this section will be applied.

Defect Codes	
329.01	Reserved
329.02	Operating speed exceeds allowable for 3-inches of unbalance, based on curvature and elevation.
329.03	Reserved
329.04	Reserved
329.05	Operating speed exceeds allowable for a FRA approved unbalance based on curvature and elevation.
329.06	Maximum crosslevel on curve exceeds allowable.

§213.331 Track surface

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

Track surface	Class of track			
	6	7	8	9
The deviation from uniform[1] profile on either rail at the midordinate of a 31-foot chord may not be more than	1"	1"	3/4"	1/2"
The deviation from uniform profile on either rail at the midordinate of a 62-foot chord may not be more than	1"	1"	1"	3/4"
The deviation from uniform profile on either rail at the midordinate of a 124-foot chord may not be more than	1-3/4"	1-1/2"	1-1/4"	1-1/4"
The difference in crosslevel between any two points less than 62 feet apart may not be more than[2]	1-1/2"	1-1/2"	1-1/2"	1-1/2"

[1] Uniformity for profile is established by placing the midpoint of the specified chord at the point of maximum measurement.

[2] However, to control harmonics on jointed track with staggered joints, the crosslevel differences shall not exceed 1-1/4 inches in all of six consecutive pairs of joints, as created by 7 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 purposed of this footnote.

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

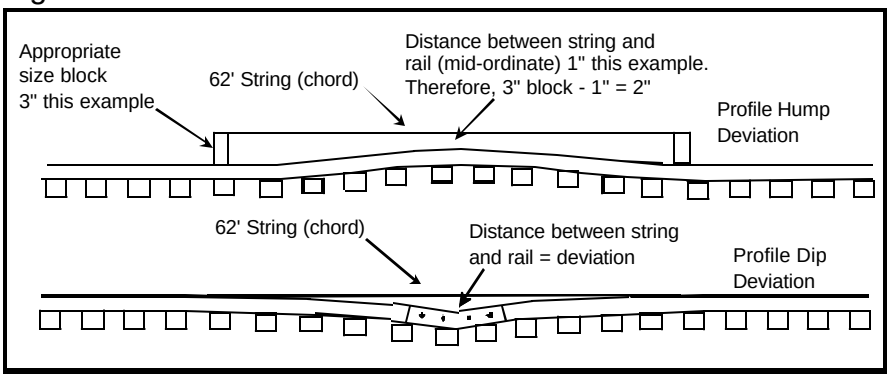
Track surface	Class of track			
	6	7	8	9
The deviation from uniform profile on either rail at the mid-ordinate of a 31-foot chord may not be more than	3/4"	3/4"	1/2"	3/8"
The deviation from uniform profile on either rail at the midordinate of a 62-foot chord may not be more than	3/4"	3/4"	3/4"	1/2"
The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

Application

As in alinement, deviation from uniform profile must be checked by using three chords: 31-foot, 62-foot, and 124-foot. A profile condition may be in noncompliance with any or all the chords. The measurement using all chords is required to cover the necessary wavelengths of interest that may excite undesirable vehicle responses.

Uniformity for profile is different than uniformity established for alinement. In the case of alinement, uniformity as described in §213.327(a) is determined by averaging mid-chord offset values for nine consecutive points centered around that point. However, uniformity for profile, as described in footnote 1 below the table, is a straight line placed across the deviation in such a manner as to measure the largest mid-ordinate. Figure 6-6 illustrates this procedure using a 62-foot chord. Depending upon the length of the profile perturbation, a particular chord may be inside or span the perturbation.

Figure 6-6



Multiple profile deviations may excite harmonic motion in the vehicle. Multiple deviations are three or more non-overlapping deviations from uniformity in track profile, occurring within a distance equal to five times the specified chord length. Refer to §213.327 for a description of "non-overlapping." The repeated condition, not each profile deviation, is considered one defect. However, similar to alinement, in the rare case where deviations repeat beyond the distance of five times the specified chord length, the Inspector shall consider all the sets of deviations as one exception. However, the total length in feet that the repeating condition occurs must be reported along with the number of repeating deviations when the magnitude of each deviation.

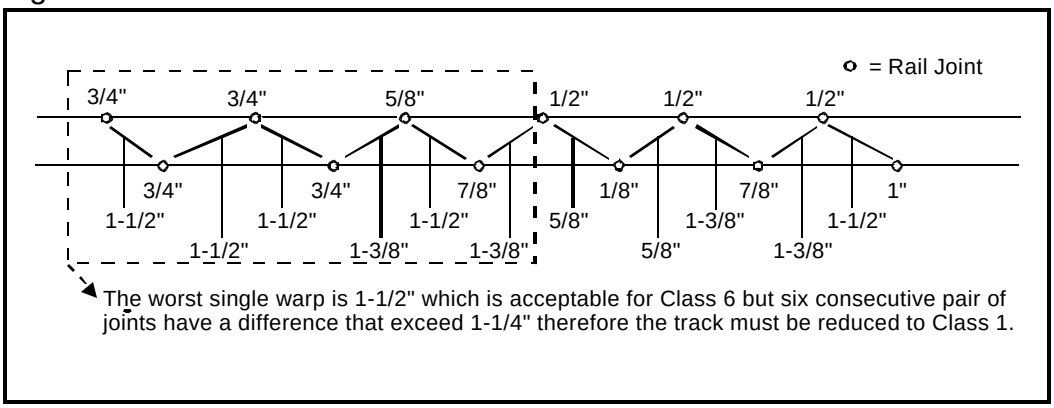
Repeated profile defects are specific to one rail at a time. If an Inspector believes that a geometry condition on the opposite rail within the same area may contribute to the excitation, the Inspector should inform the railroad representative and note the condition on the inspection report.

As in the standards for Classes 1 through 5, the "warp" condition is equally valid in contributing to vehicle twist and wheel climb. The difference in crosslevel between any two points less than 62 feet apart may not be more than the limit specified.

Jointed track is not typical for high speed track. However, Inspectors should check for a harmonic rock off condition whenever several joints in a row are low as indicated in footnote 2. Joint stagger that is not identical from stagger to stagger, such as in a curve or when a rail longer than the original construction is installed, shall be considered in the harmonic calculation. Additional joint(s) introduced because of the installation of short rail(s) are ignored in evaluating a harmonic condition.

Construction consisting of 79-foot or 80-foot rails does not result in harmonic rock off conditions since they occur outside of vehicle truck spacing. For 79-foot 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. Figure 6-7 illustrates a harmonic condition.
Inspectors shall carefully apply the provisions of this footnote. 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.

Figure 6-7



Defect Codes	
331.01	Reserved
331.02	Reserved
331.03	Reserved
331.04	Reserved
331.05	Reserved
331.06	Reserved
331.07	Difference in crosslevel between any two points less than 62 feet apart on tangents exceeds allowable.
331.08	Difference in crosslevel between any two points less than 62 feet apart on curves between spirals exceeds allowable.
331.09	Difference in crosslevel between any two points less than 62 feet apart on spirals exceeds allowable.
331.10	Reserved
331.11	Reserved
331.12	Reserved
331.13	Crosslevel differences for six or more consecutive pairs of staggered joints exceeds allowable
331.14	The profile of track exceeds the allowable deviation for a 31-foot chord for a single deviation.
331.15	The profile of track exceeds the allowable deviation for a 62-foot chord for a single deviation.
331.16	The profile of track exceeds the allowable deviation for a 124-foot chord for a single deviation.
331.17	The profile of track exceeds the allowable deviation for a 31-foot chord for three or more deviations.
331.18	The profile of track exceeds the allowable deviation for a 62-foot chord for three or more deviations.
331.19	The profile of track exceeds the allowable deviation for a 124-foot chord for three or more deviations.

§213.333 Automated vehicle inspection systems

(a) For track Class 7, a qualifying Track Geometry Measurement System (TGMS) vehicle shall be operated at least twice within 120 calendar days with not less than 30 days between inspections. For track Classes 8 and 9, it shall be operated at least twice within 60 days with not less than 15 days between inspections.

(b) A qualifying TGMS shall meet or exceed minimum design requirements which specify that --

(1) Track geometry measurements shall be taken no more than 3 feet away from the contact point of wheels carrying a vertical load of no less than 10,000 pounds per wheel;

(2) Track geometry measurements shall be taken and recorded on a distance-based sampling interval which shall not exceed 2 feet; and

(3) Calibration procedures and parameters are assigned to the system which assure that measured and recorded values accurately represent track conditions. Track geometry measurements recorded by the system shall not differ on repeated runs at the same site at the same speed more than 1/8 inch.

(c) A qualifying TGMS shall be capable of measuring and processing the necessary track geometry parameters, at an interval of no more than every 2 feet, which enables the system to determine compliance with: §213.323, Track gage; §213.327, Alinement; §213.329, Curves; elevation and speed limitations; and §213.331, Track surface.

(d) A qualifying TGMS shall be capable of producing, within 24 hours of the inspection, output reports that –

(1) Provide a continuous plot, on a constant-distance axis, of all measured track geometry parameters required in paragraph (c) of this section;

(2) Provide an exception report containing a systematic listing of all track geometry conditions which constitute an exception to the class of track over the segment surveyed.

(e) The output reports required under paragraph (c) of this section shall contain sufficient location identification information which enable field forces to easily locate indicated exceptions.

(f) Following a track inspection performed by a qualifying TGMS, the track owner shall, within two days after the inspection, field verify and institute remedial action for all exceptions to the class of track.

(g) The track owner shall maintain for a period of one year following an inspection performed by a qualifying TGMS, copy of the plot and the exception printout for the track segment involved, and additional records which:

(1) Specify the date the inspection was made and the track segment involved; and

(2) Specify the location, remedial action taken, and the date thereof, for all listed exceptions to the class.

(h) For track Classes 8 and 9, a qualifying Gage Restraint Measurement System (GRMS) shall be operated at least once annually with at least 180 days between inspections to continuously compare loaded track gage to unloaded gage under a known loading condition. The lateral capacity of the track structure shall not permit a gage widening ratio (GWR) greater than 0.5 inches.

(i) A GRMS shall meet or exceed minimum design requirements which specify that --

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

(I) At an interval not exceeding 16 inches;

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

(iii) Under an applied lateral load which provides for lateral/vertical load ratio of between 0.5 and 1.25[1], and a load severity greater than 3,000 pounds but less than 8,000 pounds per rail. 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 rail/tie which is assigned a nominal value of (0.4).

V = Actual vertical load applied (pounds).

(2) The measured gage value shall be converted to a gage widening ratio (GWR) as follows:

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

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 the point of application of the lateral load.

L= Actual lateral load applied (pounds).

[1] *GRMS equipment using load combinations developing L/V ratios which exceed 0.8 shall be operated with caution to protect against the risk of wheel climb by the test wheelset.*

(j) At least one vehicle in one train per day operating in Classes 8 and 9 shall be equipped with functioning on-board truck frame and carbody accelerometers. Each track owner shall have in effect written procedures for the notification of track personnel when on-board accelerometers on trains in Classes 8 and 9 indicate a possible track-related condition.

(k) For track Classes 7, 8, and 9, 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 shall be operated over the track at the revenue speed profile at a frequency of at least twice within 60 days with not less than 15 days between inspections. The instrumented car or the portable device shall monitor vertically and laterally oriented accelerometers placed near the end of the vehicle at the floor level. In addition, accelerometers shall be mounted on the truck frame. If the carbody lateral, carbody vertical, or truck frame lateral safety limits in the following table of vehicle/track interaction safety limits are exceeded, speeds will be reduced until these safety limits are not exceeded.

(l) For track Classes 8 and 9, an instrumented car having dynamic response characteristics that are representative of other equipment assigned to service shall be operated over the track at the revenue speed profile annually with not less than 180 days between inspections. The instrumented car shall be equipped with functioning instrumented wheelsets to measure wheel/rail forces. If the wheel/rail force limits in the following table of vehicle/track interaction

safety limits are exceeded, speeds will be reduced until these safety limits are not exceeded.

(m) The track owner shall maintain a copy of the most recent exception printouts for the inspections required under paragraphs (k) and (l) of this section.

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Vehicle/Track Interaction Safety Limits

Parameter	Safety Limit	Filter/ Window	Requirements
Wheel/Rail Forces[1]			
Single Wheel Vertical Load Ratio	≥ 0.1	5 ft	No wheel of the equipment shall be permitted to unload to less than 10% of the static vertical wheel load. The static vertical wheel load is defined as the load that the wheel would carry when stationary on level track. The vertical wheel load limit shall be increased by the amount of measurement error.
Single Wheel L/V Ratio	$\leq \frac{\tan\delta - .5}{1 + .5\tan\delta}$	5 ft	The ratio of the lateral force that any wheel exerts on an individual rail to the vertical force exerted by the same wheel on the rail shall be less than the safety limit calculated for the wheel's flange angle (δ).
Net Axle L/V Ratio	≤ 0.5	5 ft	The net lateral force exerted by any axle on the track shall not exceed 50% of the static vertical load that the axle exerts on the track.
Truck Side L/V Ratio	≤ 0.6	5 ft	The ratio of the lateral forces that the wheels on one side of any truck exert on an individual rail to the vertical forces exerted by the same wheels on that rail shall be less than 0.6.
Accelerations			
Carbody Lateral[2]	≤ 0.5 g peak-to-peak	10 Hz 1 sec window	The peak-to-peak accelerations, measured as the algebraic difference between the two extreme values of measured acceleration in a one second time period, shall not exceed 0.5 g.
Carbody Vertical[2]	≤ 0.6 g peak-to-peak	10 Hz 1 sec window	The peak-to-peak accelerations, measured as the algebraic difference between the two extreme values of measured acceleration in a one-second time period, shall not exceed 0.6 g.
Truck Lateral[3]	≤ 0.4 g RMS mean-removed	10 Hz 2 sec window	Truck hunting[4] shall not develop below the maximum authorized speed.

[1] The lateral and vertical wheel forces shall be measured with instrumented wheelsets with the measurements processed through a low pass filter with a

minimum cut-off frequency of 25 Hz. The sample rate for wheel force data shall be at least 250 samples/sec.

2 Carbody lateral and vertical accelerations shall be measured near the car ends at the floor level.

3 Truck accelerations in the lateral direction shall be measured on the truck frame. The measurements shall be processed through a filter having a pass band of 0.5 to 10 Hz.

4 Truck hunting is defined as a sustained cyclic oscillation of the truck which is evidenced by lateral accelerations in excess of 0.4 g root mean square (mean-removed) for 2 seconds.

Application

This section includes important automated inspection methods for high speed track safety including the track geometry measurement system, the gage restraint measurement system, and the systems necessary to monitor vehicle/track interaction (acceleration and wheel/rail force requirements).

For track Classes 7, 8, and 9 this section requires the periodic inspection (twice within 120 calendar days for Class 7 and twice within 60 days for classes 8 and 9) using a qualified Track Geometry Measurement System (TGMS). Railroads that operate trains at speeds above 110 m.p.h. universally employ automatic track geometry measuring systems to generate data to point out train safety hazards in the track geometry. Reliance upon only visual inspections to locate small track irregularities is difficult.

The railroad TGMS must be a vehicle that measures at the intervals and under the loading regime specified. If an Inspector has doubt as to the capabilities of the TGMS, the Inspector should request that the Regional Track Specialist seek the assistance of Headquarter's Specialists to evaluate the system.

Inspectors should periodically ride the TGMS and monitor the specified compliance with the safety limits. Specifically, Inspectors must ensure that the track is being inspected at the specified frequency and that exceptions are being corrected. Inspectors must determine if exceptions are being field verified and corrected. Output records must be produced within 24 hours of the survey and the railroad must field verify and institute remedial action within two days of the inspection. The two-day period in which to field verify locations found by the geometry car does not relieve the railroad from initiating immediate action whenever the railroad knows or has notice that a condition does not comply with the track safety standards.

Along with normal review of visual track inspection records, the Inspector shall review TGMS records, to determine if the records specify the date of inspection, the track segment involved, the remedial action and other information required. These records must be maintained by the railroad for one year following each inspection.

This section requires the inspection of Classes 8 and 9 track by a Gage Restraint Measurement System (GRMS) to measure the gage restraint of the track, including the strength of the ties and the ability of the fastenings to maintain gage. The option of using a qualified GRMS in lieu of crosstie and fastener standard is not an option in the high speed standards. The GRMS must be operated annually. GRMS on concrete ties is effective in identifying defective ties and conditions with missing fasteners or a relaxation of toe load of rail fasteners. GRMS is important to measure the resistance of the track to forces generated by wheel flanging in the gaging space. The use of the GRMS is necessary to ensure sufficient gage restraint at the gage limits set to control truck hunting.

The GRMS safety criterion for high speed track is the gage-widening ratio (GWR), which is based on the unloaded track gage, loaded track gage and actual lateral load applied. The lateral track capacity of the track structure shall not permit a GWR greater than 1/2-inch.

Inspectors shall periodically ride the railroad GRMS. If in doubt as to the GRMS capability to measure gage restraint, the Inspector should consult with the Regional Track Specialist who will seek the assistance of Headquarter's Specialists to evaluate the system. No record keeping requirements are included for the GRMS.

Paragraph (j) of this section requires that at least one vehicle in one train per day operating in Class 8 or 9 track be equipped with functioning on-board truck frame and carbody accelerometers and that the high speed railroad have in effect written procedures for the notification of track personnel when the on-board accelerometers indicate a possible track-related condition.

This requirement accomplishes several important safety goals that cannot be achieved only by an inspection using accelerometers at the frequencies required in paragraph (k). For example, if the railroad inadvertently introduced a small geometry problem during maintenance or the track settled at a culvert, the accelerometers would indicate that the location should be investigated. The accelerometers may be portable or fixed and may be installed in any vehicle in the high speed train. Many high speed trains have lateral truck frame accelerometers on every vehicle, primarily to monitor for truck hunting. In these

cases, the railroad must supplement the lateral truck frame accelerometers with functioning carbody accelerometers as described in this section.

The rule does not require a specific threshold or procedure that must be established by the railroad. The purpose of the rule is to foster the utilization of technologies which remove the subjective nature the traditional "rough track" report where engineers and other crew members call maintenance of way employees with requests to look at the track. Rather, the rule encourages the high speed railroad to have a system where accelerations are measured on a daily basis. The Federal or State Inspector should monitor the railroad's compliance with this requirement to confirm that a daily inspection is being accomplished over the route. Each track in a territory with more than one parallel track is not required to be covered on a daily basis. If the high speed trains do not operate for a period such as over the weekend, the railroad is not required to operate a non-revenue train over the route.

Paragraph (k) requires that an instrumented car having dynamic response characteristics representative of high speed equipment assigned to service, or a portable device that monitors on-board instrumentation on trains, shall be operated over the track at the specified inspection frequency at the speed normally operated by the trains. This is to monitor lateral and vertical carbody accelerometers and lateral truck-mounted accelerometers. If the carbody lateral, carbody vertical, or truck frame lateral safety limits in the Vehicle/Track Interaction safety table are exceeded, the speeds of all high speed passenger trains must be reduced for each location to a level at which the safety limits are not exceeded until the source of the exception is identified and corrected. The source may be a track condition, a vehicle condition, or a combination of both.

The Inspector must carefully monitor the railroad's activities in this area. Inspection records of the most recent inspection must be available for FRA review. The "representative" vehicle is established by the track owner and is usually a highly instrumented coach. Inspectors must periodically ride the inspection vehicle, which may or may not be the same vehicle as the TGMS and the vehicle required under paragraph (l), and make a determination of the railroad's compliance. If the Inspector has any doubt as to the effectiveness of this inspection program, the Inspector should contact the Regional Track Specialist who will request a technical evaluation team from Headquarters and its supporting agencies or contractors.

Paragraph (l) of this section requires that an instrumented car having dynamic response characteristics that are representative of other equipment assigned to service be operated over Class 8 and 9 track annually with not less than 180 days between inspections. The instrumented car shall be equipped with instrumented wheelsets, capable of accurately measuring wheel/rail forces.

These forces must be within the limits in the VTI table. If the wheel/rail force safety limits in the Vehicle/Track Interaction safety table are exceeded, the speeds of all high speed passenger trains must be reduced for each location to a level at which the safety limits are not exceeded until the source of the exception is identified and corrected. The Inspector must consult with the Regional Track Specialist to obtain the design wheel flange angle used to define the single wheel L/V ratio safety limit. The flange angle must be included in the information that the railroad must submit to the FRA Associate Administrator following testing required under §213.345.

It is of utmost importance that the Inspector monitor the railroad's compliance with this requirement. The term "representative" does not mean that every type of car which operates at Classes 8 and 9 speeds is required to be equipped with instrumented wheelsets to measure wheel/rail forces, but the instrumented car must be representative of the equipment operating at those speeds. If the Inspector has any doubt as to the effectiveness of the railroad's measurement of wheel/rail forces and its program to initiate remedial action, the Inspector should contact the Regional Track Specialist who shall seek the assistance of Headquarter's specialists to evaluate the railroad's program. The railroad must maintain a copy of the most recent exception report.

The vehicle/track interaction safety limits are the cornerstone of the high speed standards. Vehicle/track interaction has critical consequences in railroad safety, and so establishing safe parameters and developing a measurement system to adhere to those parameters is highly important for any track safety program. There are several hazardous and unacceptable vehicle/track interaction events that are well-known in railroad engineering, and for the most part, may occur on existing high speed operations, including wheel climb, rail roll-over, vehicle overturning, gage widening, and track panel shift.

Defect Codes	
333.01	Failure to inspect using TGMS at required frequency.
333.02	Failure to operate qualified TGMS as required.
333.03	Failure to keep TGMS records as required.
333.04	Failure of TGMS report to provide required information.
333.05	Failure to field verify an TGMS exception within two days.
333.06	Failure to initiate remedial action for TGMS exception within two days.
333.07	Failure to make TGMS records available for inspection.
333.08	Failure to operate GRMS at required frequency.
333.09	Lateral track capacity of track structure permits a gage widening ratio greater than allowed.
333.10	Failure to equip at least one vehicle per day with required accelerometers.
333.11	Failure to have written procedures for notification of track personnel when daily accelerometer measurements indicate a possible track-related condition.
333.12	Failure to follow written procedures for notification of track personnel when daily accelerometer measurements indicate a possible track-related condition.
333.13	Failure to operate an instrumented car or portable device to measure carbody and truck frame accelerations at required frequency.
333.14	Failure to reduce train speeds when carbody and truck frame accelerations exceed allowable.
333.15	Failure to keep records of acceleration measurements as required.
333.16	Failure to operate an inspection vehicle with instrumented wheelsets to measure wheel/rail forces at required frequency.
333.17	Failure to reduce train speed when wheel/rail forces exceed allowable.

§213.334 Ballast; general

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

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

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

(c) Provide adequate drainage for the track; and

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

Application

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.

Inspectors should consider the overall condition of a track when citing fouled ballast. For example, fouled ballast would be appropriate for a track that has a poor drainage system coupled with incipient track surface conditions at the area in question.

Defect Codes	
334.01	Insufficient Ballast
334.02	Fouled Ballast

§213.335 Crossties

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

(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 §213.323(b);

(ii) Maintain surface within the limits prescribed in §213.331; and

(iii) Maintain alinement within the limits prescribed in §213.327.

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

(3) Crossties of the type specified in paragraph (c) of this section that are(is) located at a joint location as specified in paragraph (e) of this section.

(c) For non-concrete tie construction, each 39 foot segment of Class 6 track shall have fourteen crossties; Classes 7, 8 and 9 shall have 18 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 3/8 inch relative to the crossties;

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

(5) Configured with less than 2 rail holding spikes or fasteners per tie plate; or

(6) So unable, due to insufficient fastener toeload, to maintain longitudinal restraint and maintain rail hold down and gage.

(d) For concrete tie construction, each 39 foot segment of Class 6 track shall have fourteen crossties, Classes 7, 8 and 9 shall have 16 crossties which are not--

(1) So deteriorated that the prestress strands are ineffective or withdrawn into the tie at one end and the tie exhibits structural cracks in the rail seat or in the gage of track;

(2) Configured with less than 2 fasteners on the same rail;

(3) So deteriorated in the vicinity of the rail fastener such that the fastener assembly may pull out or move laterally more than 3/8-inch relative to the crosstie;

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

(5) So deteriorated that rail seat abrasion is sufficiently deep so as to cause loss of rail fastener toeload;

(6) Completely broken through; or

(7) So unable, due to insufficient fastener toeload, to maintain longitudinal restraint and maintain rail hold down and gage.

(e) Class 6 track shall have one non-defective crosstie whose centerline is within 18 inches of the rail joint location or two crossties whose center lines are within

24 inches either side of the rail joint location. Class 7, 8, and 9 track shall have two non-defective ties within 24 inches each side of the rail joint.

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

(g) In Classes 7, 8 and 9 there shall be at least three non-defective ties each side of a defective tie.

(h) Where timber crossties are in use there shall be tie plates under the running rails on at least nine of 10 consecutive ties.

(I) 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.

Application

When determining compliance with this section, the Inspector must ascertain that crossties meet the "definitional" requirements of soundness, 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 sound ties for the track class as described in paragraph (c) and (d);and
- The proper placement of sound ties as described and positioned in paragraph (e) to support joints.

The failure of the crossties to meet any of the three above criteria constitutes a deviation from the TSS.

If track geometry measurements fail to meet the requirements of §§213.323, 213.327 and 213.331, and there is a insufficient number of sound 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 at fault, it is appropriate to cite only the defective geometry condition.

Each tie must be evaluated individually by the criteria described for timber crossties in Subsection (c) and for concrete crossties in Subsection (d).

When determining compliance with the minimum number of non-defective crossties per 39-foot segment, Inspectors are 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 applies independently of any other provision of the TSS; it does not require associated evidence of actual or incipient geometry defects or other defective conditions.

A non-defective joint tie must be found within the prescribed distance of the centerline of the joint measured at the rail and not at the centerline of track. Where a very short piece of rail exists within the joint bar, measure from the bar centerline. Where non-symmetrical bars exist (five-hole bars), measure from the design point where rail ends normally abut.

Effective distribution 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 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 primarily includes indications of actual or incipient deviations from the geometry standards. The word “incipient” means “beginning to appear.”

When citing Defect Code 213.335.03, the Inspector must show evidence of one or more of the geometry conditions cited in §213.335(b)(1). Several factors should be documented if the defect is being cited as a violation. These factors include, but are not limited to:

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

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.

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.

No criterion now 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 adjacent non-defective ties in a group.

The TSS also addresses track constructed without conventional crossties, such as concrete-slab track in which the running rails are secured through fixation to another structural member. Railroads are required to maintain gage, surface, and alinement to the standards specified in subsections (b)(1)(i), (ii), and (iii).

For non-concrete-tied construction, the requirements for ties parallel those of the lower standards, except that permissive lateral movement of tie plates is set at 3/8-inch instead of 1/2-inch and a requirement for rail holding spikes is added.

An absolute requirement in Classes 7, 8, and 9 exists that there shall be at least three non-defective ties of each side of a defective tie. Inspectors must determine the effectiveness of the ties using the criteria listed in subsection (b) and (c).

During an inspection, if the Inspector finds a missing tie plate under the rails, the Inspector must determine that tie plates are under at least nine out of 10 consecutive ties.

The reference to a metal object in paragraph (j) is intended to include only those items of track material which 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 lack of load on adjacent ties.

Defect Codes	
335.01	Fewer than minimum allowable number of non-defective ties per 39 feet.
335.02	No effective support ties within the prescribed distance from a joint.
335.03	Crossties not effectively distributed to support a 39-foot segment of track.
335.04	Reserved
335.05	Reserved
335.06	Track constructed without crossties does not effectively support track structure
335.07	Fewer than three non-defective ties each side of an effective tie.
335.08	Less than nine out of 10 consecutive ties with tie plates.
335.09	Metal object causing concentrated load between base of rail and bearing surface of tie plate.
335.10	Insufficient tie plates.

§213.337 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 §213.305 shall determine whether or not the track may continue in use. If the person 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 –

REMEDIAL ACTION					
Defect	**Length of defect (inch)**		**Percent of rail head cross-sectional area weakened by defect**		**If defective rail is not replaced, take the remedial action prescribed in note**
	More than	**But not more than**	**Less than**	**But not less than**	
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 split head Vertical split head Split web Piped rail Head web separation	1	2			H and F
	2	4			I and G
	4				B
	(1)				A
Bolt hole crack	1/2	1			H and F
	1	1-1/2			H and G
	1-1/2				B
	(1)				A
Broken Base	1	6			D
	6				[A] or [E and I]
Ordinary break					A or E
Damaged rail					D
Flattened rail	Depth ≥ 3/8 and Length ≥ 8				H.

([1]) Break out in rail head.

Notes:

A. Assign person designated under § 213.305 to visually supervise each operation over defective rail.

A2. Assign person designated under § 213.305 to make visual inspection. That person may authorize operation to continue without 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 §213.305(a)(1)(i) or (ii). The operating speed cannot be over 30 m.p.h.

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. Limit operating speed over defective rail to 30 m.p.h. until joint bars are applied; thereafter, limit speed to 50 m.p.h. When a search for internal rail defects is conducted under §213.339 and defects are discovered which require remedial action C, the operating speed shall be limited to 50 m.p.h., 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.

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. Limit operating speed over the defective rail to 30 m.p.h. or less as authorized by a person designated under §213.305(a)(1)(i) or (ii) until joint bars are applied; thereafter, limit speed to 50 m.p.h.

E. Apply joint bars to defect and bolt in accordance with §213.351(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.

I. Limit operating speed over defective rail to 30 m.p.h.

(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 one-quarter 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 a joint, which has flattened out across the width of the rail head to a depth of 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 shall 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.

Application

The remedial actions required for defective rails specify definite time limits and speeds, and allow certain discretion to the track owner for the continued operation over a defect. All rail defects should be considered dangerous by the Inspector and care should be taken to determine that proper remedial action has been undertaken 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 §213.337 and §213.339 (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 §213.305. If the rail is not replaced, another 24-hour cycle begins.

Note “B” limits speed to 30 m.p.h. as authorized by a §213.305 designated person. Notes “C,” “D,” and “H” limit the operating speed, following the application of joint bars, to 50 m.p.h.

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 five percent of the railhead cross sectional area. If a transverse defect is reported to be less than five percent, the track owner is not legally bound to correct and no remedial action would be required under the TSS. Defects reported less than five 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 five and 70 percent of cross-sectional head area, require remedial action (note B), as indicated by the prescribed notes. 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 which 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 also fail in the transverse plane and 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 five 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 between 80 percent require a visual inspection, an elective to restrict operation to a maximum of 10 m.p.h. for up to 24 hours, then another visual inspection, if the rail is not replaced, effectively repaired or the track removed from service.

The second paragraph in remedial action note (C) addresses defects which are discovered in Classes 3 through 5 track during an internal rail inspection required under §213.339, and whose size is 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. If the defective rail is not removed or a permanent repair 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 that are approaching service failure size. The result of the FRA's research indicates 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) require reinspecting the rail in 90 days, if deciding operations will continue. Defects in the range of more than two inches, but not more than four

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 in service. When any of the five defects exceed a length of four inches, a person designated under §213.305(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, extending beyond the joint bar.

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), the remedial action for a bolt hole crack, more than 1/2-inch but not more than 1-inch, if the rail is not replaced, is to limit speed to 50 m.p.h. then reinspect the rail in 90 days, if operations will continue in service. Cracks discovered greater than 1-inch, but not exceeding 1-1/2 inches, should be reinspected within 30 days and the speed limited to 50 m.p.h. For a bolt hole crack exceeding 1-1/2 inches, a person qualified under §213.305(a) may elect to designate a speed restriction, but cannot exceed 30 m.p.h.

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 defect and take the appropriate action 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, from over-crimped anchors, or it may originate in a manufactured seam. 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 one inch but less than six 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. The operating speed must be reduced to 30 m.p.h. or less, as authorized by a person under §213.305(a), until joint bars are applied. After that, operating speed is limited to 50 m.p.h.

A broken base in excess of six inches requires the assignment of a person designated under §213.305 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 §213.351(d) and (e) and thereafter must limit train operations to 30 m.p.h. 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 and originating in track, 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 rail, 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 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 §213.337(b), as being 3/8-inch or more in depth below the rest of the railhead and eight inches or more in length. As the defect becomes more severe by reducing railhead depth and width size, wheel

forces increase. If located either on the outside or inside rail, the limited cross-sectional area of the rail may increase the lateral-to-vertical ratio and cause a wheel-lift condition. The rule addresses the issue of "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 §213.307 for the class of track concerned, whichever is lower.

A "break out in rail head" is defined as a piece which has physically separated from the parent rail. Rail defects meeting this definition are required to have each operation over that rail visually supervised by a person designated under §213.305(a). 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 which have not progressed to the point where they meet this strict definition, but due to the type, length and location of the defect present a hazard to continued train operation, Inspectors should determine what remedial actions, if any, are to be instituted by the track owner

The issue of "excessive rail wear" continues to be evaluated by the FRA's rail integrity research program. 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.

Defect Codes	
337.01	Transverse Fissure
337.02	Compound Fissure
337.03	Horizontal Split Head
337.04	Vertical Split Head
337.05	Split Web
337.06	Piped Rail
337.07	Bolt hole Crack
337.08	Head Web Separation
337.09	Broken Base
337.10	Detail Fracture
337.11	Engine Burn Fracture
337.12	Ordinary Break
337.13	Broken or Defective Weld
337.14	Damaged Rail
337.15	Flattened Rail

§213.339 Inspection of rail in service

(a) A continuous search for internal defects shall be made of all rail in track at least twice annually with not less than 120 days between inspections

(b) Inspection equipment shall be capable of detecting defects between joint bars, in the area enclosed by joint bars.

(c) Each defective rail shall be marked with a highly visible marking on both sides of the web and base.

(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 paragraph (a) of this section.

(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 limits --

(1) Conduct a valid search for internal defects;

(2) Reduce operating speed to a maximum of 25 m.p.h. until such time as a valid search for internal defects can be made; or

(3) Remove the rail from service.

Application

A continuous search for internal rail defects must be made of all rail in track Classes 6, 7, 8, and 9 at a frequency of twice annually with a minimum of 120 days interval between inspections.

If a valid search for internal defects cannot be conducted because of surface conditions such as shells, head checks, etc. or lubrication or similar conditions, the inspection is not considered an inspection for the purposes of this section. The railroad must reduce operating speed to 25 m.p.h. until the valid search is made or the rail is removed from service.

Defect Codes	
339.01	Failure to inspect rail for internal defects at required frequency.
339.02	Failure of equipment to inspect rail at joints.
339.03	Defective rail not marked properly.
339.04	Failure to reduce operating speed until valid rail inspection is performed.

§213.341 Initial Inspection of new rail and welds

The track owner shall provide for the initial inspection of newly manufactured rail, and for initial inspection of new welds made in either new or used rail. A track owner may demonstrate compliance with this section by providing for:

(a) In-service inspection -- A scheduled periodic inspection of rail and welds that have been placed in service, if conducted in accordance with the provisions of §213.339, and if conducted not later than 90 days after installation, shall constitute compliance with paragraphs (b) and (c) of this section;

(b) Mill inspection -- A continuous inspection at the rail manufacturer's mill shall constitute compliance with the requirement for initial inspection of new rail, provided that the inspection equipment meets the applicable requirements specified in §213.339. The track owner shall obtain a copy of the manufacturer's report of inspection and retain it as a record until the rail receives its first scheduled inspection under §213.339;

(c) Welding plant inspection -- A continuous inspection at a welding plant, if conducted in accordance with the provisions of paragraph (b) of this section, and accompanied by a plant operator's report of inspection which is retained as a record by the track owner, shall constitute compliance with the requirements for initial inspection of new rail and plant welds, or of new plant welds made in used rail; and

(d) Inspection of field welds -- An initial inspection of field welds, either those joining the ends of CWR strings or those made for isolated repairs, shall be conducted not less than one day and not more than 30 days after the welds have been made. The initial inspection may be conducted by means of portable test equipment. The track owner shall retain a record of such inspections until the welds receive their first scheduled inspection under §213.339.

(e) Each defective rail found during inspections conducted under paragraph (a) or (d) of this section shall be marked with highly visible markings on both sides of the web and base and the remedial action as appropriate under §213.337 will apply.

Application

The railroad must provide initial inspections of newly manufactured rail and initial inspections of new welds made in either new or used rail.

To comply with the requirement to inspect newly manufactured rail, the railroad may conduct an in-service inspection, if conducted in accordance with §213.339, within 90 days after installation; or

To comply with the requirement to inspect newly manufactured rail, the railroad may elect to conduct a continuous inspection at the rail manufacturer's mill provided that the inspection equipment meets the requirements of §213.339.

If the mill inspection option is selected, the railroad shall maintain a record of the inspection as specified in this section.

Similarly, the railroad is required to inspect new welds made in new or used rail, either at the plant or in the track.

Each defective rail found under this section must be clearly marked and the proper remedial action taken. Inspector should cite the appropriate defect code in §213.339 for the type of rail defect found.

Defect Codes	
341.01	Failure to conduct initial inspection of new rail.
341.02	Failure to inspect new welds made in new or used rail.
341.03	Failure to clearly mark rail defect found during initial inspection of new rail and welds.

§213.343 Continuous welded rail (CWR)

Each track owner with track constructed of CWR shall have in effect 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 within six months following the effective date of this rule. FRA reviews each plan for compliance with the following --

(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.

(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.

(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.

(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.

(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 and/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.

(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.

(g) 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 §213.305(c) of this part as qualified to supervise the installation, adjustment, and maintenance of CWR track and to perform inspections of CWR track.

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

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

(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.

(i) 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 of 5 inches measured with a 62-foot chord. 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 to 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

Application

The definition "buckling incident" is provided to explain the industry-accepted threshold for such an event. However, the rule recognizes the importance of conditions that are precursors to buckles.

Paragraph (a) requires the railroad to have in effect and comply with their own written procedures that address the installation, adjustment, maintenance and inspection of CWR.

The written procedures 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.

The railroad must record the location of any installation or maintenance work in CWR that does not conform to its procedures in accordance with Section 213.343(h)(2). The record shall be maintained until the CWR is brought into conformance with the railroad's written procedures. The railroad may also wish to include a narrative explanation of the special circumstances involved. Inspectors should periodically review the information recorded in accordance with §213.343(h)(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 §213.343(h)(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.

Merely recording an activity which 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 and continued noncompliance may lead to an unsafe condition. The recordkeeping procedure is intended to provide a safety net by flagging those activities of noncompliance, which if not brought into compliance in a timely manner, could lead to an unsafe condition. For example, CWR track 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.

Under guidance from the Regional Track Specialist, Inspectors must determine the adequacy of the railroad's formal training program under §213.343(g) and (h). Those training procedures are required to be consistent and current with research results, clear, concise, and easy to understand by maintenance-of-way employees.

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 §213.343(a).

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

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 the 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 dependant 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." Most buckling however, 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 misalinements caused by reduced local resistance;

- high impact loads, initial rail surface (weld) imperfections and '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 or incipient geometry defects or other defective structural conditions when evaluating the adequacy of a railroad's CWR stability procedures (or lack thereof) under §213.343(b), (c), and (d). Locations where imminent track buckling is 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.*,
- minute rail alinement;
- 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 moving anchors;
- insufficient ballast section in the crib and shoulder areas;
- gaps at crosstie ends, especially on the low (inner) rail; and
- previous buckles improperly repaired.

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 "cold" 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 mis-alinement is an important consideration and it influences buckling strength significantly. An alinement offset or mid-ordinate within allowable limits may "grow" under the imposed loads, the ballast, subgrade movement and settlement. 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 §213.327, and evaluate the relevant alinement and track strength (§213.311, 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 which 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, and inadequate ballast section. Lateral and longitudinal restraint is influenced by the factors mentioned above and, if improperly executed or allowed to exist in a defective state, may produce a potential track buckle.

Tangent track buckling incidents are less frequent 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.

A track owner may update or modify CWR procedures as necessary, upon notification to the FRA of those changes.

Defect Codes	
343.01	Failure of track owner to develop and implement written CWR procedures.
343.02	Failure to comply with written CWR procedures.
343.03	Failure of track owner to develop a training program for the implementation of their written CWR procedures.
343.04	Failure to keep CWR records as required.

§213.345 Vehicle qualification testing

(a) All rolling stock types which operate at Class 6 speeds and above shall be qualified for operation for their intended track classes in order to demonstrate that the vehicle dynamic response to track alinement and geometry variations are within acceptable limits to assure safe operation. Rolling stock operating in Class 6 within one year prior to the promulgation of this Subpart shall be considered as being successfully qualified for Class 6 track and vehicles presently operating at Class 7 speeds by reason of conditional waivers shall be considered as qualified for Class 7.

(b) The qualification testing shall ensure that, at any speed less than 10 m.p.h. above the proposed maximum operating speed, the equipment will not exceed the wheel/rail force safety limits and the truck lateral accelerations specified in §213.333, and the testing shall demonstrate the following:

(1) The vertical acceleration, as measured by a vertical accelerometer mounted on the car floor, shall be limited to no greater than 0.55g single event, peak-to-peak.

(2) The lateral acceleration, as measured by a lateral accelerometer mounted on the car floor, shall be limited to no greater than 0.3g single event, peak-to-peak; and

(3) The combination of the lateral acceleration (L) and the vertical acceleration (V) within any period of 2 consecutive seconds as expressed by the square root of (V2 +L2) shall be limited to no greater than 0.604, where L may not exceed 0.3g and V may not exceed 0.55g.

(c) To obtain the test data necessary to support the analysis required in paragraphs (a) and (b) of this section, the track owner shall have a test plan which shall consider the operating practices and conditions, signal system, road crossings and trains on adjacent tracks during testing. The track owner shall establish a target maximum testing speed (at least 10 m.p.h. above the maximum proposed operating speed) and target test and operating conditions and conduct a test program sufficient to evaluate the operating limits of the track and equipment. The test program shall demonstrate vehicle dynamic response as speeds are incrementally increased from acceptable Class 6 limits to the target maximum test speeds. The test shall be suspended at that speed where any of the safety limits specified in paragraph (b) are exceeded.

(d) At the end of the test, when maximum safe operating speed is known along with permissible levels of cant deficiency, an additional run shall be made with the

subject equipment over the entire route proposed for revenue service at the speeds the railroad will request FRA to approve for such service and a second run again at 10 m.p.h. above this speed. A report of the test procedures and results shall be submitted to FRA upon the completions of the tests. The test report shall include the design flange angle of the equipment which shall be used for the determination of the lateral to vertical wheel load safety limit for the track/vehicle interaction safety measurements required per §213.333(l).

(e) As part of the submittal required in paragraph (d) of the section, the operator shall include an analysis and description of the signal system and operating practices to govern operations in Classes 7 and 8. This statement shall include a statement of sufficiency in these areas for the class of operation. Operation at speeds in excess of 150 m.p.h. is authorized only in conjunction with a rule of particular applicability addressing other safety issues presented by the system.

(f) Based on test results and submissions, FRA will approve a maximum train speed and value of cant deficiency for revenue service.

Application

This section refers to the qualification of the Vehicle/track system. High speed vehicles and the track on which they operate are an integral system. It is of utmost importance that the vehicle/track system meets minimum qualification criteria.

Rolling stock operating in Class 6 within one year prior to the promulgation of this Subpart shall be considered as qualified for Class 6 track and vehicles presently operating at Class 7 speeds by reason of conditional waivers shall be considered as qualified for Class 7. For this "grandfathered" equipment, it is not necessary that the railroad conduct qualification testing as described below. If the railroad has operated the specified equipment at Class 6 or Class 7 speeds and a particular level of cant deficiency by reason of conditional waivers, the railroad is not required to obtain FRA approval prior to operation at those speeds and cant deficiencies.

Unless the operation is grandfathered in accordance with paragraph (a), the qualification testing must ensure that when each rolling stock type is operated at any speed less then 10 m.p.h. above the proposed maximum speed, the vehicle/track system will not exceed the wheel/rail force safety limits and the truck lateral safety limits listed in §213.333 and the carbody lateral and vertical acceleration safety limits included in paragraph (b) of this section. The railroad must comply with the limitations on carbody accelerations listed in this section during the qualification phase and must comply with the carbody acceleration

limits shown in the VTI table in §213.333 during the day-to-day operation of the system.

For non-grandfathered operations, the high speed railroad must have a test plan that considers operating practices and conditions, signal system, road crossings and trains on adjacent tracks during testing. The test program shall comply with the requirements in this section.

For operations that have not been grandfathered, a report of the test procedures and results must be submitted to the FRA. The report shall also include the design flange angle that will be used in the VTI table in §213.333. On Classes 7 and 8 track, the railroad must submit an analysis and description of the signal system and operating practices to govern operation. A high speed railroad cannot operate at speeds above 150 m.p.h. without a Rule of Particular Applicability, except that it is permitted to conduct testing at 10 m.p.h. above its intended operating speed in accordance with this section.

Unless the proposed operation has been grandfathered, the Associate Administrator for Safety will review the test results and submissions and approve a specific maximum speed and value of cant deficiency based on those submissions. The Inspector may be requested to provide a memorandum containing recommendations concerning the advisability of FRA's approval of the proposed high speed operation.

During testing, the railroad Test Engineer will evaluate the data and, if safe to do so, will decide to make another run at an incremental speed, typically 5 or 10 m.p.h. higher than the last run. The FRA Headquarters staff will typically provide a Test Monitor to observe the testing. However, in some cases, the Regional Staff may be called upon to monitor testing or a decision will be reached that a Test Monitor is not necessary for a particular test. As appropriate, other FRA technical personnel may also be involved in the monitoring of the testing.

The Passenger Equipment Safety Standards' requirement for a pre-revenue service acceptance testing plan sets forth the information that must be included in the test plan for qualification and the procedures for notification and FRA approval of the plan (See §238.111). Specifically, §238.427, Suspension systems, and Appendix C to Part 238 state that passenger equipment shall be designed to limit the lateral and vertical forces and accelerations to the limits indicated. §213.345 of the Track Safety Standards, establishes the testing procedures and the safety criteria which must be met during vehicle qualification on the high speed route, as well as the materials which must be submitted for FRA's consideration of approval.

After a vehicle is qualified in accordance with §213.345, other provisions of the Track Safety Standards require the monitoring of the vehicle/track interaction (VTI) parameters. For Track Classes 7, 8 and 9, Section 213.333(k) requires that an instrumented car having dynamic response characteristics that are representative of the equipment (or a portable device that monitors on board instrumentation) shall be operated at a frequency of at least twice within 60 days. The representative car (or portable device) shall monitor vertically and laterally oriented accelerometers placed near the end of the car at the floor level. In addition, accelerometers shall be mounted to the truck frame. If the carbody lateral, carbody vertical, or truck frame lateral acceleration measurements exceed those in the VTI table in §213.333, train speeds will be reduced until these safety limits are not exceeded.

§213.333(l) states that, for Track Classes 8 and 9, an instrumented car that is representative of other equipment assigned to service shall be operated over the track at the revenue speed profile annually with not less than 180 days between inspections. The instrumented car must be equipped with functioning instrumented wheelsets to measure wheel/rail forces. If the wheel/rail forces exceed the limits in the table, speeds will be reduced until these safety limits are not exceeded.

The carbody acceleration limits in §213.345 are set at more stringent levels than those in §213.333. A new vehicle/track system is expected to demonstrate compliance with the 0.3g peak to peak lateral acceleration and 0.55g peak to peak vertical acceleration limits. As the system wears and changes over time, the railroad must comply with §213.333 which sets limits of 0.5g peak to peak lateral and 0.6g peak to peak vertical. These carbody acceleration limits are established primarily to prevent safety hazards to occupants of the high speed equipment who may lose balance or fall, but are also indicators of track quality.

An event's magnitude, as well as its duration, is important to take into consideration when examining occupant safety and track quality. After qualification, exceptions to the safety limits in §213.333, regardless of duration, must result in appropriate remedial action. A sustained, oscillatory carbody acceleration is more of concern than a single impact-related event. The following types of events are considered as exceptions to §213.345(b), regardless of the event's duration, if the events exceeded the instrumentation accuracy of the accelerometers (0.315g peak to peak lateral and 0.565g peak to peak vertical):

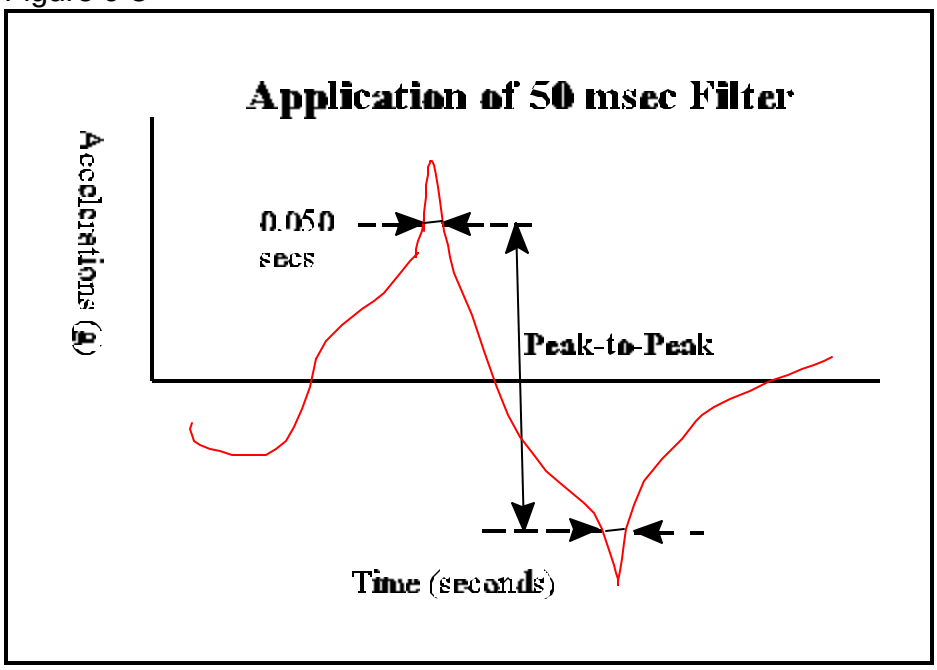
An event with a corresponding wheel/rail force or truck frame acceleration exceeding 90% of the prescribed limit (or, in the case of vertical wheel loads, less than 20% of the static load);

A sustained, oscillatory event which exhibits four or more consecutive peak to peak occurrences where each occurrence exceeds the limits within a four-second period.

For coach cars, a lateral or vertical carbody event above 0.6g peak to peak vertical or 0.5 g peak to peak lateral, and for power cars/locomotives any exceedence of 0.75g peak to peak vertical or 0.5g peak to peak lateral (with a 10 Hz filter).

Each event must then be examined for its duration (see following Figure) using a 50-msec filter. (Note: the above thresholds are applied using the measured data signature and magnitude). The 50 msec criterion has the effect of removing short duration spikes which do not affect ride safety.

Figure 6-8



Defect Codes	
345.01	Failure to conduct qualification testing as required.
345.02	Operation at Class 6 and above speeds without approval of the FRA Associate Administrator for Safety.

§213.347 Automotive or railroad crossings at grade

(a) There shall be no at-grade (level) highway crossings, public or private, or rail-to-rail crossings at-grade on Class 8 and 9 track.

(b) If train operation is projected at Class 7 speed for a track segment that will include rail-highway grade crossings, the track owner shall submit for FRA's approval a complete description of the proposed warning/barrier system to address the protection of highway traffic and high speed trains. Trains shall not operate at Class 7 speeds over any track segment having highway-rail grade crossings unless:

(1) An FRA-approved warning/barrier system exists on that track segment and;

(2) All elements of that warning/barrier system are functioning.

Application

Highway/rail crossings, public or private, or rail-to-rail crossings at-grade are prohibited on Classes 8 and 9 track.

The railroad must submit for the approval of the FRA Associate Administrator for Safety a complete description of the proposed warning/barrier system to address the protection of highway traffic and high speed trains before operation at Class 7 speeds is permitted at the crossings unless an FRA-approved warning/barrier system exists and all elements of that system are functioning.

Railroads are encouraged to install and maintain the optimal warning/barrier systems on crossings in Class 6 track.

Defect Codes	
347.01	Highway/rail crossings or rail-to-rail crossings at-grade are present on Class 8 and 9 track.
347.02	Unapproved warning/barrier systems on class 7 track.

§213.349 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 (inch)	On the gage side of the rail ends (inch)
Class 6, 7, 8, & 9	1/8	1/8

Application

Measure when bolts are tight. If bolts are not tight report the condition as a bolt defect. A deviation from the tolerance, as prescribed in the §213.349 Table, constitutes a reportable exception.

Particular attention should be given to a mismatch on the gage side. A sharp flange, skewed truck, or combination of both may cause wheel climb at a gage mismatch, particularly on the outer rail of a curve. A mismatch, vertical or lateral, is extremely critical on high speed railroads and may contribute to adverse dynamics in addition to traditional hazards.

Defect Codes	
349.01	Rail-end mismatch on tread of rail exceeds allowable.
349.02	Rail-end mismatch on gage side of rail exceeds allowable.

§213.351 Rail joints

(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.

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

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

(d) Each rail shall be bolted with at least two bolts at each joint.

(e) 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 section do not apply. Those locations, when over 400 feet long, are considered to be continuous welded rail track and shall meet all the requirements for continuous welded rail track prescribed in this subpart.

(f) No rail shall have a bolt hole which is torch cut or burned.

(g) No joint bar shall be reconfigured by torch cutting.

Application

Rail joints are considered to be a necessary discontinuity and require special attention by railroad maintenance personnel and safety Inspectors.

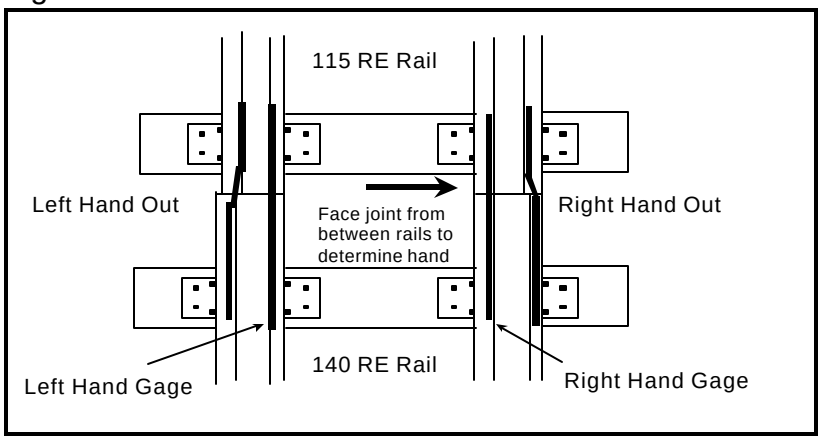
As far as possible, a rail joint should provide the same strength, stiffness, flexibility, and uniformity as the rail itself.

The TSS recognize these important aspects of rail joints and begin this section with a requirement that rail joints be of a structurally sound design and dimension for the rail on which they are applied (FRA and AREMA/AAR is to convene a working group which will issue guidelines on which joint bars meet the definition of “structurally sound” for the purpose of interchangeability with different rail sections).

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

The TSS only requires structural soundness and bolt condition based on authorized operating train speed. Inspectors are reminded to be alert to locations where different rail sections are jointed by rail joints not designed as compromise joints and not identified as fitting both rail sections. Figure 6-9 illustrates the proper application of compromise joint bars.

Figure 6-9



Failure of the owner to change out a center-cracked or other than center-cracked joint bar constitutes a reportable condition. Excessive vertical rail movement within a joint constitutes an exception to the TSS.

Track owners are required to maintain the prescribed number of bolts in rail joints.

Track bolts must be of sufficient tightness to allow the joint bars to support the joint firmly, but will not be so tight as to freeze the joint.

An Inspector must be aware that a mechanical bolt tightener has the capability to torque the bolt beyond what is required, and thereby freeze the joint.

Paragraph (f) of this section prohibits the use of a rail containing a bolt hole that has been torch-cut or burned.

Paragraph (g) of this section prohibits the reconfiguration of joint bars by torch cutting.

Rail that has been welded together, either in the field or at a central facility, into lengths exceeding 400 feet are considered continuous welded rail for purposes of applying the requirements of this section.

Defect Codes	
351.01	Rail joint not of structurally sound design and dimension.
351.02	Cracked or broken joint bar (other than center-break).
351.03	Center cracked or broken joint bar.
351.04	Worn joint bar allows vertical movement of rail in joint.
351.05	Less than 2 bolts per rail at each joint for conventional jointed rail.
351.06	Reserved
351.07	Less than 2 bolts per rail at any joint in continuous welded rail.
351.08	Loose joint bars.
351.09	Torch-cut or burned-bolt hole.
351.10	Joint bar reconfigured by torch cutting.

§213.352 Torch cut rail

(a) Except as a temporary repair in emergency situations no rail having a torch cut end shall be used. When a rail end with a torch cut is used in emergency situations, train speed over that rail shall not exceed the maximum allowable for Class 2 track. All torch cut rail ends in Class 6 shall be removed be within six months of September 21, 1998.

(b) Following the expiration of the time limits specified in paragraph (a) of this section, any torch cut rail end not removed shall be removed within 30 days of discovery. Train speed over that rail shall not exceed the maximum allowable for Class 2 track until removed.

Application

No torch cutting of rail is permitted except in an emergency such as when the track needs to be quickly returned to service following a derailment or washout.

No torch cut rails are considered to exist in Class 6 and above track prior to the effective date of this rule. Torch cut rails in Class 6, if they exist, must be removed before April 21, 1999. If found, the track speed over the torch cut rail must be reduced to Class 2 and the rail must be removed within 30 days of discovery.

Defect Codes	
352.01	Torch cut rail applied for other than emergency.
352.02	Failure to remove torch cut rails within specified time frame.
352.03	Failure to remove non-inventoried torch cut rail within 30 days of discovery.
352.04	Reserved
352.05	Train speed exceeds allowable over torch cut rail.

§213.353 Turnouts, track crossings and lift rail assemblies or other transition devices on moveable bridges

(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 shall be kept free of obstructions that may interfere with the passage of wheels. Use of rigid rail crossings at grade is limited per §213.347**.**

(b) 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. Elastic fasteners designed to restrict longitudinal rail movement are considered rail anchoring.

(c) Each flangeway at turnouts and track crossings shall be at least 1-1/2 inches wide.

(d) For all turnouts and crossovers, and lift rail assemblies or other transition devices on moveable bridges, the track owner shall prepare an inspection and maintenance Guidebook for use by railroad employees which shall be submitted to the Federal Railroad Administration. The Guidebook shall contain at a minimum –

(1) Inspection frequency and methodology including limiting measurement values for all components subject to wear or requiring adjustment.

(2) Maintenance techniques.

(e) Each hand operated switch shall be equipped with a redundant operating mechanism for maintaining the security of switch point position.

Application

A turnout is a track arrangement consisting of a switch and frog with connecting and operating parts extending from the point of switch to the heel of frog that 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 crossing is a device 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. Use of rigid rail crossings at grade is not permitted in Class 8 or 9 track.

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 mandatory on Class 6 and above. Elastic fasteners designed to restrict longitudinal rail movement are considered rail anchoring. Rail anchoring ensures the:

- Restraint of rail;
- Proper fit of the switch points; and
- Prevention of line irregularities.

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

Flangeways at turnouts and track crossings must be at least 1-1/2 inches wide.

For all turnouts and crossovers, and lift rail assemblies or other transition devices on moveable bridges, the railroad must prepare an inspection and maintenance Guidebook for use by railroad employees which shall be submitted to the FRA and which shall contain at a minimum:

- Inspection frequency and methodology, including limiting measurement values, for all components subject to wear or requiring adjustment.
- Maintenance techniques.

Inspectors must review the railroad's inspection Guidebook and conduct inspections based on the safety criteria contained therein. In addition, Inspectors must ascertain if the Guidebook contains the required information listed above. Inspectors shall use judgment when citing the railroad for its failure to adhere to its Guidebook.

The Guidebook must contain provisions addressing traditional types of high speed turnouts along with those components which may be developed in the future. Therefore, the Inspector has available those defect codes that have been used for several years on lower speed turnouts and switches.

Turnouts must be walked and measurements made before they can be included on the Inspection Report as a unit inspected.

The Inspector must do the following when inspecting switches:

- Confirm compliance with railroad Guidebook.
- Check alignment, 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.
- Test, in the presence of the owner's representative, the operation of switches for lost motion and loose connections.
- Examine, if applicable, 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. Stand and machine fastenings to the head block ties must be tight to avoid any movement or play.
- Examine switch-lock, keeper (latch), and foot-lock apparatus.
- 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 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.

- Examine the insulation in the gage plates and switch rods in signal territory.

When inspecting frogs, Inspectors should do the following:

- Confirm compliance with railroad Guidebook.

- Determine if frogs may be classified as bolted rigid, solid manganese, moveable, rail-bound manganese, or spring rail.

- Ensure that a frog is supported throughout on sound ties and is well-tamped.

- 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.

- Examine the toe of each spring rail frog. It must be solidly supported and proper hold-down housing clearance 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 machined, at the time of manufacture, to accommodate wheel tread transition.

- Determine if the toe is solidly tamped. If it is not, 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.

Defect Codes	
353.01	Loose, worn, or missing switch clips.
353.02	Loose, worn, or missing clip bolts (transit, side jaw, eccentric, vertical).
353.03	Loose, worn, or defective connecting rod.
353.04	Loose, worn, or defective connecting rod fastening.
353.05	Loose, worn, or defective switch rod.
353.06	Loose, worn, or missing switch rod bolts.
353.07	Worn or missing cotter pins.
353.08	Loose or missing rigid rail braces.
353.09	Loose or missing adjustable rail braces.
353.10	Missing switch, frog, or guard rail plates.
353.11	Loose or missing switch point stops.
353.12	Loose, worn, or missing frog bolts.
353.13	Loose, worn, or missing guard rail bolts.
353.14	Loose, worn or missing guard rail clamps, wedge, separator block, or end block.
353.15	Obstruction between switch point and stock rail.
353.16	Obstruction in flangeway of frog.
353.17	Obstruction in flangeway of guard rail.
353.18	Insufficient anchorage to restrain rail movement.
353.19	Flangeway less than 1-1/2 inches wide.
353.20	Stock rail not securely seated in switch plates.
353.21	Stock rail canted by overtightening rail braces.
353.22	Improper fit between switch point and stock rail.
353.23	Outer edge of wheel contacting gage side of stock rail.
353.24	Excessive lateral or vertical movement of switch point.
353.25	Heel of switch insecure.
353.26	Insecure switch stand or switch machine.
353.27	Insecure connecting rod.
353.28	Throw lever operable with switch lock or keeper in place.
353.29	Switch position indicator not clearly visible.
353.30	Unusually chipped or worn switch point.
353.32	Insufficient flangeway depth.
353.33	Frog point chipped, broken, or worn in excess of allowable.
353.34	Tread portion of frog worn in excess of allowable.
353.99	Severe frog condition not otherwise provided
353.35	Outer edge of wheel contacting side of spring wing rail.
353.36	Toe of wing rail not fully bolted and tight.
353.37	Ties under or wing rail not solidly tamped.
353.38	Bolt hole defect in frog.
353.39	Head and web separation in frog.
353.40	Insufficient tension in spring to hold wing rail against point rail.
353.41	Excessive clearance between hold-down housing and horn.

353.42	Turnout or crossover not being maintained in accordance with Guidebook.
353.43	Lift rail assembly or other transition device on moveable bridge not being maintained in accordance with Guidebook.
353.99	Severe frog condition not otherwise provided.

§213.355 Frog guard rails and guard faces; gage

The guard check and guard face gages in frogs shall be within the limits prescribed in the following table --

Class of track	Guard check gage 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
Class 6 track	4' 6-1/2"	4' 5"
Class 7 track	4' 6-1/2"	4' 5"
Class 8 track	4' 6-1/2"	4' 5"
Class 9 track	4' 6-1/2"	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 5/8 inch below the top of the center line of the head of the running rail, or corresponding location of the tread portion of the track structure.*

Application

- In some high speed turnout designs, guard rails are not installed.

- A guard rail is laid parallel to the running rail opposite a frog to form a flangeway with the rail and thereby to hold wheels of equipment to the proper alignment when passing through the frog.

- A guard rail must be maintained in the proper relative position to the frog in order to accomplish its important 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.

Section 213.355 clearly specifies allowable tolerances for guard check and guard face gage for Classes 6 through 9 track.

Defect Codes	
355.01	Guard check gage less than allowable.
355.02	Guard face gage exceeds allowable.
355.03	Cracked or broken guard rail.

§213.357 Derails

(a) Each track, other than a main track, which connects with a Class 7, 8 or 9 main track shall be equipped with a functioning derail of the correct size and type, unless railroad equipment on the track, because of grade characteristics cannot move to foul the main track.

(b) For the purposes of this section, a derail is a device which will physically stop or divert movement of railroad rolling stock or other railroad on-track equipment past the location of the device.

(c) Each derail shall be clearly visible. When in a locked position, a derail shall be free of any lost motion which would prevent it from performing its intended function.

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

(e) Each derail shall be properly installed for the rail to which it is applied.

(f) If a track protected by a derail is occupied by standing railroad rolling stock, the derail shall be in derailing position.

(g) Each derail on a track which is connected to a Class 7, 8 or 9 main track shall be interconnected with the signal system.

Application

Each track, other than a main track, which connects with a Class 7 and above main track must be equipped with a functioning derail of the correct size and type. For purposes of this section, main track is a track, other than an auxiliary track, extending through yards and between stations, upon which trains are operated by timetable or train orders, or both, or the use of which is governed by block signals. Thus, a controlled siding is considered a main track.

- For purposes of §213.357, a derail is a device which will physically stop or divert movement of railroad rolling stock or other railroad on-track equipment past the location of the device.

- Inspectors must use judgment in evaluating whether or not a particular situation should constitute an exception to the requirement for derails. If there is any doubt that the railroad equipment, "because of grade characteristics, cannot move to foul the main track," the Inspector should promptly contact the Regional Track Specialist for guidance. The Inspector should note that §213.361 requires the railroad to submit a "right-of-way plan" for FRA approval. This plan must contain provisions for the intrusion of vehicles from adjacent tracks. Inspectors must be constantly vigilant to identify circumstance where intrusion protection is needed.

- 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 must be installed to derail rolling stock in a direction away from the track or facility to be protected.

- If track protected by a derail is occupied by standing railroad rolling stock, the derail must be in derailing position. Of course, the derail would have to be placed in a non-derailing position to prepare for an intentional train movement.

- It is absolutely critical that derails on track connected to Class 7 and above main track shall be interconnected with a signal system. Inspectors shall periodically make joint inspection with Signal and Train Control Inspectors to determine compliance with this requirement.

Defect Codes	
357.01	Derail not clearly visible.
357.02	Derail operable when locked.
357.04	Improper size derail.
357.05	Improperly installed derail.
357.06	Loose, worn, or defective parts of derail.
357.07	Derail not present when required.
357.08	Derailing device not of proper design physically stop or divert movement
357.09	Derail not interconnected to the signal system when required.

§213.359 Track stiffness

(a) Track shall have a sufficient vertical strength to withstand the maximum vehicle loads generated at maximum permissible train speeds, cant deficiencies and surface defects. For purposes of this section, vertical track strength is defined as the track capacity to constrain vertical deformations so that the track shall return following maximum load to a configuration in compliance with the vehicle/track interaction safety limits and geometry requirements of this subpart.

(b) Track shall have sufficient lateral strength to withstand the maximum thermal and vehicle loads generated at maximum permissible train speeds, cant deficiencies and lateral alinement defects. For purposes of this section lateral track strength is defined as the track capacity to constrain lateral deformations so that track shall return following maximum load to a configuration in compliance with the vehicle/track interaction safety limits and geometry requirements of this subpart.

Application

Compliance with this section is demonstrated by compliance with track geometry, vehicle/track interaction and CWR requirements in this subpart. Since direct measurements of vertical and lateral track strength are currently difficult to obtain, Inspectors must monitor track strength using the tools contained in the track geometry, automated inspection and CWR sections.

Track must have sufficient vertical strength and lateral strength to withstand the maximum loads generated at maximum permissible train speeds, cant deficiency and lateral or vertical defects so that the track will return to a configuration in compliance with the track performance and geometry requirements of this subpart.

It is imperative that the track structure is structurally qualified to accept the loads without unacceptable deformation. The limit of 0.5 for the Net Axle L/V Ratio in the table of vehicle/track interaction safety limits in §213.333 is based on an extrapolation of the Prud'homme limit and experimental data.

Lateral loads generated by vehicles operating under maximum speed, cant deficiency, thermal loads, and initial line defect conditions should not cause the exception of an allowable deflection limit. Key influencing parameters are the track lateral resistance characteristics, tie/ballast friction coefficients, vehicle vertical axle loads, track curvature, thermal loads, and constant versus variable lateral axle loads.

§213.361 Right-of-Way

The track owner in Class 8 and 9 shall submit a barrier plan, termed a "right-of-way plan," to the Federal Railroad Administration for approval. At a minimum, the plan will contain provisions in areas of demonstrated need for the prevention of --

(a) Vandalism;

(b) Launching of objects from overhead bridges or structures into the path of trains; and

(c) Intrusion of vehicles from adjacent rights-of-way.

Application

The railroad is required to submit a barrier plan to the FRA Associate Administrator for Safety for approval. The plan shall address vandalism, launching of objects from overhead bridges or structures, and intrusion.

Inspectors must obtain a copy of the railroad's "right-of-way" plan either from the railroad or the Regional Track Specialist. Inspectors will be asked to evaluate the railroad's right-of-way plan for comprehensiveness and may be directed to prepare a memorandum of recommendations concerning the plan. After the plan becomes effective, Inspectors must monitor the safety of the high speed railroad and advise the Regional Track Specialist of any concerns.

Defect Codes	
361.01	Failure to provide "Right-of-way" plan.
361.02	Failure of "Right-of-way" plan to contain required information.

§213.365 Visual inspections

(a) All track shall be visually inspected in accordance with the schedule prescribed in paragraph (c) of this section by a person designated under §213.305.

(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 m.p.h. 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 Inspector's 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.

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

Class of track	**Required frequency**
6, 7, & 8	**Twice weekly** with at least 2 calendar-day's interval between inspections.
9	**Three times per week**.

(d) If the person making the inspection finds a deviation from the requirements of this part, the person shall immediately initiate remedial action.

(e) Each switch, turnout, crossover, and lift rail assemblies on moveable bridges shall be inspected on foot at least weekly. The inspection shall be accomplished in accordance with the Guidebook required under § 213.353.

(f) In track Classes 8 and 9, if no train traffic operates for a period of eight hours, a train shall be operated at a speed not to exceed 100 m.p.h. over the track before the resumption of operations at the maximum authorized speed.

Application

The success of the track safety program depends on the adequacy of the railroad's inspection and compliance program.

To assure that railroads are providing proper inspection coverage, Federal and State Inspectors must periodically examine the railroad's inspection records.

As specified in this section of the TSS, the owner must see that all track is inspected in accordance with the prescribed schedule. Failure of the owner to comply with this schedule may constitute a violation.

If an owner's designated inspector or supervisor finds a deviation from the TSS, failure to initiate remedial action immediately may constitute a violation.

The FRA or State Inspector will not make the owner's prescribed inspections, but will monitor them for adherence to the TSS.

For purposes of this section, "main track" is defined as a track, other than an auxiliary track, extending through yards and between stations.

Paragraph (b) does not require five m.p.h. over highway crossings. However, this section still requires an operator to perform an adequate inspection regardless of the need to permit safe operation of inspection vehicles through highway crossings.

Paragraph (b) contains language specifying the number of additional tracks that can be inspected, depending on whether one or two qualified individuals are in the vehicle, and depending on the distance between adjacent tracks measured between track center lines. Inspectors may inspect multiple tracks from hi-rail vehicles only if their view of the tracks inspected is unobstructed by tunnels, differences in ground level, or any other circumstance that would prevent an unobstructed inspection of all the tracks they are inspecting.

  This section also requires railroad to traverse each main track bi-weekly and each siding monthly, and to so note on the appropriate track inspection records.

It is recognized that many high speed turnouts (and lift assemblies on moveable bridges) and those which will probably be designed in the future may have unique properties. The railroad must thoroughly understand the nature of these

turnouts and establish maintenance and inspection procedures which shall be monitored by FRA and State Inspectors. Each turnout, crossover, and lift rail assembly on moveable bridges shall be inspected at least weekly and accomplished in accordance with the Guidebook required under §213.353. Federal and State Inspectors must be familiar with the Guidebook and conduct inspections to monitor the railroad's compliance with the safety limits and procedures established in the Guidebook. The Guidebook must also include provisions for the inspection and maintenance of traditional turnouts. The high speed railroad must inspect the condition of frogs, stock rails, switch points, etc. as the railroad would do in the lower track classes. (See the discussion in §213.353.)

In track Classes 8 and 9, if traffic is not operated for a period of eight hours, the railroad is required to operate a train not to exceed 100 m.p.h. before the resumption of operations at the maximum authorized speed. This provision addresses the possibility of objects or debris being placed on the track. It also mitigates the potential occurrences of vandalism.

This section requires that each inspection performed in accordance with the schedule 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. Therefore, 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 Reserved to comply with frequency requirements.

Inspecting after dark is in compliance with the requirements of this Subpart, as long as the railroad inspector is capable of detecting defects. As an example, inspections are routinely made in tunnels or subways with limited or no lighting, and maintenance requirements may require inspections after daylight hours. Appropriate artificial lighting often can be substituted.

When FRA and State Inspectors are conducting inspections on a hi-rail vehicle, only the track occupied will be inspected and recorded on the F 6180.96 form. 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 and State Inspectors may include multiple tracks while conducting walking inspections. Inspectors will use good judgment in ensuring a high quality inspection while conducting walking inspections. In order to insure that FRA inspections are high quality, when making hi-rail inspections, FRA Inspectors will only inspect the track they occupy.

Defect Codes	
365.01	Track inspected by other than qualified designated individual.
365.02	Track being inspected at excessive speed.
365.03	Failure to inspect at required frequency.
365.04	Failure to initiate remedial action for deviations found.
365.05	One Inspector inspecting more than two tracks.
365.06	Two Inspectors inspecting more than four tracks.
365.07	Inspection performed on track outside of maximum allowable track center distances.
365.08	Main track not traversed within the required frequency.
365.09	Siding track not traversed within the required frequency.
365.10	Failure to inspect turnouts at required frequency.
365.11	Failure to inspect track crossings at required frequency.
365.12	Failure to inspect lift rail assemblies or other transition devices on moveable bridges at required frequency
365.13	Failure to operate a train at 100 m.p.h. or less after an eight hour period with no train operation

§213.367 Special inspections

In the event of fire, flood, severe storm, temperature extremes 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.

Application

This section is necessarily general in nature because it is not practical to specify all the conditions that could trigger a special inspection, nor the manner and timing which any particular special inspection should be conducted. 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 a safety advisory recommending procedures that reflect best industry practice for special track inspections. The procedures consist of: (1) prompt notification of 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 special inspection can be performed; (3) identification of bridges carrying Class

4 or higher track which 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 assist the track Inspectors in interpreting the Inspectors' findings.

Although the advisory contains a sample list of surprise events that routinely occur in nature, this provision is not limited to only the occurrences listed or to only natural disasters. Section 213.367 addresses the need to inspect after "other occurrences" which include such natural phenomena as temperature extremes, as well as unexpected events that are human-made, 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 "surprise" 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 §213.367, mindful that advisory procedures are not mandatory. Procedures should include the method employed by the railroad to receive information on severe weather, i.e., who receives the information and what is done with that information. When the railroad is notified of a track-damaging occurrence, a special inspection must be made. A track owner may designate any official to be responsible to make a determination on whether a special inspection, under §213.367, is required. The designation is not limited to any certain craft, but the official must be trained and qualified to assure a proper inspection is conducted.

Defect Codes	
367.01	Failure to conduct special inspections when required.

§213.369 Inspection records

(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.

(b) Except as provided in paragraph (e) of this section, each record of an inspection under §213.365 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 record which apply to those operations are either maintained or can be viewed following 10 days notice by the Federal Railroad Administration.

(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 § 213.339(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.

(d) Each owner required to keep inspection records under this section shall make those records available for inspection and copying by the Federal Railroad Administrator.

(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 such that the integrity of each record 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; and

(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 FRA and track Inspectors responsible under §213.305. Such paper copies shall be

made available to the track Inspectors and at the locations specified in paragraph (b) of this section.

(7) Track inspection records shall be kept available to persons who performed the inspection and to persons performing subsequent inspections.

(f) Each vehicle/track interaction safety record required under §213.333 (g), and (m) shall be made available for inspection and copying by the FRA at the locations specified in paragraph (b) of this section.

Application

Track owners are required to keep a record of each inspection according to the requirements of this subpart, prepared on the day of inspection and signed by the person making the inspection.

The regulation allows railroads to designate a location within 100 miles of each state (designated locations) where records can be viewed by Inspectors. 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

Paragraph (c) requires a track owner to record any locations where a proper rail inspection cannot be performed because of rail surface conditions. Section §213.339(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 §213.339(a) which requires a search for internal defects at specific intervals. Subsection (c) requires a record keeping of those instances.

Section 213.369(e) 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 or by railroad track Inspectors.

The track owner has the liberty to devise any form deemed sufficient to meet the required standards. If the owner requires inspections at more frequent intervals than specified by §213.365(c), then the only requirement is to prepare and maintain an inspection record to conform 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 §213.365(b)(3)], date of inspection, location and nature of any defect, and the remedial action taken by the person making the inspection. If train operations were conducted over the defect, the nature of the defect would require a measurement to include the specific parameters or limits. When defects are discovered, the track owner's inspectors must determine the risk imposed and immediately initiate remedial action, in accordance with §213.303. 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 and State Inspectors should review a railroad inspection record to determine if the reported data accurately indicates 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). 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 traversed, and any tracks not inspected due to visibility obstruction or excessive distance as required under §213.365.

When two qualified persons inspect multiple tracks in accordance with §213.365(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 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.

Inspection records must be made available to the FRA or State Inspector for inspection and copying. 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 will contact the appropriate Track Specialist immediately. Should the Track Specialist be unavailable the Inspector will notify the appropriate Regional Administrator. Headquarters Track Division will also be notified.

The system must assure 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. Inspectors, therefore, must rely on viewing the record on the terminal or monitor screen whenever it is made available for viewing by the railroad. Although printouts of records must be made available to Federal and State 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.

Paper copies of electronic records and amendments will be made available for inspection and copying to the FRA or State Inspector. These 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.

Defect Codes	
369.01	Failure to keep records as required.
369.02	Failure of Inspector to complete report at time of inspection.
369.03	Failure of Inspector to sign report.
369.04	Failure of Inspector to provide required information.
369.05	Failure of rail inspection record to provide required information.
369.06	Failure to make records available for copying and inspection.
369.07	Electronic system does not maintain the integrity of each record.
369.08	Electronic system allows record or amendments to be modified.
369.09	Electronic amendments not stored separately from record.
369.10	Person making electronic amendment not identified.
369.11	Electronic system corrupts or losses data.
369.12	Paper copies of records not made available for inspection and copying.
369.13	Inspection reports not available to Inspector or subsequent Inspectors.
369.14	Electronic storage not initiated within 24 hours.

End of Chapter Six