brightline

49 CFR Part 213
Track Safety Standards
Subparts A - F

FACILITATOR GUIDE

For Brightline Employees and Contractors

Created by RailPros

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Track Safety Standards Training (49 CFR Part 213)

Facilitator Guide

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About This Facilitator Guide & Course

This Facilitator Guide is designed to be a comprehensive tool for leading the Track Safety Standards Instructor-Led course, including Subparts A – F, covered in this Guide. (Subpart G has its own presentation and Facilitator Guide and should be taught separately from Subparts A – F.)

The course duration will be 16 hours (2 days) in a traditional instructor led classroom setting, with an optional 8 hours (1 day) of field training and exercise. More experienced personnel will require less training hours than a new employee with little or no experience.

Note there is also a 1-day Refresher Course that is all classroom based. That presentation and Facilitator Guide are separate from the Full Course materials.

Please review this guide and the included class resources prior to teaching the course to ensure you are prepared and have the necessary materials and equipment.

> Plan Ahead! Ensure you and your class have appropriate track access and On-Track Safety for any field instruction time/ days.

This course is designed for all railroad employees, managers and supervisors responsible for compliance with 49 CFR 213 Track Safety Standards (TSS). It is designed to be an informative and practical mix of classroom instruction and hands-on field training, so be prepared to be both indoors and outdoors. You will acquaint students with the Track Safety Standards prescribed by Federal Regulation, as well as the means to detect deviations from these standards and prescribed appropriate remedial action to correct or safely compensate for these deviations.

Facilitator Discussion Points

1. Start each class with a thorough safety briefing and re-brief upon return from breaks.
2. Unless class participants already know one another and are known to you, take a moment after introducing yourself to have each member introduce themselves. (Introductions offer you an opportunity to determine the level of experience participants have with track inspection procedures and railroad work.)
3. Don't be afraid to be repetitive about key matters.
4. Look for opportunities to involve everyone in the class.
5. Ask questions that stimulate discussions and give you feedback regarding the knowledge level of the class participants.
6. Make use of breaks to get feedback from students.
7. Provide current information relevant to the training such as recent injuries, Federal fines, FRA audits, etc.

Course Materials & Equipment

To teach this course effectively, you should have, at a minimum, the following items. Some of these items are teaching/ learning tools and others are required administrative files for training & recordkeeping.

Suggested Class Materials & Equipment:

1. Presentation file: *49 CFR 213 Track Safety Standards (Parts A-F) Brighline.pptx*
2. Facilitator Guide
3. Student Guide/ Workbook (1 per student +extras)
4. FRA Compliance Manual – *effective March 2018*
5. RailPros CFR 213 Regulatory Pocket book (1 per student +extras)
6. Final Exam (1 per student +extras)
7. Answer Sheet (1 per student +extras)
8. Answer Key (available in this guide)
9. Sign-In Sheet/ Class Log
10. Track Calculator
11. Measuring Tape and level
12. Blank name tags/ place cards
13. Pencil/ Pen for each student
14. Computer w/ display & audio output
15. Projector (if necessary)
16. Large screen/ Monitor/ TV
17. Cables (HDMI or similar for connecting computer to display)

Suggested Field Materials & Equipment:

18. Field access with appropriate/ available On-Track Safety
19. Level board
20. Stringlining kit
21. Clipboard
22. Graph paper

Presenting

This course uses a PowerPoint presentation that includes static slides and video. You should familiarize yourself with the presentation and ensure it plays smoothly from your computer prior to class.

Please practice navigating through the presentation prior to leading your first class.

1. This Facilitator Guide provides a suggested Course Schedule to help Instructors stay on task and get through all required material in the allotted time.

2. As facilitator, you must advance through the slides using the arrow keys or a remote 'clicker'. The presentation is divided into Sections that correspond with each Subpart of the Regulations (Part A, B, C, D, E and F).

3. This Facilitator Guide provides KEY MESSAGES, INSTRUCTOR GUIDANCE and EXERCISES. Use this Guide to help keep students engaged and to ensure understanding of the content.

4. The facilitator should position himself/herself in the front of the room so as to be accessible and visible to the students for questions and discussion during the entire class.

5. The facilitator should encourage students to ask questions during the presentation – this is not an "interruption" but rather is an important part of the class.

6. If students don't jump in to ask questions, the facilitator should pause the presentation periodically and ask the students questions or interject comments.

7. The role of a facilitator is to encourage the students to become involved and learn the material, as well as present information.

8. This Guide does NOT provide suggestions on break times. That is left to the discretion of the facilitator.

Creating the Necessary Training Records for Your Class

Prior to conducting a class, you should begin creating the training records. To do this, enter the names of each student into the provided Sign In/ Class Log sheet and print a copy; or, you may print a blank Sign-In sheet and write in the required information at class time.

RECORDKEEPING IS CRITICAL!

These records are subject to inspection and photocopying by the FRA during regular business hours. Records must be maintained for two years.

Make sure every student signs in EACH DAY OF CLASS.

1. Ensure student information (including spelling of legal name and employee/ contractor ID) is legible and correct.
2. Record final exam scores in the appropriate column at the end of the class.
3. Submit/ Enter the completed Class Sign-In Form with participant signatures and Final Exam scores in the appropriate manner for Brightline.
4. Retain records for a period of at least two years.

Additional Information

The *Final Exam* and *Answer Sheet* are included as PDF files in the Course Folder.

The facilitator should print one copy of the Final Exam for each student in the class.

Collect the Final Exam from each student at the end of the class.

ABOUT THE PROGRAM

Program Description

Target Audience

This course is designed for all railroad employees, managers and supervisors responsible for compliance with 49 CFR 213 Track Safety Standards (TSS).

Purpose

This course will acquaint students with the Track Safety Standards prescribed by Federal Regulation, as well as the means to detect deviations from these standards and prescribed appropriate remedial action to correct or safely compensate for these deviations.

Program Length

This course is designed to take 5 days for parts A – F; 4 days of classroom and demonstrations, 1 day of field training and exercises. The schedule can be modified to suite schedule and experience of the class. If adding Part G to the course, then plan to add 1 additional day of classroom training and at least ½ day additional field time.

Course Goal

Upon successful completion of this course, students will understand minimum safety requirements for railroad track to comply with 49 CFR Part 213 and will have practiced the skills necessary to inspect track for compliance to keep your railroad operating safely.

Course Outline

1. Origins and Scope of 49 CFR Part 213
2. Track Safety Standards 213, Subpart A
3. Track Safety Standards 213, Subpart B Roadbed
4. Track Safety Standards 213, Subpart C Track Geometry
5. Bonus content: String lining a curve
6. Track Safety Standards 213, Subpart D Track Structure
7. Track Safety Standards 213, Subpart E Track Appliances
8. Track Safety Standards 213, Subpart F Inspection

Requirements

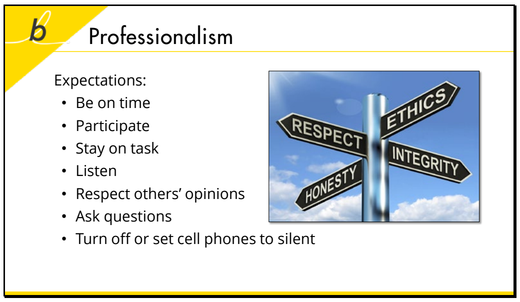
Successful completion of the program requires:

1. Class & Field participation
2. Passing score (80%) on final exam

All questions answered incorrectly on the final examination must be reviewed with the participant by the instructor.

COURSE WELCOME

Slides 1, 2 & 3



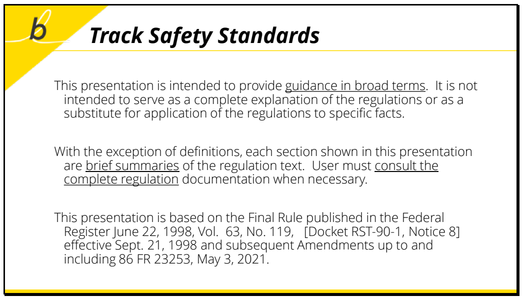
Key Message: These opening slides serve as an introduction to the course and the classroom. These slides include introductions of the participants and instructor(s); and, they serve as a reminder that safety and professionalism are a priority on the railroad and in the classroom.

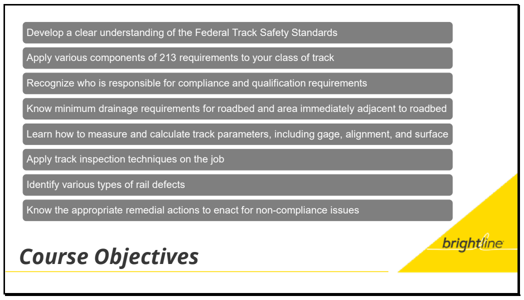
Instructor Guidance:

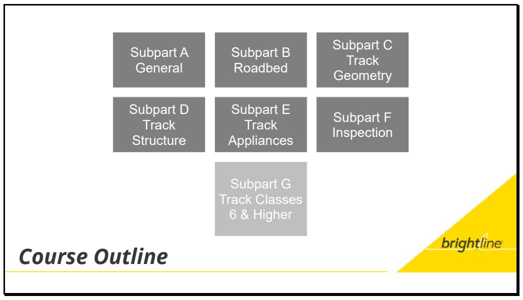
1. Post your name and contact information clearly in the room
2. Welcome participants as they enter the room
3. When all are seated, perform class introductions and welcomes
    1. Introduce yourself
    2. Introduce the course topic
    3. Conduct a safety briefing (post information on board if available)
    4. Discuss expectations of the students while they are in attendance

Course Objectives

Slides 4, ,5 & 6







Key Message: This course will follow the regulations but is not a comprehensive review of the regulations. In other words, regulations may be summarized or omitted completely.

Note that Subpart G Track Classes 6 & Higher is available in a separate presentation and requires additional materials and time to teach.

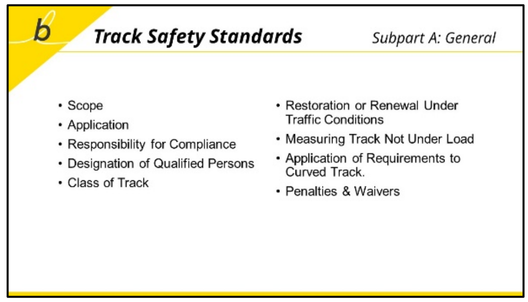
Instructor Guidance:

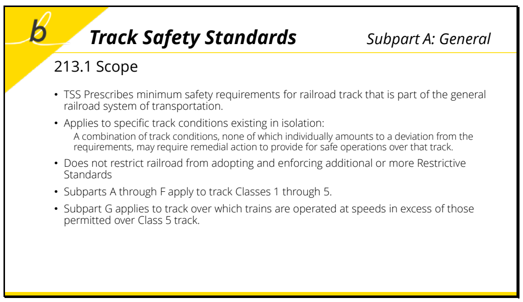
1. Introduce the course
2. Direct students to their 213 pocket reg booklet (if available) and encourage them to follow along with the presentation
3. Indicate that the instruction follows along with the regulation in order (Parts A – F)
4. Use this moment to also remind students to follow along in their Workbooks (if available) and to take notes and participate the exercises that are offered
5. Ask the class if there are any questions so far

NOTE: Class participation is imperative for each student's success. Encourage participation through frequent questions and engagement.

SUBPART A - General

Slides 7, 8, & 9



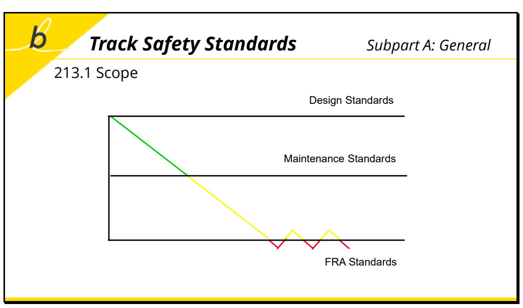


Key Message: Session Objectives: The participants will be able to discriminate the minimum requirements for this subpart and understand the basic intent and application of 213.1, 213.3, 213.4, 213.5, 213.7, 213.9, 213.11, 213.13, 213.15, 213.17 and 213.19.

Instructor Guidance:

1. Introduce Subpart A – General
2. Review the Scope with the class (213.1 Scope)

Slide 10 *(animation)*



Key Message: Design standards are often different from maintenance standards, which are, in turn, often different from ***minimum*** FRA standards.

49 CFR Part 213 is the ***minimum*** safety standard. This means, if you maintain your railroad only to the minimum safety standard, you are likely to incur defects and/ or

violations. Most railroads establish maintenance standards that are more stringent than the FRA standards. And even more restrictive than the railroad's standards are the design standards – meaning the actual specifications the railroad should be at when in perfect condition.

The FRA has allowed for a great amount of leeway before a condition is considered a defect or violation. For example, a design spec may have gage set perfectly at 56 ½". But the FRA says you can have tolerance up to 57 ½" wide before the class of track must be reduced. (Essentially, the FRA has given the railroads 1 inch of play with this particular example.) The railroads respond with their own maintenance specifications which could mean that they consider it a defect at 57 ¼". In this case, the railroad track inspector should find a defect long before it fails to meet the ***minimum*** safety standards set forth by the FRA.

If you are going to maintain your track at the FRA minimum safety standard, you will be incurring defects and violations frequently. If you have a maintenance spec that is above the minimum safety standard, but not perfectly in line with the design spec, you are more likely to find a defect before the FRA finds it.

Instructor Guidance:

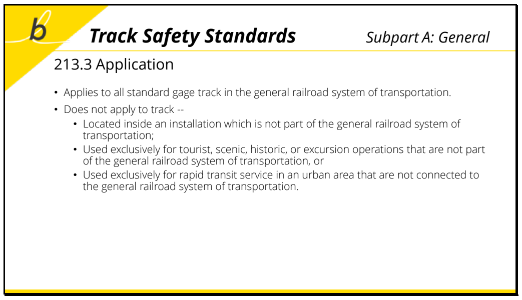
1. Ask the class who sets the minimum safety requirements for track on their property.
    1. Answer: 49 CFR 213 Subparts A – F
    2. Encourage students to write the answers in blanks when provided in their Student Workbook

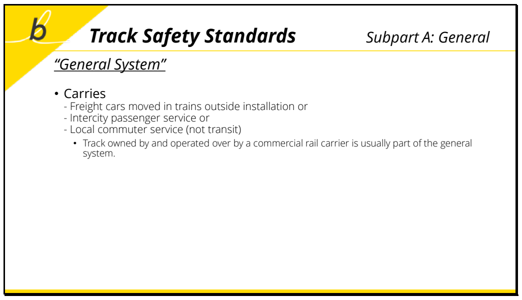
2. Explain that track buckling-caused derailments rank #1 in both the number of derailments and the resulting damage cost across all railroads a. On a hot day in 2012, two major derailments occurred due to improper CWR procedures

b. The work your students will be doing on Brightline matters to our millions of passengers and the communities we operate in

3. List a few topics that will be covered today (on slide) that could have helped prevent these derailments and minimize the risk on Brightline

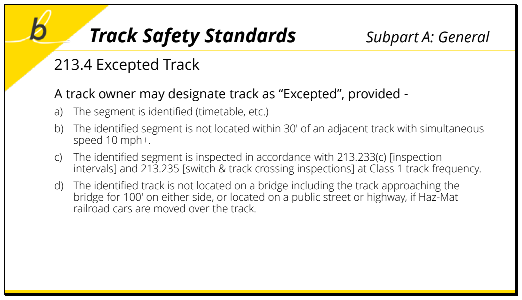
Slides 11 - 12

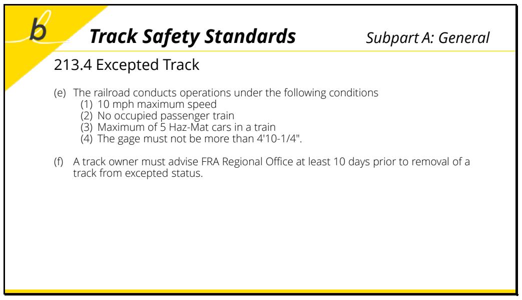


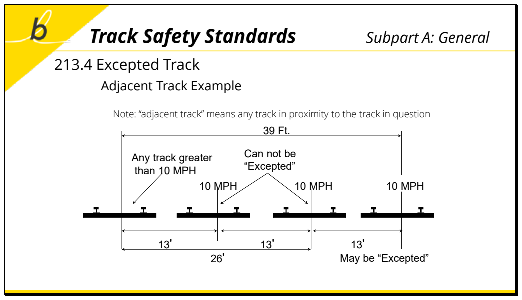


Instructor Guidance: Review the regulation and what "General Railroad System" refers to.

Slides 13 -16 (Hidden)



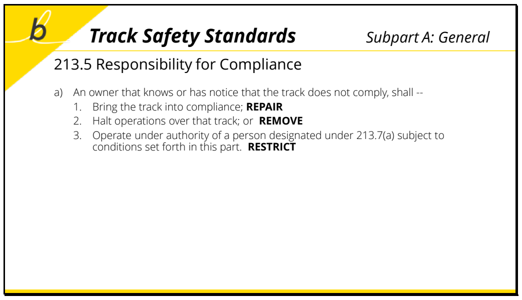




Instructor Guidance: Inform students that for Brightline properties, there is no Excepted Track, so 213.4 does not apply.

Note: All slides covering 213.4 Excepted Track have been hidden, which means they will not appear while in presentation mode. However, the slides have been left in just in case they are needed for reference.

Slide 17



Key Message: This section describes the action that must be taken by the track owner once he/she knows that the track is not in compliance with Track Safety Standards. The track owner must:

(1) Bring the track into compliance by either repairing the defects or imposing an appropriate speed restriction – ie. **Repair**

(2) Remove the track from service – ie. **Remove**; or

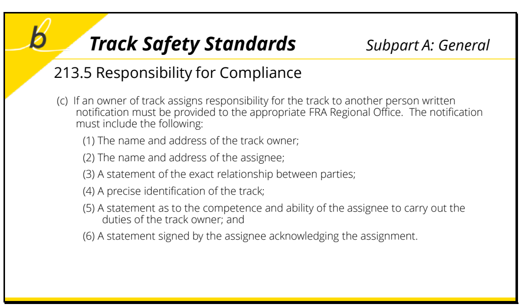
(3) Operate under authority of a qualified person designated under §213.7 in accordance with the following provisions:

§213.9(b)	Class of Track - 30 day provision;
§213.11	Restoration or Renewal of Track Under Traffic Conditions; or
§213.113	Rail Defects. ie. **Restrict**

Instructor Guidance:

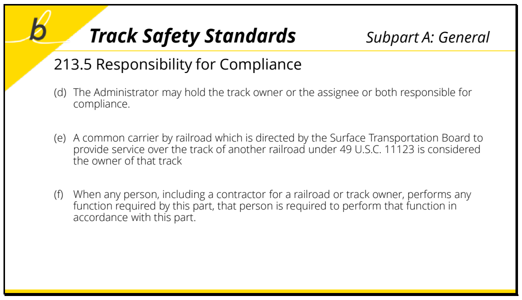
1. Review the slide with students
2. Suggest students write "Repair," "Remove," and "Restrict" directly in their 213 pocket guide or workbook as you will be referencing these terms throughout the training.

Slide 18



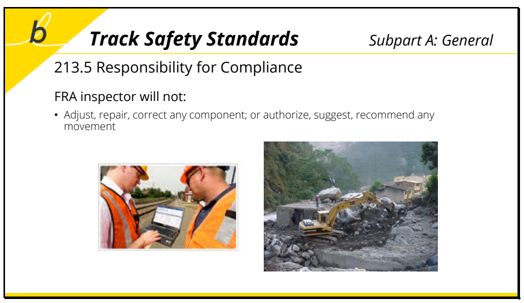
Key Message: Section 213.5(c) gives a track owner the responsibility to notify the FRA, through the appropriate regional office, when the responsibility for compliance with this part is assigned. For example, leased track or reassignment of the primary responsibility. Notification must contain the specific information required in this paragraph and shall be made 30 days prior to the assignment of the responsibility.

Slide 19



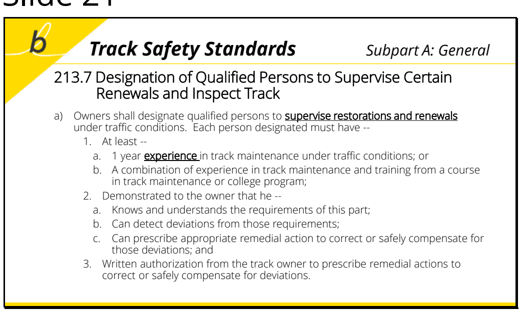
Key Message: Section 213.5(d) also provides that the party responsible for compliance can be other than the actual owner of the track through assignment of responsibility or if the Surface Transportation Board has issued a directed service order. FRA may hold responsible any party contracted by the track owner to ensure compliance with this part. The FRA may hold the track owner, the assignee, or both responsible.

Slide 20



Key Message: FRA inspectors do not prescribe remedial action for defects found during routine inspections. FRA inspectors rarely conduct inspections unaccompanied. However, in the rare occasion when an inspector is working alone and discovers a non-complaint condition, the inspector will immediately notify proper railroad authorities.

Slide 21

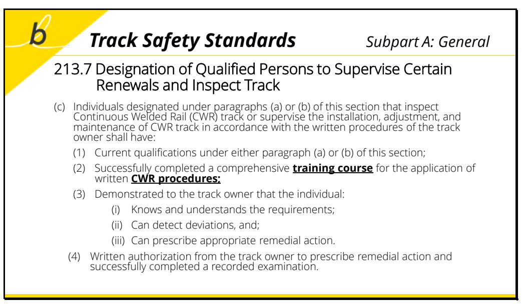


Key Message: 213.7(a) provides for the qualification of person who supervise restorations under traffic conditions.
Inspectors may request of an owner, verification of the experience and qualifications of his supervisory and track inspection personnel. Specific names of individuals should be made available in writing by the owner.

Slide 22

Key Message: 213.7(b) provides for the qualification of persons who inspect track. The TSS requires the retention of required track inspection reports for one year at the owner's division office.

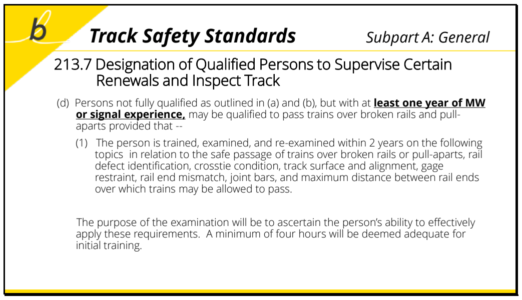
Slide 23



Key Message: Paragraph (c) spells out the training and qualification process of individuals designated to inspect, supervise installation, adjust, or maintain CWR

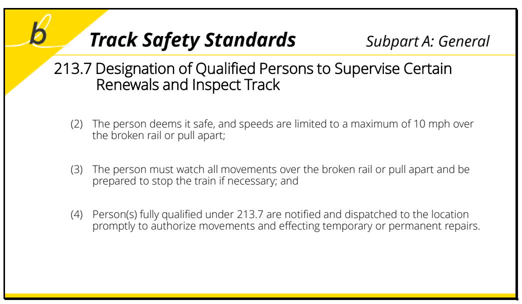
This Course does NOT qualify as the required comprehensive training course for the application of written CWR Procedures. You must take Brightline's CWR training course to meet the qualifications of 213.7.

Slide 24



Key Message: Paragraph (d) allows employees to be qualified for the specific purpose of authorizing 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.

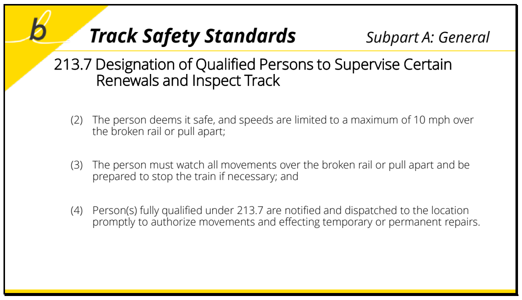
Slide 25



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

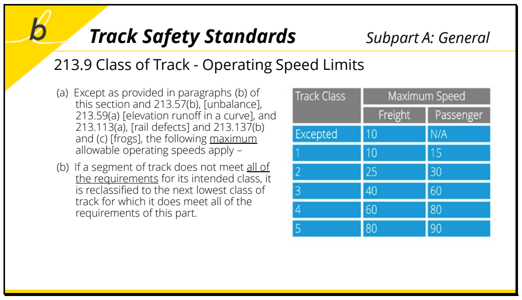
Fully qualified persons under §213.7 must be notified and dispatched to the location promptly to assume responsibility for authorizing train movements and effecting repairs. The word "promptly" is meant to provide the railroad with some flexibility in event where there is only one train to pass over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

Slide 26 -27



Key Message: Failure of the owner to have and maintain written records designating employees or the basis for each designation is a deviation from the TSS. Designated employees include supervisors, inspectors, and those partially qualified to pass trains over broken rails and pull-aparts.

Slide 28



Key Message: The TSS classify track solely on the basis of authorized speeds for freight and passenger trains. Tolerances are specified in the TSS for each class of track. A deviation beyond the limiting tolerances for Classes 1 through 5 requires repair, or reduction of speeds to the appropriate class. The only structural or geometry defect that is applicable on excepted track is gage exceeding 4-foot 10-1/4 inches.

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

As described in paragraph (a), the maximum allowable operating speed for each class of track is shown in the table. However, the maximum allowable operating speed on a curve is limited by the geometric parameters contained in §213.57(b) [unbalance] and 213.59(a) [superelevation runoff]. For example, a speed for a passenger train based on the elevation at a curve may be only 18 m.p.h. even though the track may otherwise comply with a higher class. Additionally, regardless of the track class, the appropriate remedial action for a defective rail under §213.113 must be initiated.

Part (b) continues: However, if the segment of track does not at least meet the requirements of Class 1 track, operations may continue at Class 1 speeds for a period of not more than 30 days without bringing the track into compliance, under the authority of a person designated under § 213.7(a), after that person determines that operations may safely continue and subject to any limiting conditions specified by such person.

Instructor Guidance:

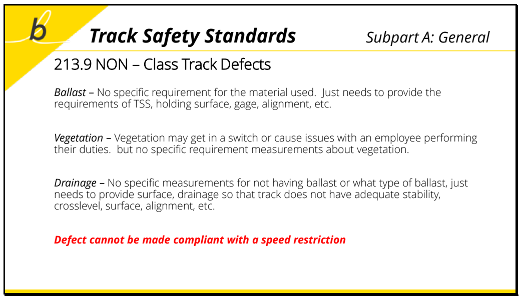
1. Review the Regulation, Table and Key Message with the Class
2. Direct students to their Student Workbook and have them answer the questions for the 213.9 Exercise using the table on the slide.
3. Once everyone is done, review the answers with the class (answers are highlighted in yellow on following page)
4. These Exercises are an opportunity to ensure students are understanding the intent and application of various rules and tables. Go back and review any slides that need more explanation.

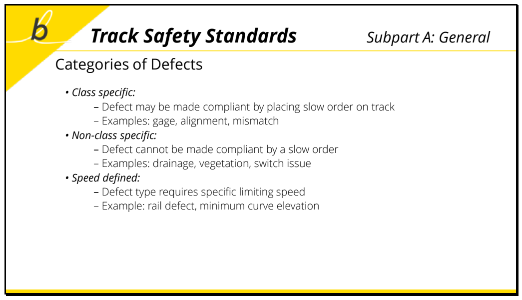
Section 213.9 Exercise

Instructions: Determine the appropriate class of track for each of the following maximum track speeds using the 49 CFR Part 213 Regulation.

49 MPH Freight	______________________	4
15 MPH Passenger	______________________	1
59 MPH Passenger	______________________	3
60 MPH Freight	______________________	4
75 MPH Passenger	______________________	4
80 MPH Passenger	______________________	4
20 MPH Freight	______________________	2
88 MPH Passenger	______________________	5
5 MPH Passenger	______________________	1
35 MPH Passenger	______________________	3
25 MPH Freight	______________________	2
10 MPH Passenger	______________________	1
35 MPH Passenger	______________________	3
45 MPH Passenger	______________________	3
45 MPH Freight	______________________	4
50 MPH Passenger	______________________	3
55 MPH Passenger	______________________	3
70 MPH Passenger	______________________	4
65 MPH Passenger	______________________	4
29 MPH Passenger	______________________	2

Slides 29 – 30

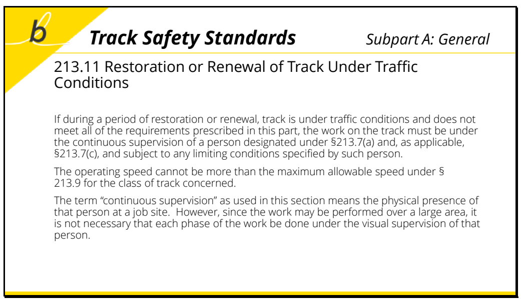




Instructor Guidance: Review 213.9 and categories of defects with students.

Note: Refer to table 2 in Compliance Manual regarding Defects

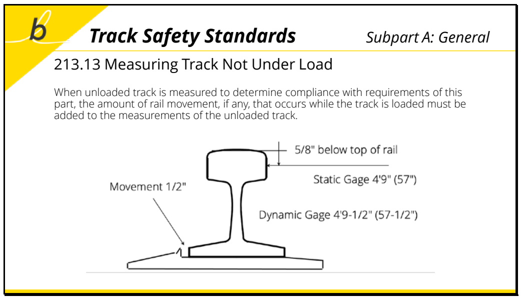
Slide 31

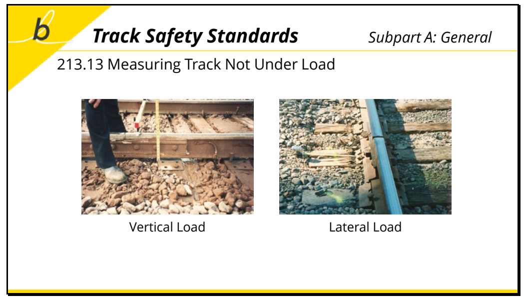


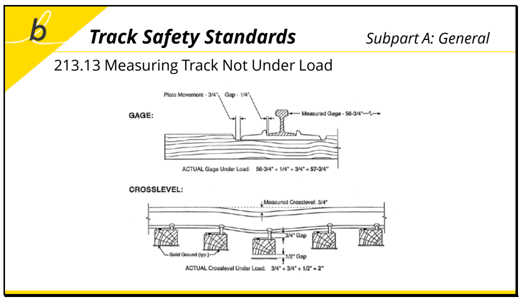
Key Message: The qualified person at a work site may determine that it is safe to permit a train to pass through the work area at any speed up to the permanent speed on the track. For example, during a crosstie and resurfacing project, the qualified person may analyze the conditions present and authorize a speed higher than 10 m.p.h. through the limits of the work when temporary crosslevel conditions exceed the limits in §213.63 for Class 1 track.

Similarly, a welder may permit a train to pass over a frog when the point is temporarily removed by the welding and grinding process more than six inches back and 5/8-inch down. At the end of the work period when the designated person leaves the work site, the track must be in compliance with the TSS. It is acceptable for the designated person to determine that the track is safe for operation at Class 1 speeds and use §213.9(b) as a remedial action.

Slides 32 – 34

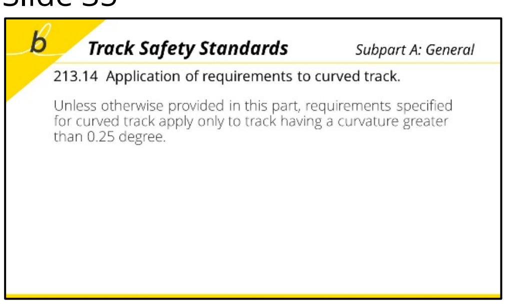




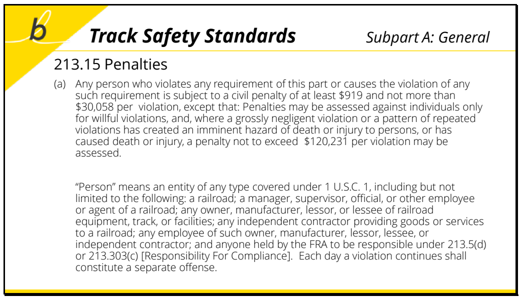


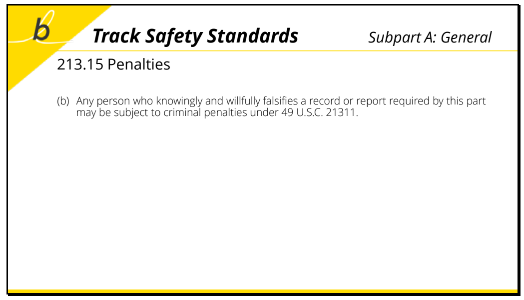
Key Message: In addition to the static (unloaded) geometry measurements taken, the amount of visually detectable dynamic (loaded) deflection that occurs under train movement must be considered. This includes the amount of vertical or lateral rail deflection occurring between rail base and tie plate, 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.

Slide 35



Slides 36-37





Key Message: This section covers all subparts of 213 including a schedule of civil and criminal penalties found under Appendix B part 213.

Instructor Guidance:

1. If time allows or students need additional exercises regarding Subpart A – General, read the following scenario to the class
2. Use the white board to write out the details and encourage students to answer out loud and discuss

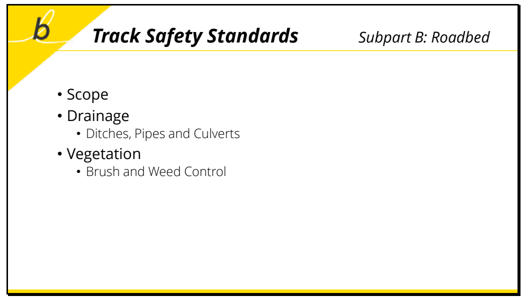
<u>Additional Exercise – Subpart A.</u> You are a track inspector and today you are inspecting a track segment that is classified as FRA Excepted Track. This track is an industrial lead that services several industries, one being an Ethanol terminal that unloads placarded tank cars for distribution by trucks. During your inspection, three items get your attention.

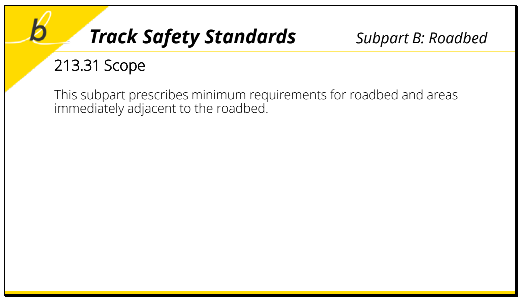
1. Item 1: At a joint location on the track, you notice there might be a problem so you stop and measure the gage. The static gage measures exactly 58 1/4 inches. The crossties are good and there is no lateral plate to tie or rail to plate movement.
2. Item 2: A yard engine moved five placarded ethanol cars from the ethanol terminal to the yard and then made a return trip and moved three more of the same type cars to the yard from the terminal
3. Item 3: On the yard engine's second trip, the yardmaster instructed the yard engine to take a different route that ran beside the main track with track centers of 28 feet. The posted speed on the main track at this location was 30 m.p.h.

Are any of these items exceptions to the FRA Regulations for Excepted Track and if so, which one or ones and why?

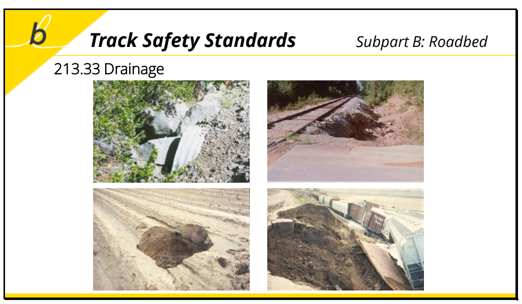
SUBPART B - ROADBED

Slides 38, 39 & 40





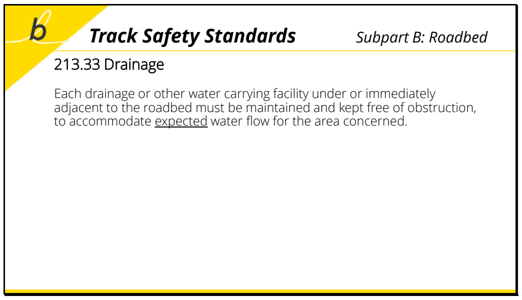
Slide 41



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

Instructor Guidance: Review each photo with the class and explain the significance.
Top left - obstructed culvert.
Top right - scouring due to water diverted onto the track structure due to construction of housing sub-division.
Bottom left - First indication of potential mud slide problem caused by farmer performing fill work adjacent to track.
Bottom right - mud slide due to heavy rain where farmer performed fill work.

Slide 42



Key Message:
The rule 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.

Slide 43

Instructor Guidance: Review photos with the class.
Top left - combustible vegetation at bridge.
Top right - general brush conditions.
Bottom left - Vegetation in pole line. Note, inspectors must verify that the vegetation is interfering with the function of the C&S system.
Bottom right - Illustration of properly controlled vegetation at a highway-rail grade crossing cross buck..

Slide 44

Key Message: 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. 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. 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.
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.

Instructor Guidance:

1. If time allows or students need additional exercises regarding Subpart B – Roadbed, read the following scenario to the class
2. Use the white board to write out the details and encourage students to answer out loud and discuss

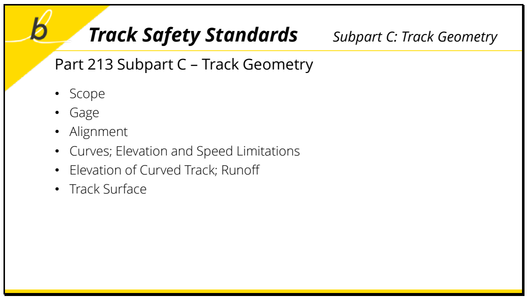
Additional Exercise – Subpart B. While riding a train over your assigned territory, the engineer calls your attention to a couple of items that he feels needs your attention.

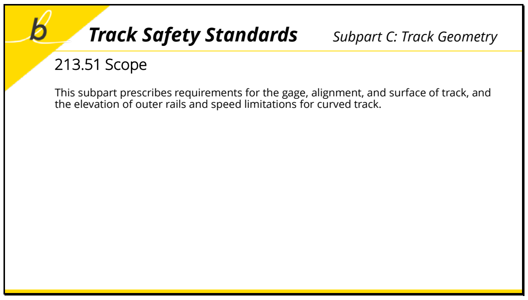
1. At milepost 16.5, there is a field signal that is partially blocked by a tree branch. The branch is attached to a large tree but the tree is not on the railroad right of way. Given the fact that this is only a field signal and the tree is not on the railroad right of way, is this a true FRA defective condition? If it is a defective condition, what is the defect code? If it is a defect, what remedial action needs to be taken and how can it be handled since the tree is off the railroad right of way?

2. At milepost 35.4, the engineer points out a problem with water backing up around and near the ballast line of the track. A beaver dam can clearly be seen at the inlet of a pipe that goes under the track but the beaver dam is located off the railroad right of way. Since the water is not over the track, is this a defective condition and if so, what is the defect code? If this is found to be a defective condition, how can remedial action be performed if the source of the defect is off the railroad right of way?

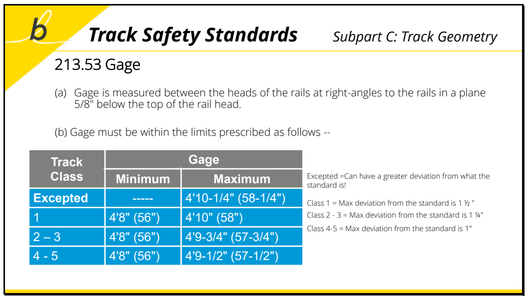
SUBPART C - GEOMETRY

Slides 45, 46 & 47





Slide 48

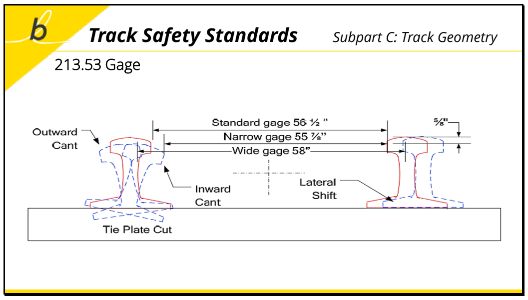


Track Class	Gage	
	Minimum	Maximum
Excepted	-----	4'10-1/4" (58-1/4")
1	4'8" (56")	4'10" (58")
2 – 3	4'8" (56")	4'9-3/4" (57-3/4")
4 - 5	4'8" (56")	4'9-1/2" (57-1/2")

Instructor Guidance:

1. Review 213.53 with the class
2. Demonstrate the correct way to measure gage with an actual tape measure and rail piece or draw it on the board for emphasis

Slide 49



Key Message:
There are various reasons why a track may measure out of gage. This slide is an illustration of various gage measurements and possible contributing factors.

Instructor Guidance:
1. Review these visual indicators that a track may be out of gage:

High spikes tipping outward
- Misalignment of the rails
- Flat alignment of the low rail of a curve
- A rust or grease streak on field side of the ball of the rail
- Lateral rail and plate movement and damage to, or peeling of the top of the ties on the field side the tie plate
- Flange marks in the mud rail or flangeway of a grade crossing
- Gage corner of rail worn, particularly on a curve

Wide Gage Causes
- - Defective ties
- - Curvature
- - Heavy train tonnage
- - Improper maintenance practices

Tight Gage Visual Signs
- - Skewed ties
- - Twisted tie plates and spikes
- - Gage corner of the rail shaved

Tight Gage Visual Signs
- Insufficient ballast
- Insufficient anchoring
- Heavy train tonnage

2. Direct students to their Student Workbook and have them answer the questions for the 213.53 Exercise
3. Once everyone is done, review the answers with the class (answers are highlighted in yellow)

Section 213.53 Exercise

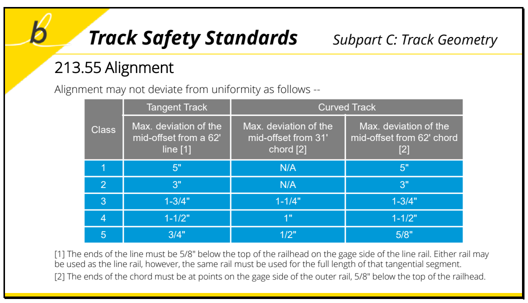
Instructions: Calculate the maximum gage for each measurement and determine the appropriate class of track for each using the 49 CFR Part 213 Regulation.

Measurement	Gage	Class
56-13/16” static, 5/16 movement under load	57 1/8	5
57-7/16" static, 1/8" movement under load	57 9/16	3
57-11/16" static, 3/16” movement under load	57 7/8	1
57-9/16" static, 1/8” movement under load	57 11/16	3
57-3/8" static, 1/16” movement under load	57 7/16	5
57-15/16" static, 0” movement under load	57 15/16	1
57-7/8" static, 1/16” movement under load	57 15/16	1
57-3/8" static, 5/16” movement under load	57 11/16	3
57-3/16” static, 1/4“movement under load	57 7/16	5
57-13/16” static, 3/16" movement under load	58	1
56-5/8" static, 0” movement under load	56 5/8	5
57-3/16" static, 7/16” movement under load	57 5/8	3
58-3/16" static, 0” movement under load	58 3/16	OOS OR EXCEPTED
55-3/4”, static, 3/16” movement under load	55 15/16	OOS
57-3/8" static, 5/16” movement under load	57 11/16	3
57-7/16" static, 1/2" movement under load	57 15/16	1
58-1/2" static, 0” movement under load	58 1/2	OOS
57-11/16" static, 3/8” movement under load	58 1/16	OOS OR EXCEPTED

Slide 50

Instructor Guidance: Review photos with the class.
Top left - shows why streaks occur on tread of rail when gage is wide. Note hi-rail wheel is close to falling off rail into the gage.
Right - Curved closure rail with high spikes indication wide gage.
Bottom left - Measurement of gage with tape.

Slide 51



Class	Tangent Track	Curved Track	
	Max. deviation of the mid-offset from a 62' line [1]	Max. deviation of the mid-offset from 31' chord [2]	Max. deviation of the mid-offset from 62' chord [2]
1	5"	N/A	5"
2	3"	N/A	3"
3	1-3/4"	1-1/4"	1-3/4"
4	1-1/2"	1"	1-1/2"
5	3/4"	1/2"	5/8"

[1] The ends of the line must be 5/8" below the top of the railhead on the gage side of the line rail. Either rail may be used as the line rail, however, the same rail must be used for the full length of that tangential segment.
[2] The ends of the chord must be at points on the gage side of the outer rail, 5/8" below the top of the railhead.

Key Message: This rule establishes the maximum alignment deviations allowed for tangent and curved track in Class 1 through 5 track.
Alignment is the local variation in curvature of each rail of the track. On tangent track, the intended curvature is zero, and thus the alignment is measured as the variation or deviation from zero. In a curve, the alignment is measured as the variation or deviation from the "uniform" alignment over a specified distance.

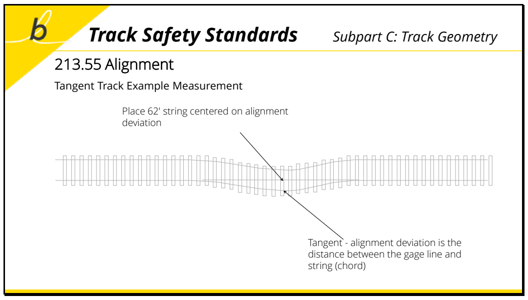
Instructor Guidance:
1. Review the rule and table with students
2. Have students complete the 213.55 Exercise, Part 1
3. Review answers with the class

Section 213.55 Exercise

Instructions: *PART 1* – Using 49 CFR Part 213, determine the maximum class of track for each alignment deviation below:

Measurement	Class of Track
2-13/16" on tangent track	__________ 2
4-1/8" on tangent track	__________ 1
1-5/8" on tangent track	__________ 3
Curved track: 1-1/8" using a 31' chord, 2-11/16" using a 62' chord	__________ 2
Curved track: 7/16" using a 31' chord, 1-5/8" using a 62' chord	__________ 3
Curved track: 15/16" using a 31' chord, 1-5/16" using a 62' chord	________ 4
11/16" on tangent track	__________ 5
Curved track: 1-3/8" using a 31' chord, 2-5/8" using a 62' chord	__________ 2
Curved track: 7/16" using a 31' chord, 11/16" using a 62' chord	__________ 4
7/16" on tangent track	__________ 5
5-1/4" on tangent track	OOS/Excepted
Curved track: 1-13/16" using a 31' chord, 1-1/2" using a 62' chord	__________ 2
Curved track: 13/16" using a 31' chord, 1/2" using a 62' chord	__________ 4
Curved track: 7/8"using a 31' chord, 2" using a 62' chord	__________ 2

Slide 52

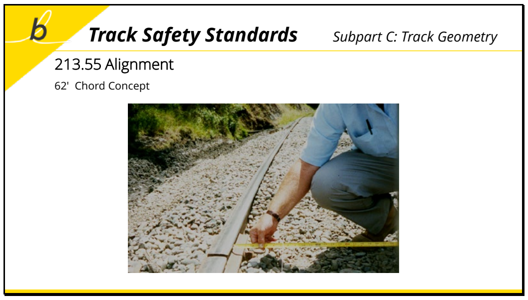


Key Message: In tangent track, the MCO is measured directly with a 62-foot chord and graduated ruler. In spirals, the alignment gradually changes from tangent to the full degree of curve at the curve body. Therefore, to determine an alignment deviation at a given point in a spiral, it will be necessary to determine the proper MCO based on the projected value at each point of concern.

Poor alignment Visual Signs
- Mis-aligned track
- Rail worn unusually

Poor alignment Causes
- Poor track surface
- Rail movement - Insufficient anchoring
- Excessive train braking
- Wide gage
- Excessive compressive forces (sun kink\buckled track)
- Insufficient ballast
- Train braking

Slide 53



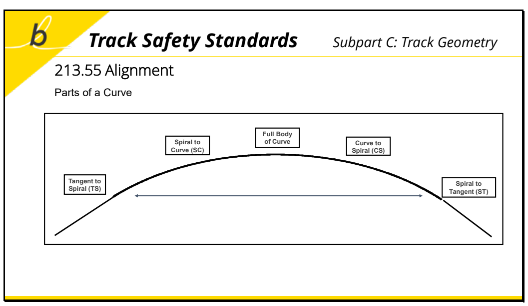
Key Message: Maintaining appropriate curve alignment helps reduce wear on the track structure and rolling stock and it is a critical component of derailment prevention.

One method used to measure curve alignment and alignment deviations is string lining.

The ultimate purpose of string lining is to determine if a curve is within allowable tolerances, or if it requires remedial action.

These next slides will help discuss how to conduct string lining of a curve to determine alignment.

Slide 54



Key Message: To discuss alignment through a curve, it is important to understand the most basic parts of a curve.
In a simple curve, the distance from the middle of a constant-length chord to the curve is constant… that is, as long as the curve has no deformities. This distance – the midpoint of the chord to the curve – is called the mid-ordinate.

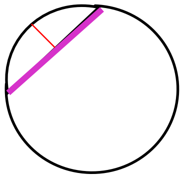
With a deformity – or what we can call a mis-alignment – the distance from the center of the chord to the curve will vary. String lining will help you find and measure these deformities, or mis-alinements – so that they can be corrected and the curve can be aligned.

However, a railroad curve is never just part of a simple circle. It also requires straight track – tangent; circles that make up the simple curve, sometimes called full body of the curve, and Spirals that connect the tangent track to the curve.

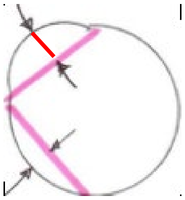
Instructor Guidance:

1. It may be helpful to draw on the board to illustrate your points about curve, mid-ordinate and deviation from alignment:

 A simple curve is a segment of a circle

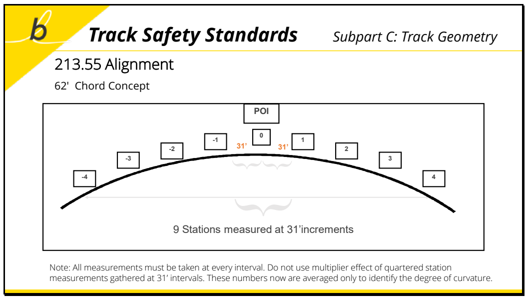


A chord is a straight line that connects two points on a curve. The distance from the middle of that chord to the curve is constant – as long as there are no deviations.

 Introduce a deviation – or mis-alignment – and the distance will change. String lining is meant to help find and measure these deviations.

2. Review the parts of the curve while explaining the parts that make up the curve (tangent, spiral, curve)

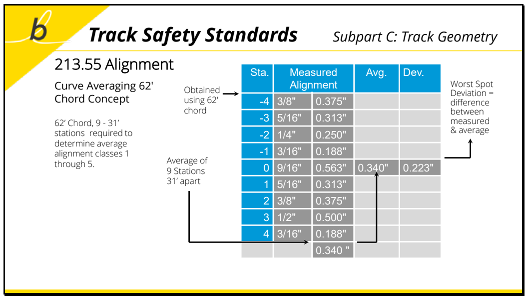
Slide 55



Instructor Guidance:

1. Provide a brief overview of stringlining using the 62-foot chord
2. Must mark and measure **at least** 9 stations 31 feet apart through the curve with Station 0 starting at the point of deviation or Point of Interest
3. Pull/ Stretch the 62' chord from Station 0 to Station -2 to get your reading at Station -1
4. Record the reading
5. NOTE: Some properties like to measure off and mark all necessary stations first, then start stringlining at the very first station. Others may start at Station 0 and stringline back from there, then stringline forward. The results should be the same. Try to teach to what the Railroad prefers.
6. Continue through the curve, recording measurements for at least 9 stations – one at Station 0 and 4 more to each side.
7. NOTE: Remember to account for the distance of the paddle if required for your stringlining kit
8. Next, you will demonstrate for the class how to use these readings to calculate the deviation

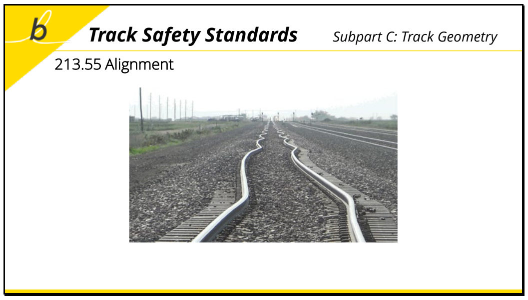
Slide 56

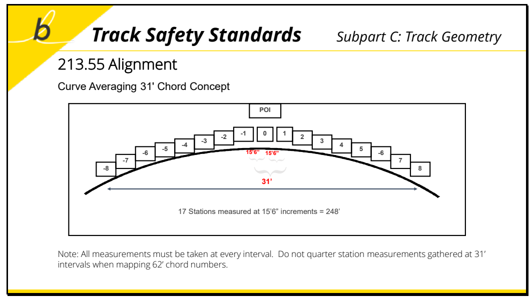


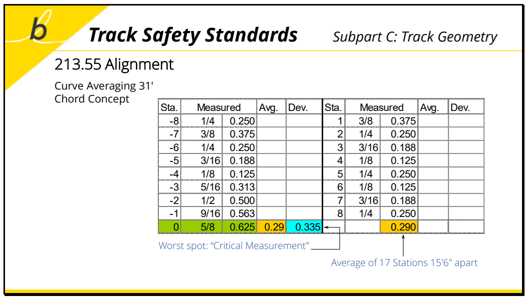
Key Message: This example shows how to calculate the deviation from the average of 9 stations using a 62 ft. chord (Classes 1 through 5). The measured values are converted to decimal of an inch for ease in calculation. The total of the values of stations -4 through 4 are added then divided by 9 for an average of 0.340 inches. This value is subtracted from the value of station 0 (the worst spot) to obtain the deviation from the average (0.222 inches).

1. Using the board, walk students through the calculations and how to determine the mis-alignment

Slides 57-59







Sta.	Measured		Avg.	Dev.	Sta.	Measured		Avg.	Dev.
-8	1/4	0.250			1	3/8	0.375		
-7	3/8	0.375			2	1/4	0.250		
-6	1/4	0.250			3	3/16	0.188		
-5	3/16	0.188			4	1/8	0.125		
-4	1/8	0.125			5	1/4	0.250		
-3	5/16	0.313			6	1/8	0.125		
-2	1/2	0.500			7	3/16	0.188		
-1	9/16	0.563			8	1/4	0.250		
0	5/8	0.625	0.29	0.335			0.290		

Key Message: An optional method to determine average alinement includes 17 stations spaced at 15 feet 6 inches (see table below). For curves in Classes 3 through 5, it is necessary to determine compliance with the requirement for the maximum deviation of the MCO from a 31-foot chord in addition to the 62-foot chord. The following figure illustrates the method to determine alinement deviation using both chords.

For curves in Classes 3 through 5 track, an alignment defect may be in noncompliance with either the maximum limits for the 31-foot chord or the 62-foot chord, or both. A 31-foot chord is particularly necessary for determining short alinement deviations. Inspectors must be aware that a 62-foot chord may be "blind" to short alinement conditions, whereby a 31-foot chord can detect those noncomplying conditions. See the following figure.

Instructor Guidance:

1. Review the chart with the class
2. Have students complete the 213.55 Exercise, Parts 2 and 3 in their workbooks
3. Review each Exercise with the class before moving on

Section 213.55 Exercise

Instructions: *PART 2* – You noticed a suspicious looking deviation appearing in the full body of a curve during your inspection. You decide to take some measurements. Using the measurements below, calculate the deviations accordingly. After the deviations have been calculated, answer questions 1-6 using 49 CFR Part 213. The posted speed for this curve is 20MPH Freight Only.

Station (31-ft)	MCO 62-ft chord (inches)	Deviation
-4	3	14/16
-3	2 15/16	15/16
-2	3 1/8	12/16
-1	5	1 2/16
0	6 1/16	2 3/16
1	4 3/4	1 4/16
2	3 3/4	2/16
3	3 2/16	12/16
4	3	14/16

1. What class of track is this prior to taking measurements? 2
2. What is the average MCO for this segment? 3 14/16 or 3.861
3. What is the maximum alinement deviation? (3 14/16 – 6 1/16) 2 3/16 or 2.202
4. What station is the maximum alinement deviation located at? Station 0
5. Is the maximum deviation allowable for the class of track? Yes – Class 2 good for no more than 3"
6. If the answer to question 5 is no, what is the permitted track class? N/A

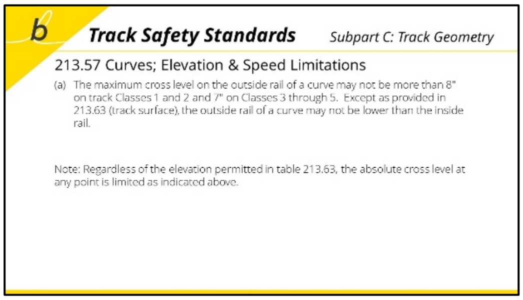
Section 213.55 Exercise

Instructions: *PART 3* – You found another suspicious looking deviation appearing in the full body of a curve during your inspection. You decide to take some measurements. Using the measurements below, calculate the deviations accordingly. After the deviations have been calculated, answer questions 1-6 using 49 CFR Part 213. The posted track speed is 65 MPH Freight only.

Station (15.5 ft)	MCO, 62-ft chord (inches)	MCO, 31-ft chord (inches)	Deviation, 62-ft chord	Deviation, 31-ft chord (inches)
-8	2 3/16	10/16	7/16 (CLS5)	4/16 (CLS5)
-7		11/16		0 (CLS5)
-6	2 7/16	11/16	3/16 (CLS5)	0 (CLS5)
-5		14/16		12/16 (CLS4)
-4	2 4/16	9/16	6/16 (CLS5)	8/16 (CLS5)
-3		10/16		4/16 (CLS5)
-2	2 10/16	12/16	0 (CLS5)	4/16 (CLS5)
-1		10/16		4/16 (CLS5)
0	3 10/16	14/16	1 (CLS4)	12/16 (CLS4)
1		14/16		12/16 (CLS4)
2	3 1/16	11/16	7/16 (CLS 5)	0 (CLS5)
3		10/16		4/16 (CLS5)
4	2 8/16	11/16	2/16 (CLS5)	0 (CLS5)
5		9/16		8/16 (CLS5)
6	2 4/16	8/16	6/16 (CLS5)	12/16 (CLS4)
7		10/16		4/16 (CLS5)
8	2 8/16	11/16	2/16 (CLS5)	0 (CLS5)

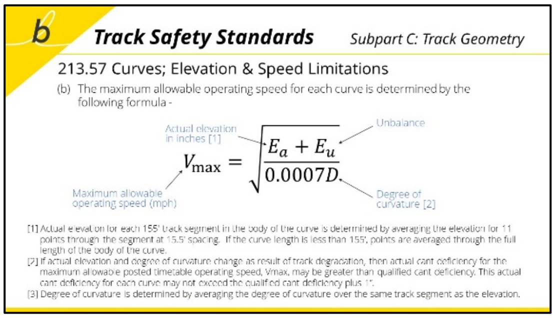
1. What is the average MCO for this curve using a 62' chord? 2 10/16 or 2.60
2. What is the average MCO for this curve using a 31' chord? 2 12/16 or 2.72
3. What is the maximum alinement deviation found with the 62' chord? 1" – average of 2 10/16 – 3 10/16 = 1" – Good for Class 4
4. What is the maximum alinement deviation found with the 31' chord? 12/16 – Class 4
5. Are the maximum alinement deviations allowable for the track class? No
6. If you answered "NO" to question 5, what is the permitted track class? Class 4

Slide 60



Key Message: The crosslevel limits in §213.63 notwithstanding, paragraph (a) of this standard establishes the maximum crosslevel at any point on the curve which may not be more than eight inches on track Classes 1 and 2 and seven inches on track Classes 3 through 5. This paragraph 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. In curves, crosslevel is measured by subtracting the relative difference in height between the top surface (tread) of the inside (low) rail from the tread of the outside (high) rail. Both §213.63 and this section limit the amount of reverse elevation (outside rail lower than the inside rail). While the table in §213.63 permits reverse elevation on a curve, the Vmax formula must also be checked when reverse elevation is encountered. The Inspector must substitute a negative number for the actual elevation in the formula as discussed below. The Vmax formula applies only in the body of a curve.
L\V forces can create wide gage, rail wear and worn ties

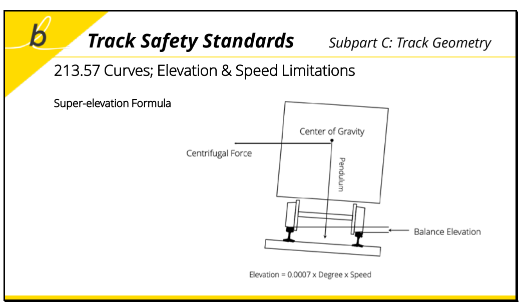
Slide 61



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

Trains traveling around a curve are subjected to an outward horizontal centrifugal force that acts conceptually through a car's center of gravity away from the center of the curve and tends to overturn the cars by directing the train weight toward the outside rail. To counteract the centrifugal force, the outer rail is raised over the lower rail, or superelevated. In effect, the combined effect of centrifugal force and weight produces a resultant force that is intentionally moved toward the center of the track. A balanced (equilibrium) condition implies the vertical forces on each rail are equal.

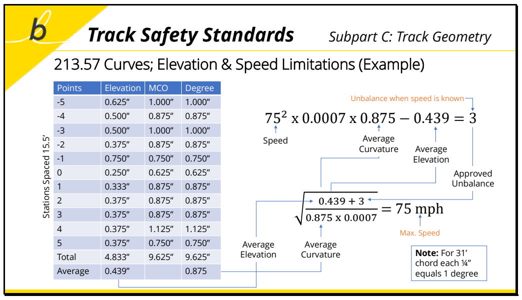
Slide 62



Key Message: The above diagram shows a balanced condition where the curve degree, superlevation, and speed match to balance the weight to the low and high rails.

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

Slide 63



Average Elevation & Curvature 155’ Segment (EXAMPLE)

This is an example showing the relationship between curvature, elevation, and speed. The elevation from 11 stations are added (4.833) then divided by 11 to obtain an average elevation of 0.439 inches. The degrees is also obtained in the same manner. In this example, a 62 ft chord is used therefore, each inch MCO equals one degree. The average curvature is 0.875 degrees.
The maximum speed can be determined by plugging the average elevation (0.439 inches) and average curvature (0.875 degrees) and approved unbalance (3 inches this example) into the bottom formula to determine the maximum speed (75 m.p.h.)
The unbalance can also be determined by plugging the average elevation (0.439), average curvature (0.875 degrees), and maximum authorized speed (75 m.p.h. this example) into the top formula to determine the unbalance (3 inches).
NOTE: While 3” unbalance is used in most of our examples, different Brightline Properties will have trains with varying maximum unbalances.

Instructor Guidance:

1. Direct students to the 213.57 Exercise, Part 1. If students seem capable, have them complete this part themselves and review their answers. If students need more practice, help them work through the answers step-by-step.

Section 213.57 Exercise

Instructions: *Part 1.* You have just finished measuring a curve within a 155' section in the full body. The measurements are as follows:

62' MCO Readings - 6-15/16, 7, 7-1/16, 7-1/16, 7, 6-15/16, 6-7/8, 6-15/16, 7, 6-15/16, 7

Elevation Readings - 3, 2-7/8, 2-7/8, 2-13/16, 2-7/8, 2-15/16, 2-15/16, 3, 3-1/8, 3-1/16, 3

1. Using the readings above, determine the average degree of curvature and average elevation.

   Average Degree _7 Degrees_____ Average Elevation ___3"_________

2. What is the maximum allowable timetable speed for this curve using the 3" unbalanced parameters? You can use VMAX and/or the tables in the back of 49 CFR Part 213. If you feel comfortable calculating the speed using the Vmax formula, take a stab at it and compare the differences between your math and the table.

   VMAX Calculation = __34.99______3 Inch Unbalance Table Speed ____35______

VMAX Explanation

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

Where:

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

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

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

Step by Step Process for using VMAX.

Step 1 – Start by taking your average elevation from the curve from above. ___3 inches___________

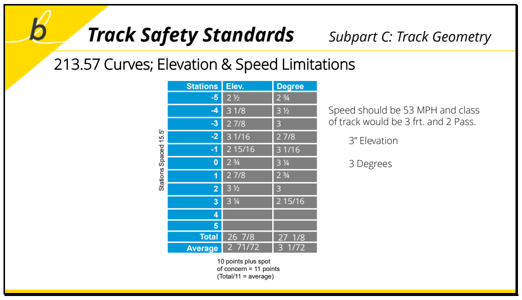
Step 2 – You then add the average elevation to 3 because you are using a 3-inch unbalance calculation. This becomes your top number. ___Top Number 3 inches +3 = 6____________

Step 3 – You will now multiply 0.0007 x the degree of curvature you determined above. This becomes your bottom number. __0.0049

Step 4 – You will now divide the top number by the bottom number. _6/0.0049 = 1224.4898

Step 5 – After you hit equal on your calculator, hit the square root button which will give you the speed the curve is good for. _Square root of 1224.4898 = 34.992711 MPH.

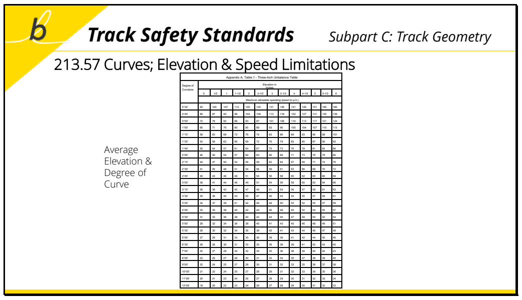
Slide 64



Instructor Guidance:

1. Click next to animate on first column of numbers (elevation)
2. This is an example showing the relationship between curvature, elevation, and speed. The elevation from 11 stations are added (4.833) then divided by 11 to obtain an average elevation of 0.439 inches.
3. Click next to animate on Total and Average for Column 1
4. Click next to animate on second column of numbers (degree)
5. The degrees is also obtained in the same manner. In this example, a 62 ft chord is used therefore, each inch MCO equals one degree. The average curvature is 0.875 degrees.
6. Click next to animate on Total and Average for Column 2
7. The maximum speed can be determined by plugging the average elevation (0.439 inches) and average curvature (0.875 degrees) and approved unbalance (3 inches this example) into the bottom formula to determine the maximum speed (75 m.p.h.)
8. The unbalance can also be determined by plugging the average elevation (0.439), average curvature (0.875 degrees), and maximum authorized speed (75 m.p.h. this example) into the top formula to determine the unbalance (3 inches).

Slide 65



Instructor Guidance:

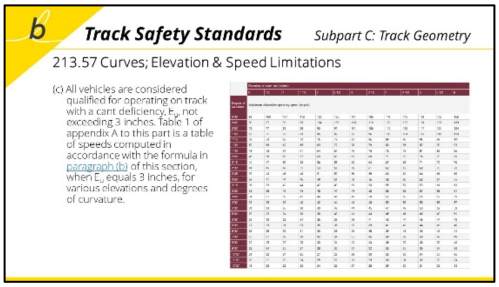
1. Have students complete the 213.57 Exercise, Part 2
2. Review with students before continuing

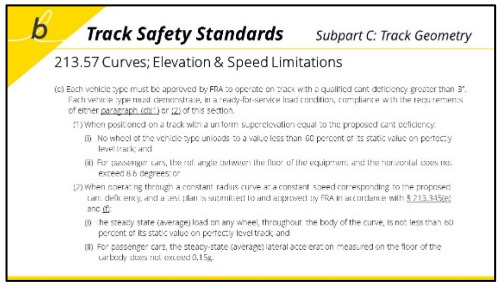
Section 213.57 Exercise

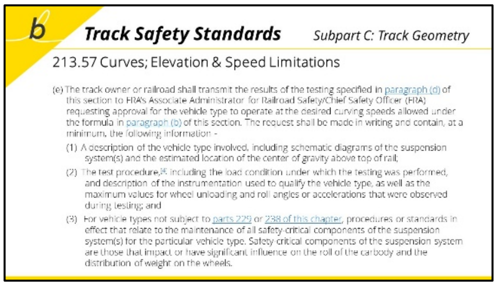
Instructions: *Part 2.* What is the maximum allowable track speed for the following conditions using the 3-inch unbalance chart? Values given are averages per the measurement procedure. You do not have to compute the average degree of curvature or elevation instead use each measurement isolated as if you found it in the field during an inspection.

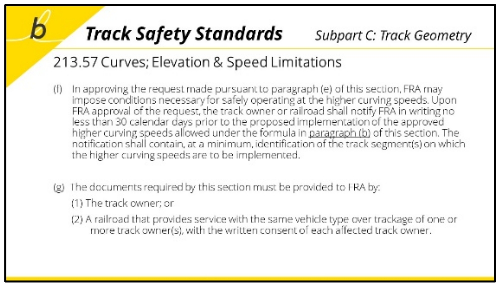
Speed	MCO 62’	Elevation
__57__	2.01”	1.78”
__32__	9.27”	3.98”
__76__	0.67”	1.02”
__46__	3.74”	2.20”
__38___	5.98”	3.02”
__33___	8.05”	3.47”
__36___	4.49”	1.95”
__32___	10.95”	4.78”

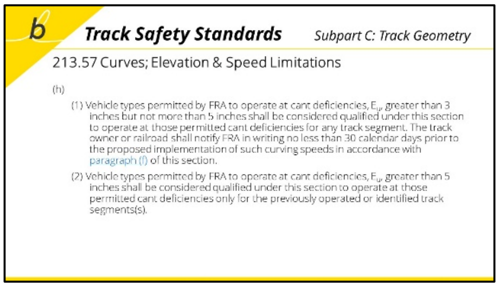
Slides 66 - 71

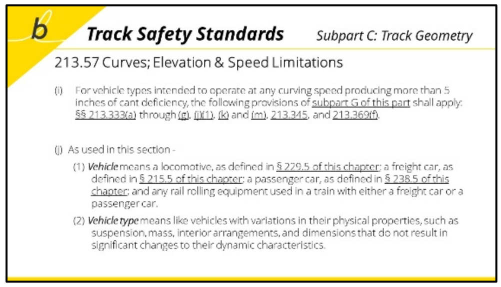








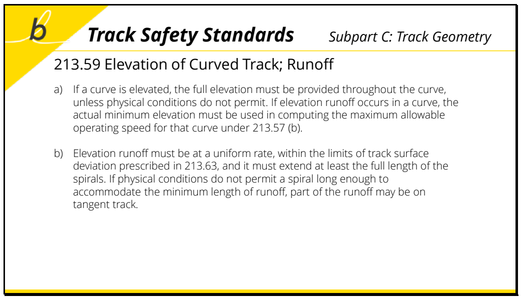




Instructor Guidance:

1. Review the rest of 213.57 with the class
2. **Note**: There are additional tables in Appendix A for various Unbalances (4", 5" and 6")

Slide 72

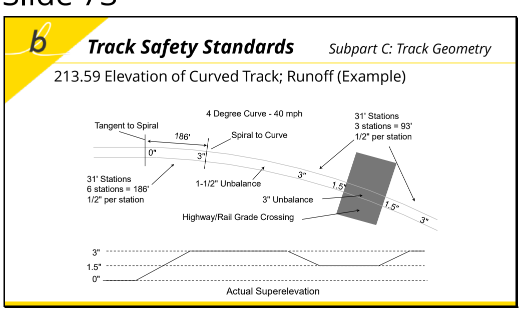


Key Message: The nature of this section should be considered advisory rather than mandatory and, therefore, no Defect Codes are provided for an alleged violation of the rule. However, the full elevation should normally be provided throughout the body of the curve. In all cases, §§213.57 and 213.63 must be carefully examined for compliance. If elevation runoff commenced within the body of the curve rather than at the point of curve-spiral, the least average elevation that exists in the body of the curve will govern the allowable operating speed throughout the full curve.

Elevation runoff at the end of curves or between segments of compound curves must be at a uniform rate within the limits of track surface deviations prescribed in the table under §213.63.

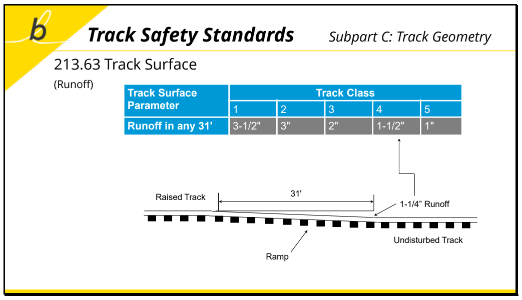
Particular attention must be given to the prescribed limits for difference in crosslevel between any two points less than 62-feet apart on spirals.
If physical conditions do not permit a spiral long enough to accommodate the minimum length of runoff, the runoff may be carried into the tangent. In these circumstances, the surface table parameters under §213.63 will govern.
The actual minimum elevation and actual degree of curvature is determined by using the averaging techniques described under §213.57.

Slide 73



Key Message: This illustration illustrates how a railroad reduced superelevation in the body of the curve to accommodate a highway/rail crossing for unqualified equipment (three inches unbalance):

Slide 74

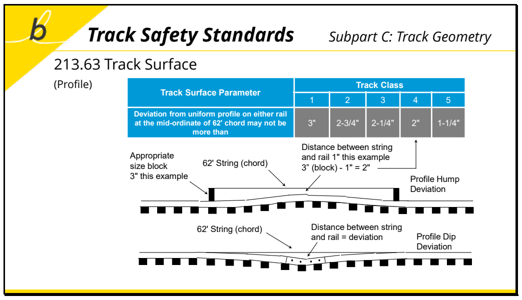


Key Message: The first parameter in the table in this section refers to the runoff (ramp) in any 31 feet at the end of a raise where the track is elevated as a result of automatic or manual surfacing or bridge work. Conditions created by track degradation (e.g., settlement or frost heaves) are to be addressed using the uniform profile parameter, under §213.63. Trains encountering a ramp (up or down) will experience a vertical pitch or bounce if the runoff is too abrupt or short. As in the more general profile parameter, damage to car components, undesirable brake applications, or derailments may occur, especially when the vehicle experiences a lateral force such as a buff force.

Slide 75

Key Message: Illustration of large runoff. String is held level using string bubble and distance between string and rail is measured 31 feet away from the high track.

Slide 76



Key Message: Trains encountering short dips or humps in the track can cause vertical separation of couplers, broken springs, bolsters, and truck frames. When encountering a hump, i.e., frost heaves over culverts, place two uniform (reference offset) blocks on top of the running rail. Stretch (taut) a 62-foot string, positioned over the blocks, with the observed highpoint at the 31-foot midpoint of the string. Measure the distance from the string to the running surface of the rail. Subtract this distance from the height of the (offset) blocks to determine the mid-offset.

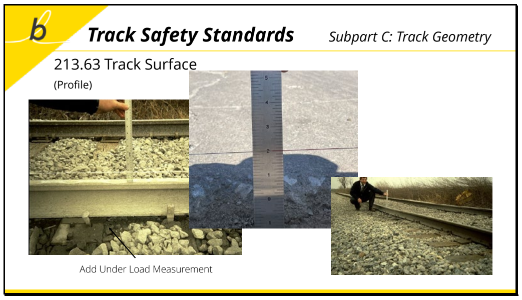
Poor Surface Visual Signs

- Low spots or joints
- Sags or crosslevel
- Poor train ride quality
- Subgrade or ballast pushing up in and around the tie crib

Poor Surface Causes

- Soft subgrade (soil)
- Wet or saturated subgrade due to drainage problem
- Subgrade not compacted
- Insufficient ballast
- Poor condition of components of the track structure
- Heavy train tonnage

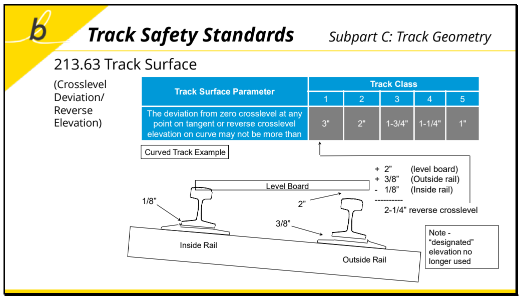
Slide 77



Instructor Guidance: Review photos with class

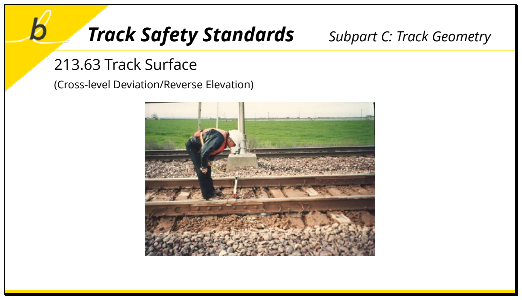
Left - static measurement with string plus dynamic movement.
Middle – close up of measuring stick for class to see
Bottom right - profile measurement.

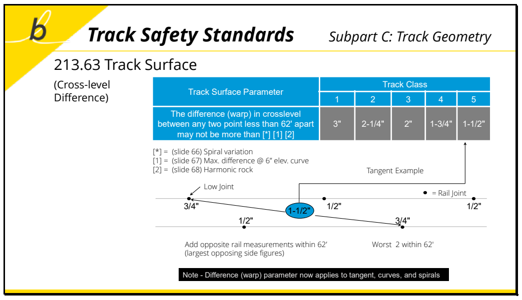
Slide 78



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

Slide 79 - 80



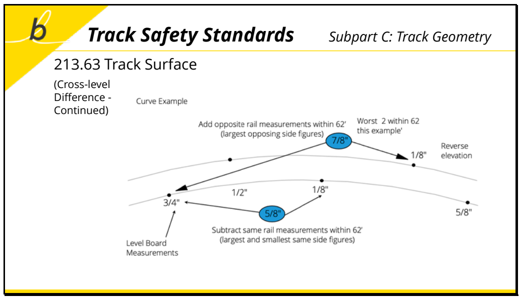


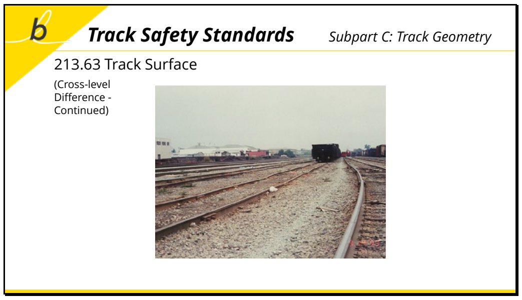
Key Message: The parameter for the difference in crosslevel between any two points less than 62 feet apart is commonly referred to as the "warp" parameter. This parameter provides maximum change in crosslevel between two points within specific distances along the track. The warp parameter is, perhaps,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

These values apply to any location (tangent, curve, or spiral) except spiral variation (“short spiral”), high elevation curve, and harmonic rock (all three discussed in the next few slides). In all examples, the calculations are based on using a level board with a scale on one side and applying the values to the same rail as the scale. Therefore, add opposite rail and subtract same rail values. If all numbers are placed on the same rail, plus and minus numbers must be used to obtain the same warp values.

The above shows warp calculation at tangent track.

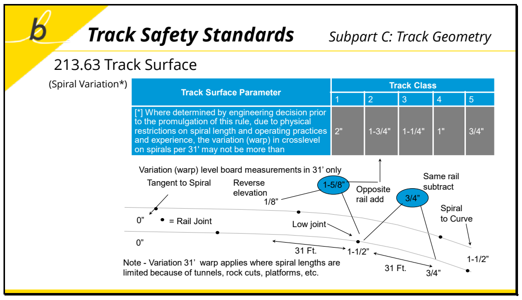
Slides 81 & 82





Key Message: These slides show warp calculation at curved track.

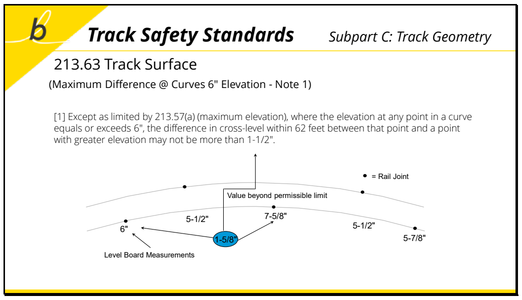
Slide 83



Key Message: Footnote designated by a "*" is an exception to the above warp requirement in spirals because the railroad has made a prior engineering decision, due to physical restrictions, to design a shorter spiral than would be found in new construction. When encountering a spiral that does not have a sufficient length to "runoff" elevation in accordance with the warp parameter, the Inspector must determine if the "short spiral" is a result of a man made or other natural obstruction. In short spirals, the amount of warp determined by measuring the "variation" in crosslevel between two points 31 feet apart.

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

Slide 84



Key Message: Under Footnote 1, where the elevation at any point in a curve equals or exceeds six inches, the difference (warp) in crosslevel within 62 feet between that point and a point with greater elevation may not be more than 1-1/2 inches regardless of track class. This footnote is included to address the condition where a vehicle is operating on a curve with a large amount of elevation and then encounters a warp condition. Since the vehicle is typically in an unbalance condition, the warp may induce wheel climb. Slow speed curve negotiation is a particular concern since the wheels on the outside rail of the curve will tend to unload due to the overbalanced condition of the vehicle. Where this condition is found, the appropriate corrective action would be reduction to Class 1 speed under the provisions of §213.9(b).

Instructor Guidance:

1. After reviewing all of 213.63 ask students if there are any questions
2. Have students complete the 213.63 Exercise
3. Review answers with the class

Section 213.63 Exercise

Instructions: You have just finished taking measurements during your track inspection. Using 49 CFR Part 213, determine the class of track for each of the following deviations. The measurements were calculated under load.

___2___ Runoff at the end of a surfacing operation is 2 13/16" within 31'

___2___ 2 ½" deviation from uniform profile at a muddy location.

___5___ 9/16" deviation from zero cross level on tangent track.

___5___ 15/16" deviation from zero cross level on tangent track.

___5___ 1-1/16" difference in cross level over 31' in a curve

2 (Divide ½) Runoff at the end of a highway crossing rehab is 4-1/2" in 62'.

___2___ Cross level on the right rail on tangent track is 1-15/16".

___4___ Profile of 1-5/8" at an area where the ballast is washed out.

___3___ Cross level on a tangent track at the end of a spiral is 1-1/2"

_1 (4-1 7/8 = 2 1/8)_ The outside rail in a curve is elevated 4" at one location, and 1- 7/8" 44' away.

_5 (1 3/8)___ In a curve, the outside rail is elevated 4-1/2" at one point. 40' away it is 3-1/8".

___4___ Runoff at the end of a ballast raise is 1-1/4" in 31'.

___3___ In tangent track, a warp of 1-7/8" was measured within 45'.

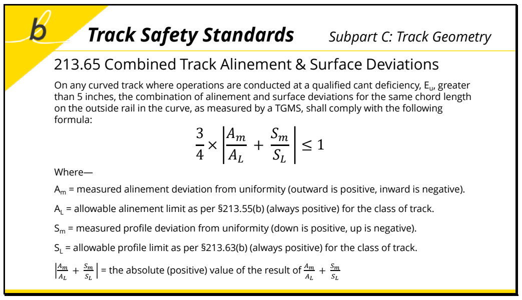
1 (2 ¾" Warp) The west rail on a tangent track is 2" low. The east rail 55' away is ¾ low.

___1___ The difference in cross level in 6 consecutive pairs of joints is 1-1/2"

___1___ The difference in cross level on tangent track is 2-1/2" measured within 60'.

___3___ A curve has 1 5/8" of reverse elevation.

Slide 85



Key Message: This section contains limits addressing combined track alinement and surface deviations for operations above 5 inches of cant deficiency on curves and therefore may not be relevant to many properties. The equation is given for computing the combined track alinement and surface deviations within a single chord length. The limits are intended to be used only with a TGMS, and applied on the outside rail in curves.

Brightline runs on a 5” cant deficiency.

Instructor Guidance:

1. If time allows or students need additional exercises regarding Subpart C – Track Geometry, read the following scenario (on next page) to the class
2. Remember! Subpart C is a large section and contains several concepts that may seem intimidating to less experienced students. Although there were many exercises supporting these concepts, it is imperative to ensure students understand and **can apply these regulations** in a field setting.

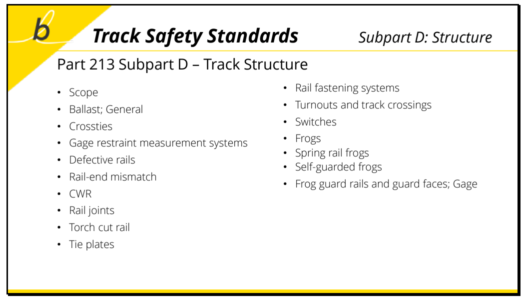
Additional Exercise – Subpart C

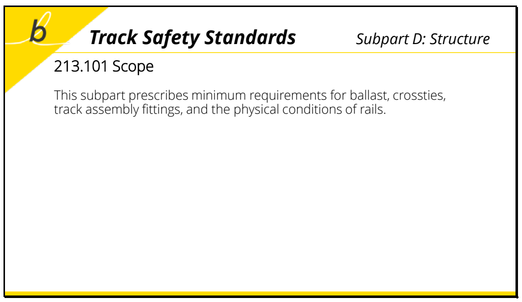
You have noticed lately on inspection trips some changes in curves that have not been seen in the past. This track segment is FRA Class 4 track with a maximum authorized speed of 50 m.p.h. In addition to the normal train traffic of six general freight trains and one local freight daily, last month two loaded coal trains have been running weekly with a return trip of empty coal cars. These trains use six axle power with remote engines on the rear. There are several four and five degree curves with two percent descending grade down a two mile hill. The trains are using dynamic braking to stay within the posted speed on the descending grade. The changes noted are dark streaks, oil and grease build up with metal flaking on the ball(top) of the inside(low) rails of the curves. Also, rail cant and tie plate cutting on the outside(high) rail has been noted.

1. Taking these factors into account, what defective condition would you look for?
2. How would you measure this defect?
3. What action would you take if the condition you found did not meet the FRA standards for the class of track?
4. Discuss further.

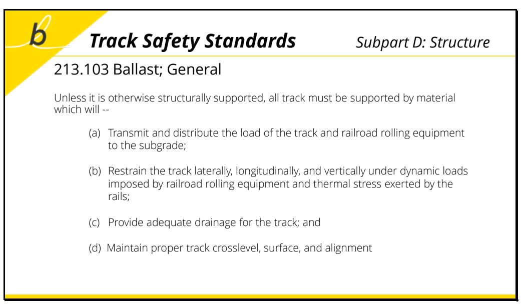
SUBPART D – Track Structure

Slides 86, 87 & 88





Slide 89



Key Message: 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.

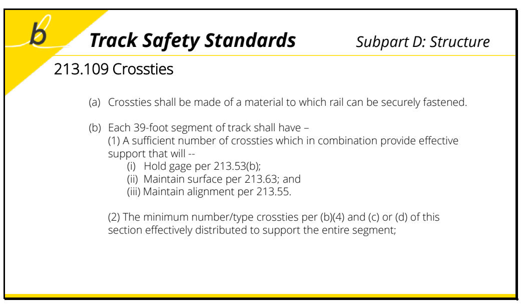
Ballast, regardless of the material, must satisfy the requirements stated in the TSS. Inspectors should consider the overall condition of a track when citing fouled ballast. For example, fouled ballast would be appropriate for a track that has a poor drainage system coupled with incipient track surface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

Slide 90

Instructor Guidance:
Top left - insufficient ballast and bridge approach.
Right - fouled ballast.
Bottom left - proper ballast section.

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.

Slide 91

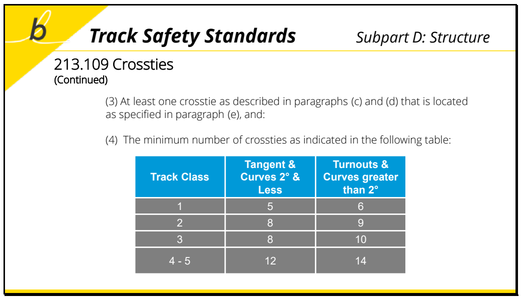


Key Message: When determining compliance with this section, make geometry measurements to verify that each 39-foot segment of track has:

1. A sufficient number of effective ties to maintain geometry;
2. The required number of sound ties for the track class as described in paragraph (c) [paragraph (d) after September 21, 2000]; and
3. The proper placement of sound ties as described in paragraph (c) and positioned as required in paragraph (f) to support joints.

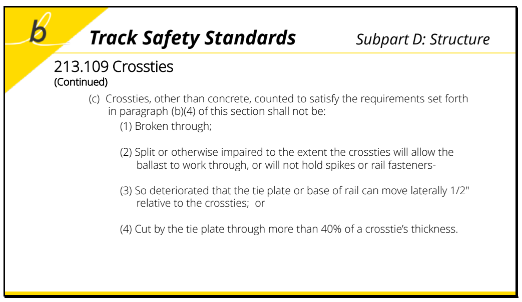
The failure of the crossties to meet any of the three above criteria constitutes a deviation from the TSS.

Slide 92



Key Message: Curved track greater than two degrees will be determined by actual field measurements. Turnouts, regardless of their location (tangent or curve), shall have the same number of effective crossties as required for curves greater than two degrees.

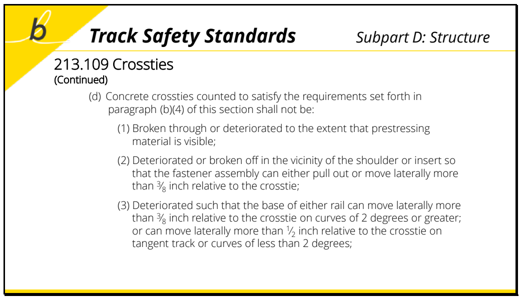
Slide 93



Key Message: When a crosstie exhibits any one or more of the conditions described in the four criteria for evaluation [§213.109(c)1-4] it may be considered non-effective Several factors should be documented if the defect is being cited. These factors include, but are not limited to:

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

Slide 94



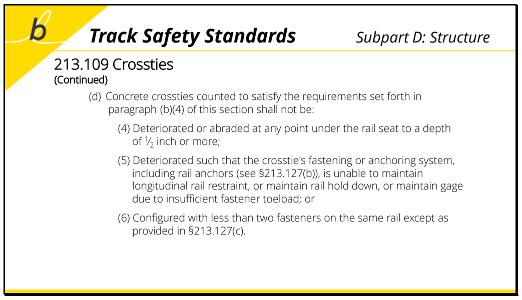
Key Message: Paragraph (d) delineates the requirements related to concrete crossties. Modern concrete crossties are designed to accept the stresses imposed by irregular rail head geometry and loss, excessive wheel loading caused by wheel irregularities (out of round), excessive unbalance speed, and track geometry defects. Section 213.109 considers the worst combinations of conditions, which can cause excessive impact and eccentric loading stresses that would increase failure rates and other measures concerning loss of toeload, longitudinal and lateral restraint, in addition to improper rail cant.

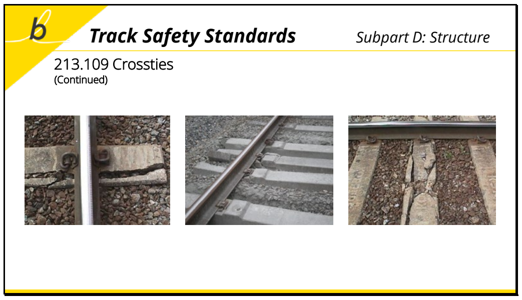
Paragraph (d)(1) states that as with non-concrete crossties, concrete crossties counted to fulfill the requirements of paragraph (b)(4) must not be broken through or deteriorated to the extent that prestressing material is visible.

Crossties must not be so deteriorated that the prestressing material has visibly separated from, or visibly lost bond with, the concrete, resulting either in the crosstie's partial break-up, or in cracks that expose prestressing material due to spalls or chips, or in significant broken-out areas exposing prestressed material. Currently, wire or strands are used as the prestressing material in concrete crossties. FRA uses the term "prestressing material" in lieu of "metal wire or strands" to allow for future technological advances.

There is a distinction between the phrases "broken through" and "deteriorated to the extent that prestressing material is visible." (Photos provided in later slides)

Slide 95, 96, 97





Instructor Guidance:

Photo 1 – Sample of "Broken through" concrete tie (as opposed to "deteriorated")

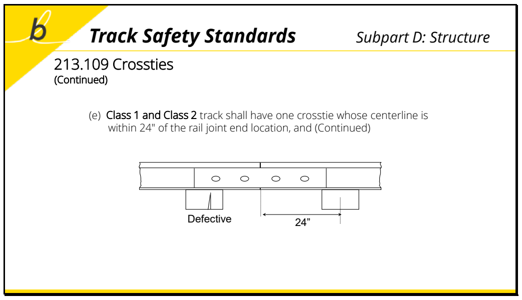
Photo 1 – Crosstie transversely broken between the rail seats

Crosstie failure is exhibited in three distinct ways: stress induced breaks, cracks; mechanical abrasion; or chemical decomposition. These conditions in small or large degrees compromise the crosstie's ability to maintain proper gage, alignment, and track surface. Walking inspections would demonstrate clearly visible spalls, chips, cracks, and similar breaks. However, the compression of prestressed concrete crossties may close cracks as they occur, making them difficult to observe. Such closed cracks, if oriented vertically and located near the center of the crosstie, may weaken the crossties if the tie is center bound.

Prestressing material is often exposed in a concrete crosstie as a crack or spall, but it can also be exposed on the side of the tie. When prestressing material becomes exposed on the side of a crosstie, the prestressing material may no longer be in tension, the prestressed concrete can no longer withstand the tensile loads and can structurally fail. This does not apply to reinforcing material left visible at the end of the crosstie during the manufacturing process.

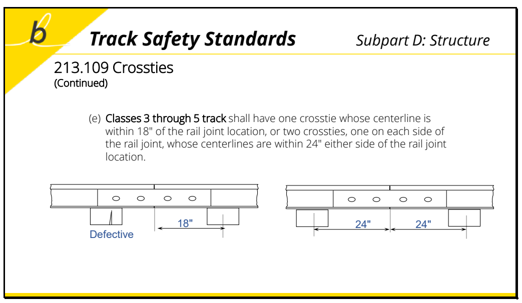
Crossties transversely broken between the rail seats and showing signs of further deterioration (loss of tension in prestressing material—upper and lower levels of exposure to metal wires or strands) constitute failure. This means that there cannot be a complete separation of the concrete material making up the crosstie.

Slide 98



Key Message: A non-defective joint tie must be found within the prescribed distance of the centerline of the joint measured at the rail end. Where a very short piece of rail exists within the joint bar (dutchman), measure from the bar centerline. Where non-symmetrical bars exist (five-hole bars), measure from the design point where rail ends normally abut.

Slide 99

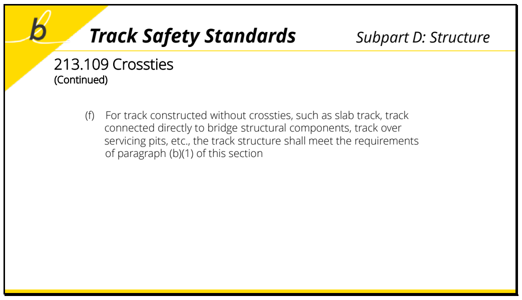


Key Message: The existing requirement calls for one crosstie within a specified distance from the rail joint location, while the proposed optional requirement would allow two crossties, one on each side of the joint, within a specified distance from the rail joint (e) to address track constructed without conventional crossties, such as concrete-slab track.

A separate task group continues to evaluate GRMS technology for possible incorporation into the Track Safety Standards

In Classes 3 through 5, joint tie placement can be satisfied by either a one tie configuration, or by a two-tie configuration.
Paragraph (g) [not shown] addresses track constructed without conventional crossties, such as concrete-slab track, in which running rails are secured through fixation to another structural member. 213.109(g) - *For track constructed without crossties, such as slab track, track connected directly to bridge structural components and track over servicing pits, the track structure shall meet the requirements of paragraphs (b)(1)(i), (ii), and (iii) of this section.*

Slide 100



Key Message: In Classes 3 through 5, joint tie placement can be satisfied by either a one tie configuration, or by a two-tie configuration.

Paragraph (g) [not shown] addresses track constructed without conventional crossties, such as concrete-slab track, in which running rails are secured through fixation to another structural member. 213.109(g) - *For track constructed without crossties, such as slab track, track connected directly to bridge structural components and track over servicing pits, the track structure shall meet the requirements of paragraphs (b)(1)(i), (ii), and (iii) of this section.*

Traffic density (annual tonnage)

Rail weight and condition

Condition of other components of the track

Instructor Guidance:

1. After reviewing all of 213.109 ask students if there are any questions
2. Navigate back to the table on Slide 86 and leave it up on the screen
3. Have students complete the 213.109 Exercise – Part 1
4. Review answers with the class

Section 213.109 Exercise

Instructions: *Part 1* - The tie condition on your territory is in bad shape. You have just finished inspecting for defects and found the following conditions. Using 49 CFR Part 213 determine the class of track and permitted speed for each location. Each location measured is for a 39' segment of track. You have made the determination the ties are effectively distributed.

Class	MPH	Condition
3	40	9 good ties in tangent track and 1 good tie 16" from a joint.
5	80	14 good ties in tangent track and 1 good tie 10" from a joint.
2	25	15 good ties in tangent track and 1 good tie 22" from a joint.
1	10	6 good ties in 3° curved track and 1 good tie 12" from a joint.
5	80	20 good ties in 5° curved track and 2 joint ties 20" from a joint.
1	10	8 good ties in 9° curved track and 2 good ties 18" from a joint.
2	25	17 good ties in tangent track and 1 good tie 22" from a joint.
5	80	12 good ties in 1° curved track and 2 good ties 23" from a joint.
1	10	4 good ties in tangent track and 1 good tie 12" from a joint.
3	40	10 good ties in 2° curved track and 1 good tie 18" from a joint.

Slides 101 – 112

Track Safety Standards — Subpart D: Structure

213.110 Gage restraint measurement systems.

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

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

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

Track Safety Standards — Subpart D: Structure

213.110 Gage restraint measurement systems.

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

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

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

Track Safety Standards — Subpart D: Structure

213.110 Gage restraint measurement systems.

(c)(1) The track owner shall also provide to FRA sufficient technical data to establish compliance with the following minimum design requirements of a GRMS vehicle:

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

(i) At an interval not exceeding 16 inches;

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

(iii) Under an applied lateral load that provides for a lateral/vertical load ratio of between 0.5 and 1.25, and a load severity greater than 3 kips but less than 8 kips per rail.

Track Safety Standards — Subpart D: Structure

213.110 Gage restraint measurement systems.

(d) Load severity is defined by the formula:

$$S = L - cV$$

(e) Measured gage values shall be converted to a Projected Loaded Gage 24 (PLG 24) as follows:

$$PLG\ 24 = UTG + A \times (LTG - UTG)$$

For all track:

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

S = Load severity
L = Actual lateral load applied (kips)
c = Coefficient of friction between rail/tie
V = Actual vertical load applied (kips), or static vertical wheel load if vertical load is not measured
UTG = Unloaded track gage
LTG = Loaded track gage
A = The extrapolation factor used to convert the measured loaded gage to expected loaded gage under a 24-kip lateral load and a 33-kip vertical load

Track Safety Standards — Subpart D: Structure

213.110 Gage restraint measurement systems.

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

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

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

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

Track Safety Standards — Subpart D: Structure

213.110 Gage restraint measurement systems.

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

(j) The track owner shall institute the necessary procedures for maintaining the integrity of the data collected by the GRMS and PTLF systems.

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

Track Safety Standards — Subpart D: Structure

213.110 Gage restraint measurement systems.

(l) The GRMS record of lateral restraint shall identify two exception levels. At a minimum, the track owner shall initiate the required remedial action at each exception level as defined in the following table –

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

Track Safety Standards — Subpart D: Structure

213.110 Gage restraint measurement systems.

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

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

(i) The total gage widening at that location does not exceed5/8 inch when increasing the applied force from 0 to 4,000 pounds; and

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

Track Safety Standards — Subpart D: Structure

213.110 Gage restraint measurement systems.

(m)

(2) Gage widening in excess of5/8 inch shall constitute a deviation from Class 1 standards.

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

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

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

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

Track Safety Standards — Subpart D: Structure

213.110 Gage restraint measurement systems.

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

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

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

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

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

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

Track Safety Standards — Subpart D: Structure

213.110 Gage restraint measurement systems.

(p) As used in this section

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

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

(3) *L/V ratio* means the numerical ratio of lateral load applied at a point on the rail to the vertical load applied at that same point. GRMS design requirements specify an L/V ratio of between 0.5 and 1.25.

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

Track Safety Standards — Subpart D: Structure

213.110 Gage restraint measurement systems.

(p) As used in this section

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

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

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

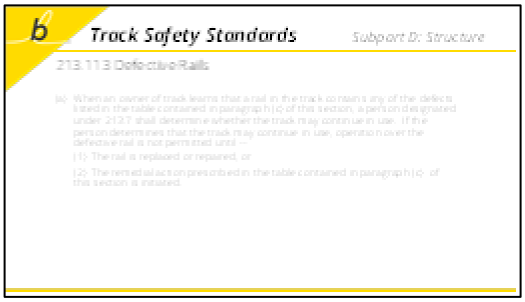
(8) *Unloaded Track Gage (UTG)* means the gage measured by the GRMS vehicle at a point no less than 10 feet from any lateral or vertical load.

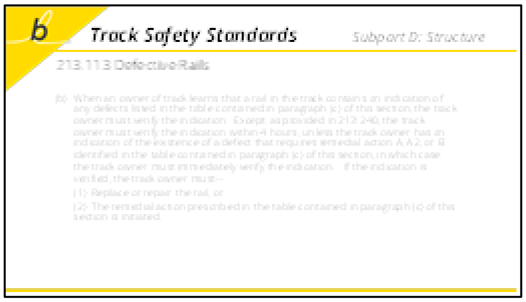
Key Message: 213.110 provides for the implementation of a Gage Restraint Measurement System (GRMS), supplemented by the use of a Portable Track Loading Fixture (PTLF), to determine compliance with the crosstie and rail fastener requirements specified in §§ 213.109 and 213.127.

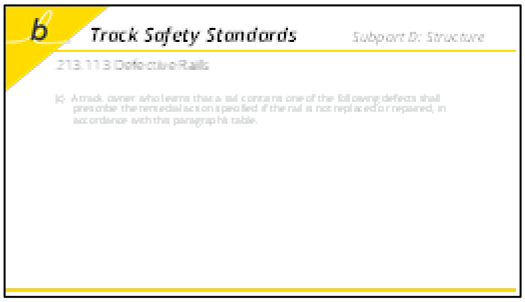
For reasons of safety, GRMS vehicles have their split-axle in the retracted position when testing through special trackwork such as turnouts at grade rail-to-rail crossings (diamond), expansion joints, lift rail assemblies, etc. Where certain trackage within is not part of the designation, notifications should identify what and where these locations are and what distance approaching and leaving these locations are also excluded from GRMS designation.
Part (d) prescribes a formula for the calculation of load severity required by 110(c)(2)iii
Part (e) prescribes the formula for the calculation of projected load gage 24.

Instructor Guidance:
1. Provide an overview of 213.110 using the Key Message if relevant to the class

Slides 113 – 115



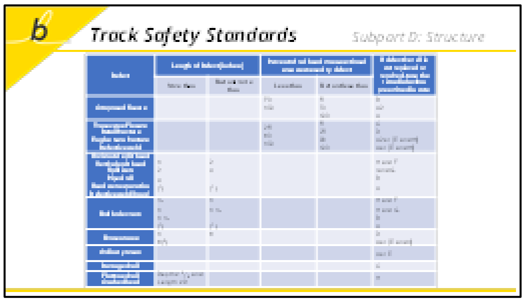


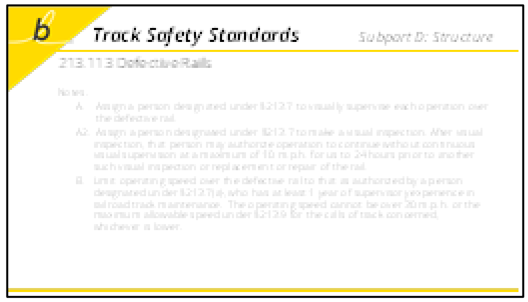


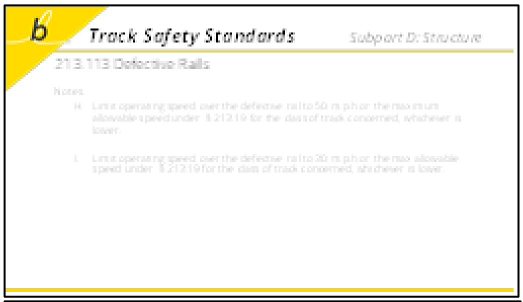
Key Message: Only a qualified person is allowed to determine if a track may continue in use once a defective condition is identified. The remedial actions required for defective rails specify definite time limits and speeds, and allow certain discretion to the track owner for the continued operation 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.

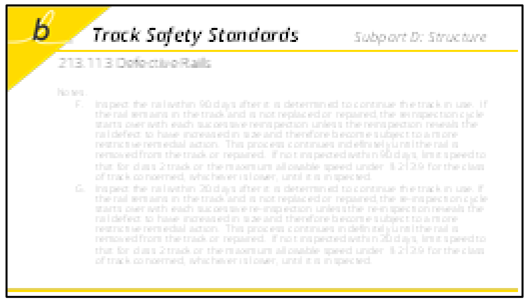
The remedial action table and specifications in the rule address the risks associated with rail failure. These risks are primarily dependent upon defect type and size and should not be dependent upon the manner or mechanism that reveals the existence of the defect. Failure of the track owner to comply with the operational (speed) restrictions, maintenance procedures and the prescribed inspection intervals specified in §213.113 and §213.237 (defective rails and inspection of rail, respectively), may constitute a violation of the TSS.

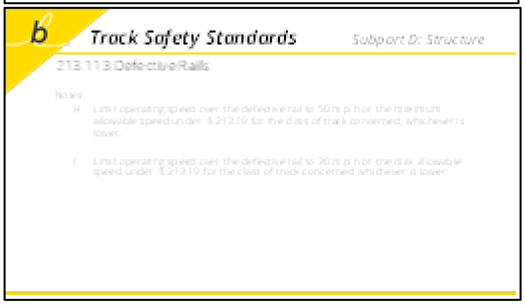
Slides 116-120









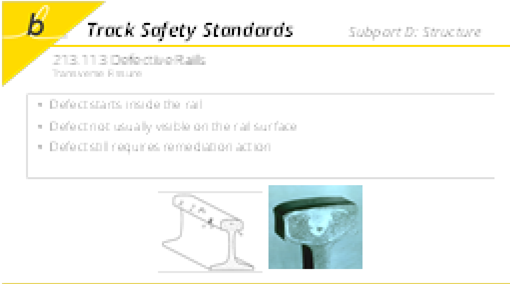


Key Message: This series of slides covers the Remedial Action Table (available in 49 CFR 213.113) and accompanying notes.

Instructor Guidance:

1. Have students navigate to the table in their 213 pocket book or Student Workbook and follow along
2. Review the table and notes carefully with the class
3. Note that you will be returning to this table and corresponding notes throughout section 213.113.

Slide 121



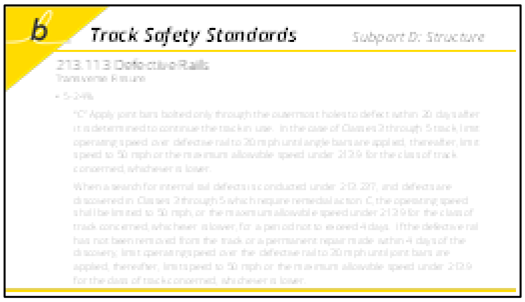
Key Message: This next section reviews the various terms regarding Defective rail, found in 213.113 (d) (1 – 16)

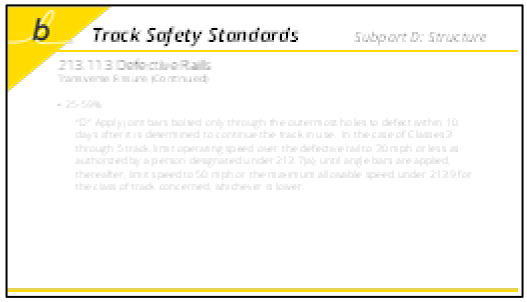
Instructor Guidance:

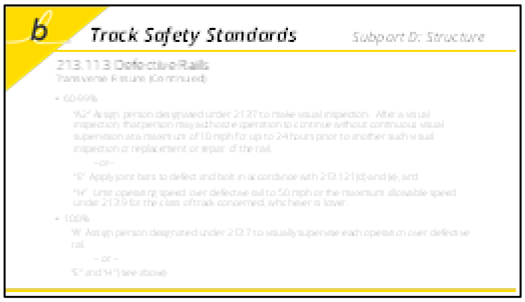
1. These next slides in particular go into much detail regarding Transverse and Compound Fissure. The most important thing for students to understand is that these types of defects start inside the rail and are almost never visible on the surface of the rail. Even the best track inspector may miss these types of defects. Just understand that these defects happen, and that you must apply appropriate remediation action based on the defect.

2. CLICK NEXT to remove the summary bullets and reveal definition of Transverse/ Compound Fissure.

Slides 122-124





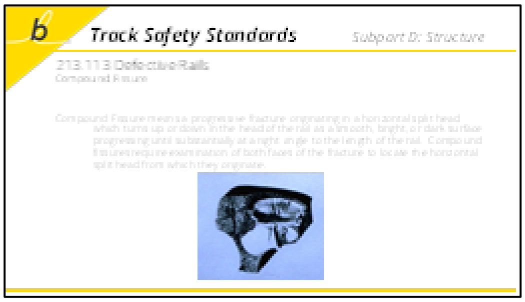


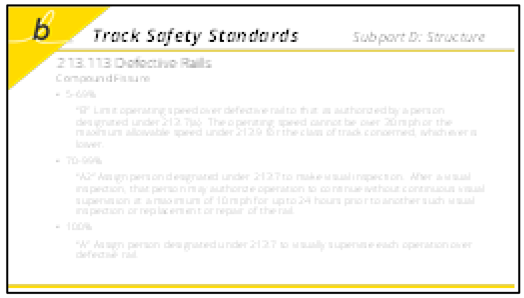
Key Message: The remedial action table for defects (see slide 106) falling in the transverse plane (transverse fissures, compound fissure, detail and engine burn fractures, and defective welds) specifies a lower limit range base of five percent of the railhead cross sectional area. If a transverse defect 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.

Instructor Guidance:

1. Encourage students to read along using their table and notes
2. Try asking students to answer out loud what the correct remedial action is for each deficiency

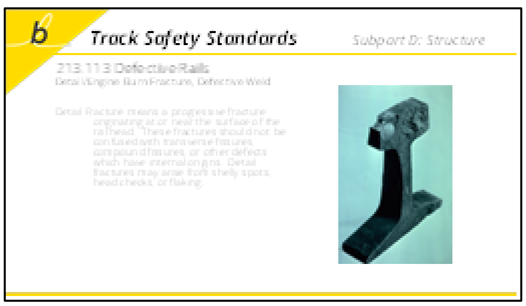
Slides 125 -126 213.113 (d)(3)

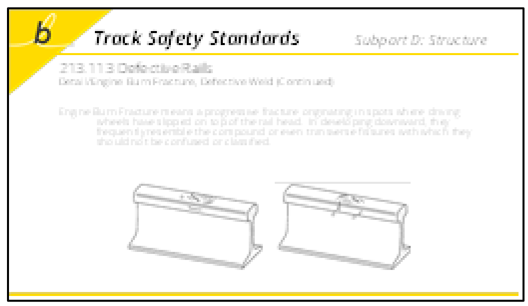


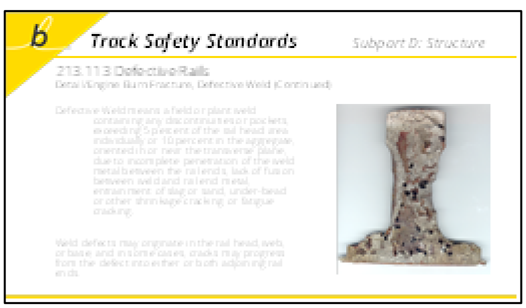


Key Message: Compound fissure defects that weaken between 5 and 70 percent of cross-sectional of the rail head area are defects requiring remedial action (Note B). Defects in the range between 70 and less than 100 percent of cross-sectional head area require remedial action (Note A2), as prescribed. Defects that affect 100 percent of the cross-sectional head area require remedial action (Note A) as prescribed, the most restrictive remedial actions

Slides 127 - 132 213.113 (d)(7); (d)(8)







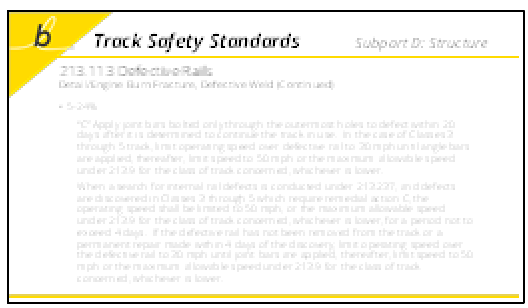
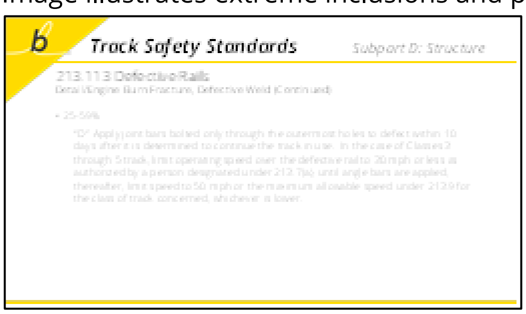
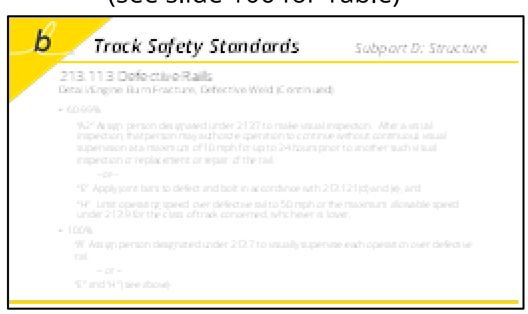


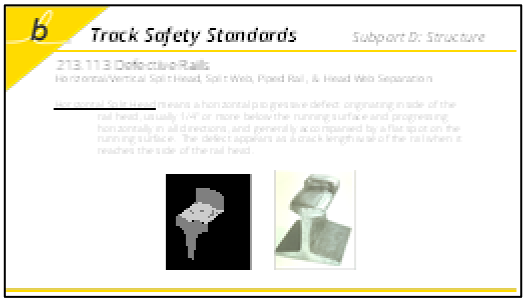
Image illustrates extreme inclusions and porosity.

(see slide 106 for Table)

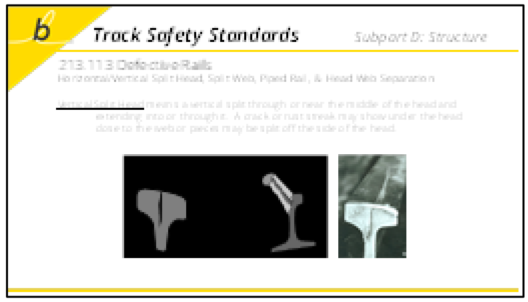




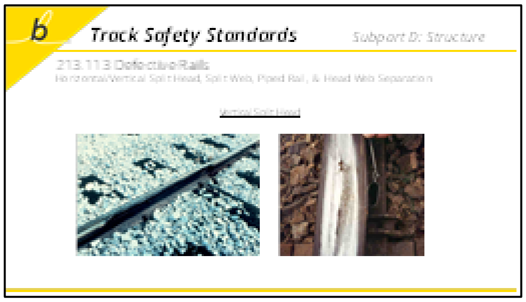
Slides 133 - 140



213.113 (d)(11)



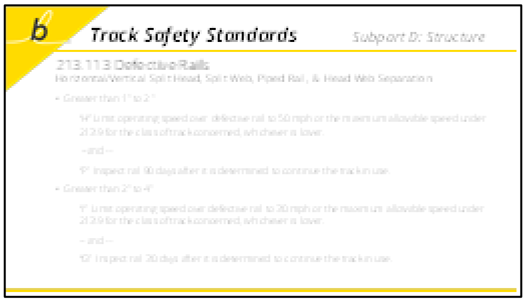
213.113 (d)(16)

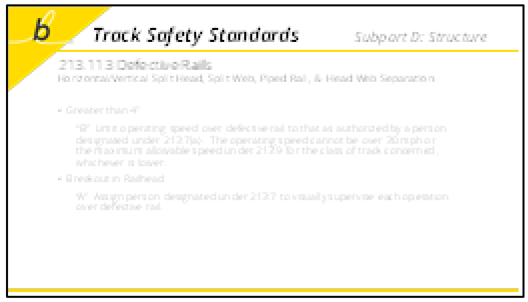


213.113 (d)(14)

213.113 (d)(13)

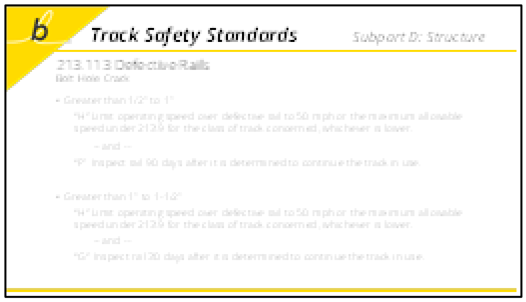
213.113 (d)(10)

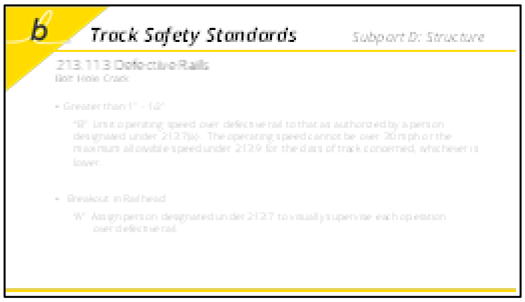




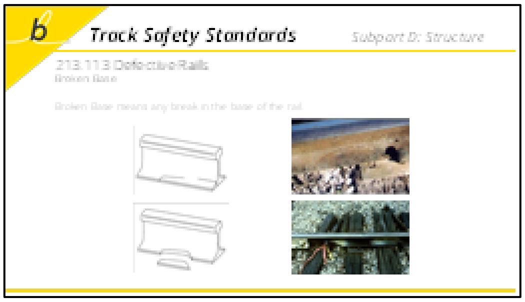
Note: Under FRA's interpretation, "break out in rail head" is defined as a piece which has physically separated from the parent rail. Rail defects meeting this definition are required to have each operation over that rail visually supervised by a person designated under §213.7.

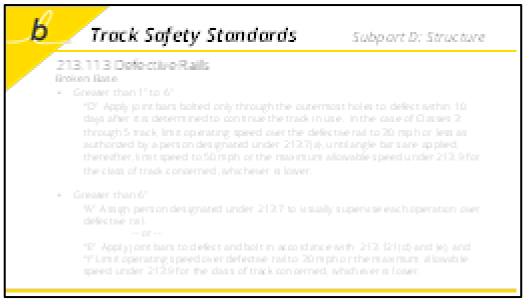
Slides 141 - 143 213.113 (d)(1)



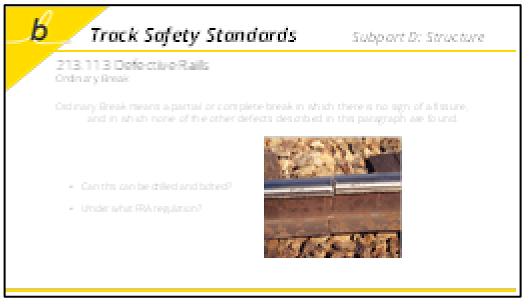


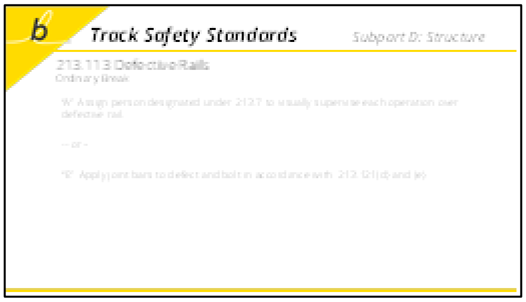
Slides 144 & 145 213.113 (d)(2)





Slides 146 & 147 213.113 (d)(12)





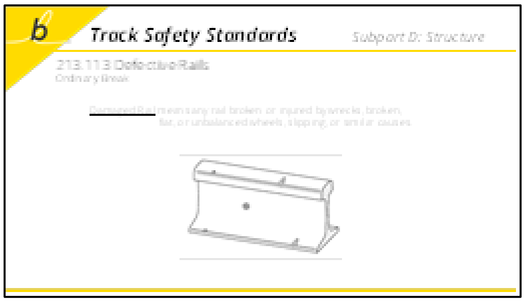
Instructor Guidance:

1. Ask the class:

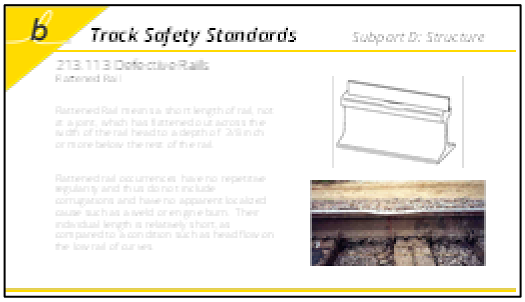
Can the rail in this picture be drilled and bolted? Under what FRA Regulation?

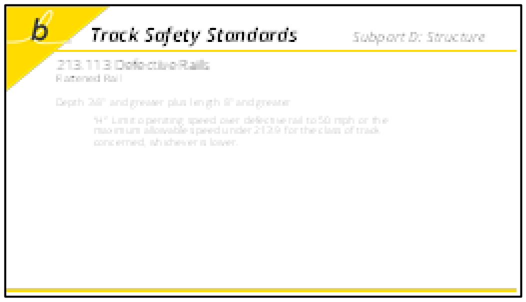
Answer: Yes

Slides 148 & 149   213.113 (d)(5)

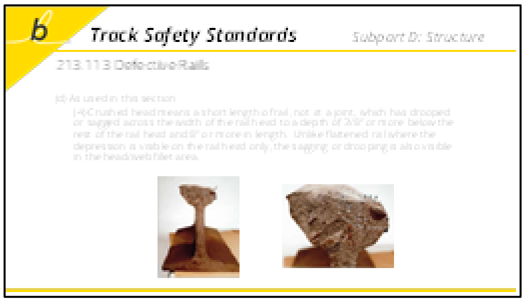


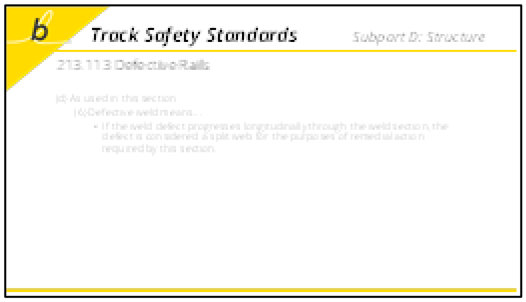
Slides 150 & 151   213.113 (d)(9)





Slides 152 & 153





Instructor Guidance:

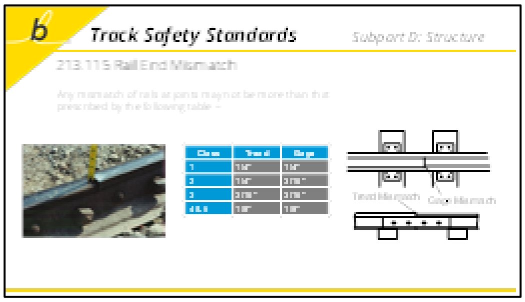
1. After reviewing all of 213.113, ask students if there are any questions
2. Have students complete the 213.113 Exercise using the table in their Regulatory Booklet
3. Review answers with the class

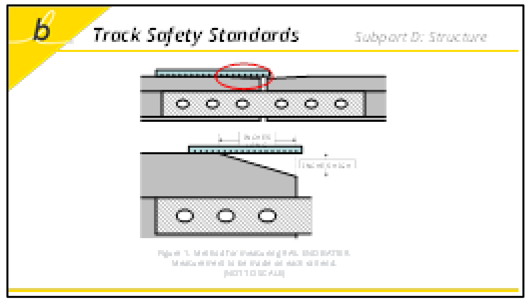
Section 213.113 Exercise

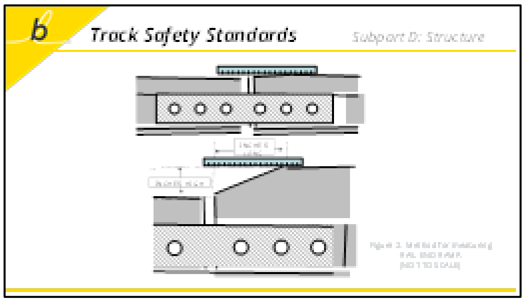
Instructions: Using the remedial action table in 49 CFR Part 213.113, decide what the required remedial action is for each of the following defects if they are not removed from the track.

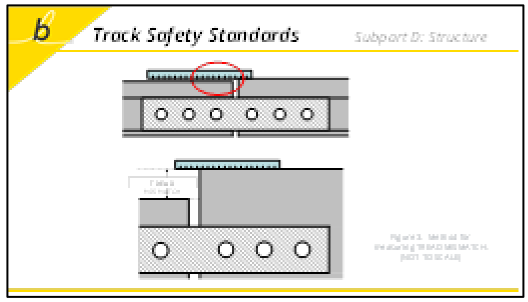
213.113 (b)	Compound fissure with 50% of the rail head weakened.
213.133 (c)	Transverse fissure with 20% of the rail" head weakened.
I & G	Vertical split head 3 inches long.
H & G	Bolt hole crack 1-1/2 inches long.
N/A	Corrugated rail with 2" wavelength and 1/16" depth.
A or E	Ordinary break 4 inches long.
I & G	A 3-inch split in the rail web.
N/A	3/16-inch rail end batter at a joint
1.A	A vertical split head with a breakout in the rail head.
H	Flattened rail 10 inches long and 1/2 inch deep.
D	Fracture affecting 50% of the rail head at an engine burn.
A2 or E & H	A defective field weld with rail head weakened 90%.
Not a Defect	A vertical split head 1/2-inch long.
I & G	A head-web separation 3-1/2 inches long.
H & F	Bolt hole crack 3/4 inches long.
A or E	A rail broken in half for no apparent reason.
B	A 7" long horizontal split in the rail head.
Not a Defect	A shelly spot 3/32" deep and 2" long.

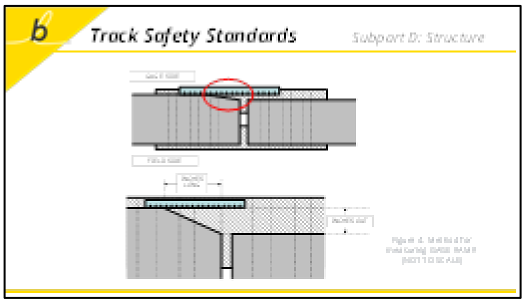
Slides 154-158











Key Message: Measure mismatch when track bolts are tight. If bolts are not tight, report the condition as loose joint bars, under §213.121.08. Use a straight-edge to measure the distance between each rail ends. Do not bridge the two rail-ends, but hold the straight-edge longitudinally along the higher rail (tread) or along the gage-side (5/8-inch down from the running surface) of the rail. Measure the distance directly between the two rails. Disregard plastic overflow (gage-side rail edge lipping), if any.
A mismatch may result in high impact forces especially at higher speeds. If a mismatch in excess of the allowable results in significant rail end damage, a violation should be considered.
Particular attention should be given to the mismatch on the gage-side of a rail. A thin flange, skewed truck, or combination of both may cause a wheel to climb, particularly on the outer rail of a curve.

Instructor Guidance:

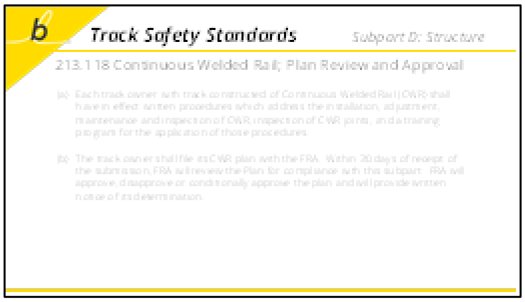
1. Ensure class understands difference between tread mismatch and gage mismatch
2. Demonstrate or draw the correct way to measure rail end mismatch for each type. (Use the slide illustrations to help.)
3. When done reviewing 213.115, have students complete the Exercise using the table in their regulatory booklet (or navigate back to the table on Slide 142)
4. Review answers with the class

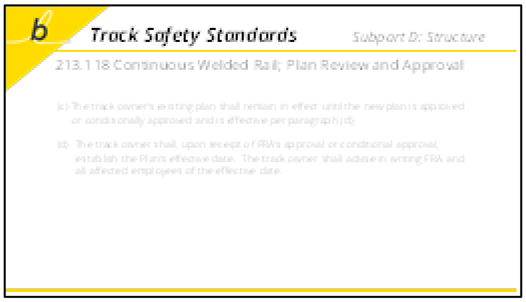
Section 213.115 Exercise

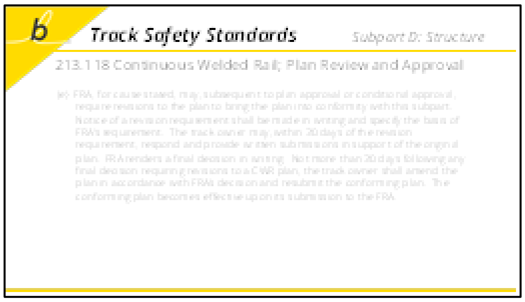
Instructions: You have just taken some rail end mismatch measurements. Using 49 CFR Part 213.115 determine the class of track for each measurement.

Class	**Measurement**
1	¼" tread and ¼" gage mismatch
2	¼" tread and 0" gage mismatch
1	1/8" tread and ¼" gage mismatch
2	¼" tread and 3/16" gage mismatch
5	0" tread and 1/8" gage mismatch
Excepted/ OOS/213.9B	½" tread and 1/8" gage mismatch
1	3/16" tread and ¼" gage mismatch
5	1/16" tread and 1/8" gage mismatch
3	1/8" tread and 3/16" gage mismatch
5	1/16" tread and 1/16" gage mismatch

Slides 159 -161







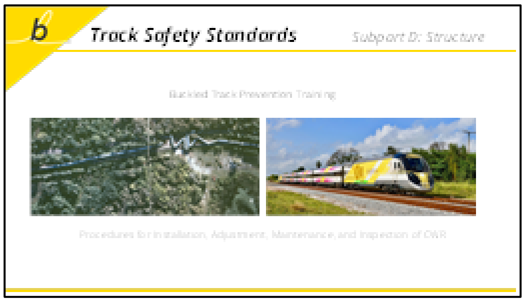
Key Message: Each railroad must have in effect and comply with their own written procedures that address the installation, adjustment, maintenance and inspection of CWR, continuous welded rail. Brightline has a CWR plan specific to our property and processes that complies with all requirements under 213.118 and 213.119.

Instructor Guidance:

1. Provide a brief overview of the key message
2. Define for the class what CWR stands for and what it is:

Continuous Welded Rail (CWR) **=** Rail that has been welded together into lengths exceeding <u>400 feet</u>. This means there are no joints to allow for expansion and contraction due to external forces such as temperature and train dynamics. Following correct procedures when installing, repairing and maintaining CWR is critical to the integrity of the overall track.

Slide 162

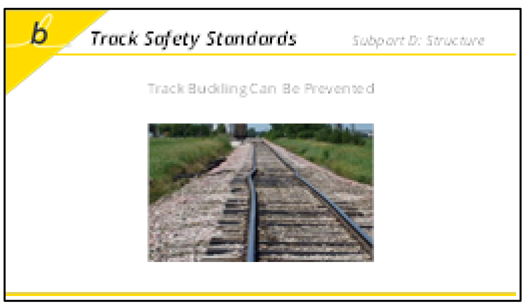


Key Message: CWR Procedures are in place to avoid track buckling and pull-aparts caused.

Instructor Guidance:

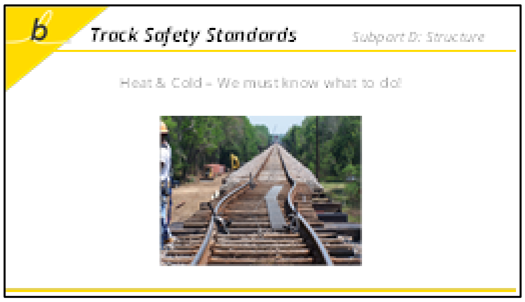
1. Explain that track buckling-caused derailments rank #1 in both the number of derailments and the resulting damage cost across all railroads.

Slide 163



Key Message: By knowing and following the requirements of the regulations and Brightline's CWR Plan, track buckling incidents are preventable.

Slide 164



Key Message: The main factor (force) that contributes to changes in CWR is temperature. Temperature variations affect the length of the rail. Rail expands (lengthens) when heated and contracts (shortens) when cold.

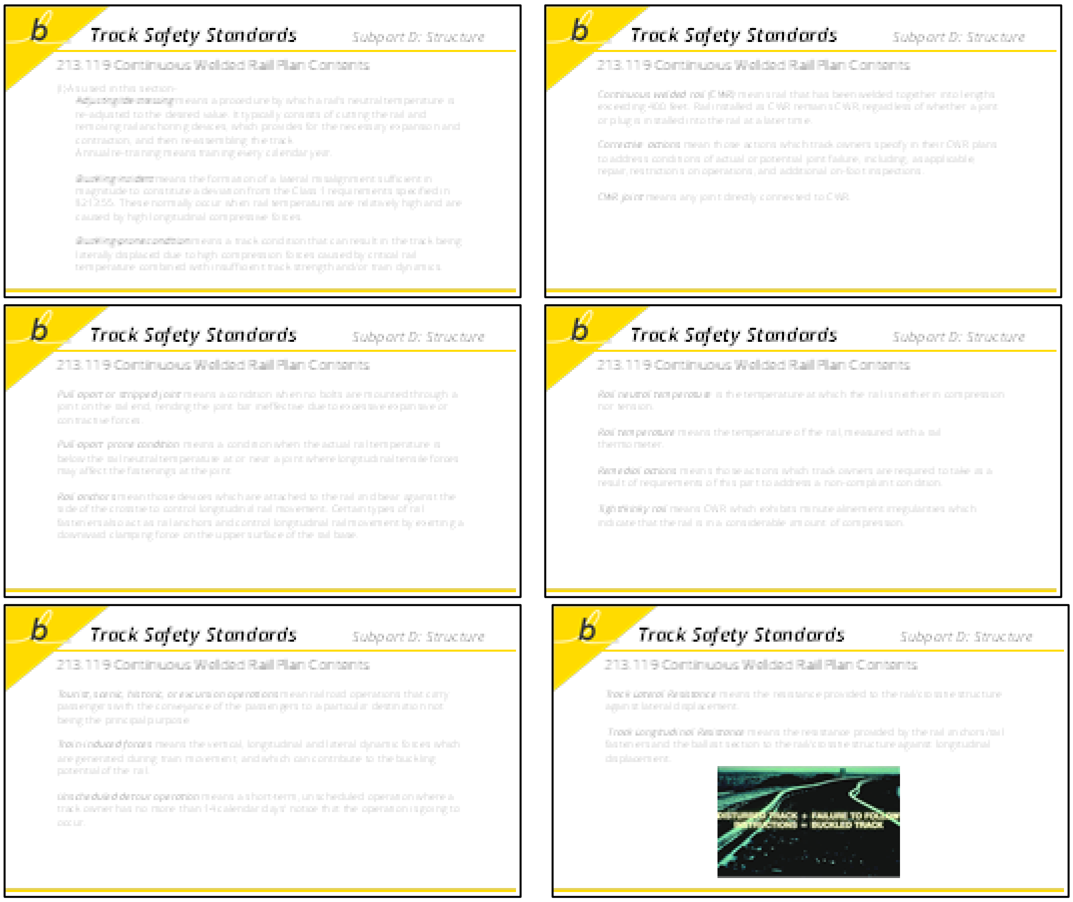
Thermal expansion is well understood in our industry. So are the methods for controlling thermal expansion.

Compressive forces formed when rail increases in temperature, and tensile forces, formed when rail decreases in temperature can be contained when the track structure is to standard.

The track structure (the assembly of rails, fastenings, ties and ballast) is designed to resist a certain amount of longitudinal and lateral pressure that comes from thermal stresses created by heat and cold.

When, however, the amount of compression generated in the rails exceeds the ability of the structure to hold itself in place, track movement occurs. This movement is known as a misalignment (or buckle) and track pull-apart.

Slides 165-170

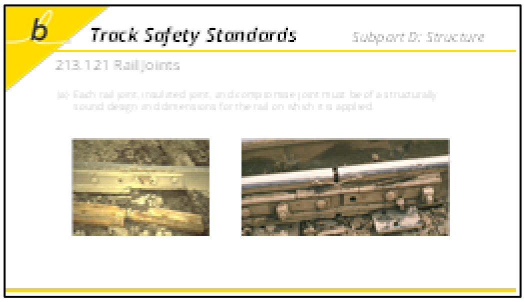


Instructor Guidance:

1. Review these common terms and definitions with the class
2. Inform students that 213.119 does have training requirements regarding CWR Procedures and that this training does NOT meet those requirements. That is a separate training program.

Answer any additional questions the class may have.

Slide 171

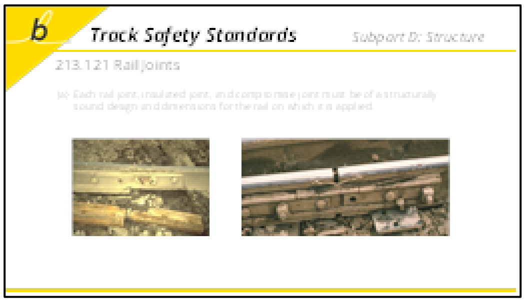


Key Message: Rail joints are considered to be a necessary discontinuity and require special attention by railroad maintenance personnel and safety Inspectors.
As far as possible, a rail joint should provide the same relative strength, stiffness, flexibility, and uniformity as the rail itself.

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.

Slide 172



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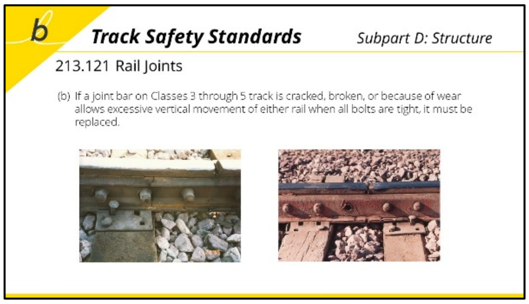
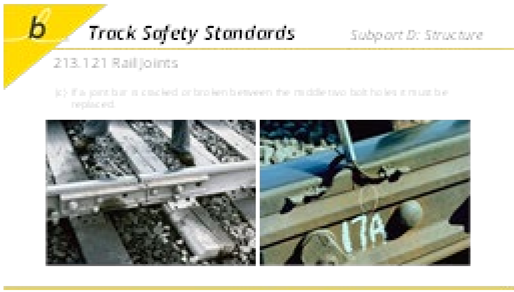
Slide 173



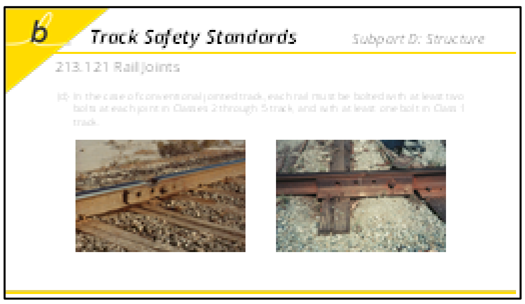
Key Message: Proper corrective action for a joint bar cracked or broken, other than center break, in Classes 3 through 5 track would be replacement or a reduction to Class 1 or 2. If both joint bars are cracked or broken between the 1st and 2nd bolt hole (including through the 2nd bolt hole) it should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

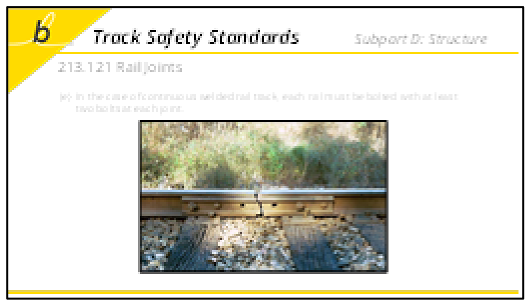
Slide 174



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

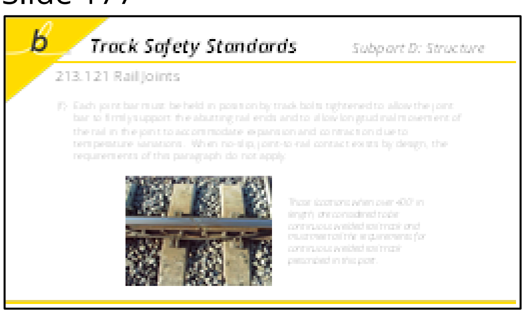
Slide 175 - 176





Key Message: It is important to maintain proper rail anchoring, neutral temperature, and adjustment records on CWR, otherwise pull-aparts can result. In addition, only one bolt in a rail end in CWR can also enhance the possibility of a pull-apart.

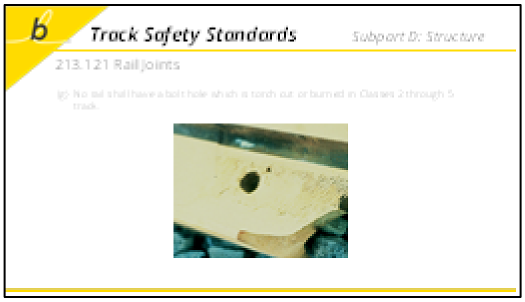
Slide 177



Instructor Guidance:

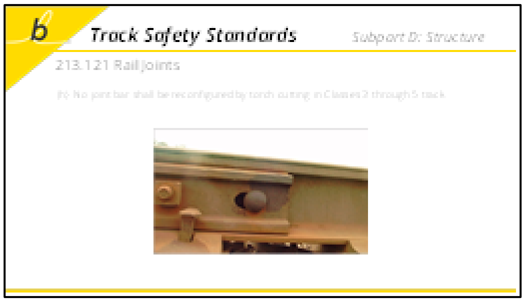
1. Emphasize note in slide.

Slide 178



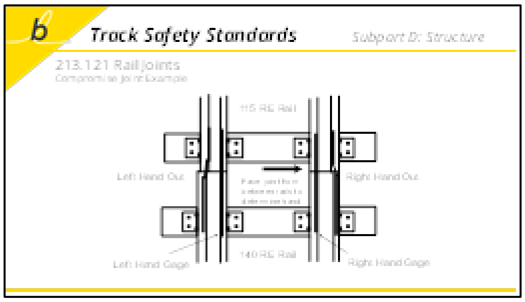
Note: Heat stress cracks in torch cut bolt hole.

Slide 179



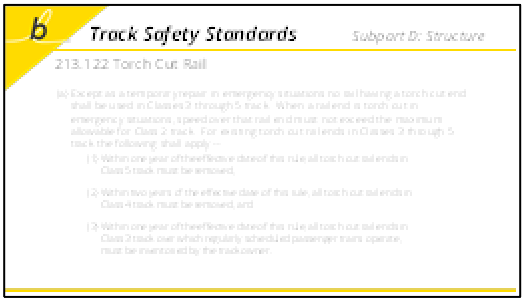
Key Message: Torch cut bolt hole in joint bar

Slide 180



Key Message: The TSS only require structural soundness and bolt condition based on authorized operating train speed. Inspectors must 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.

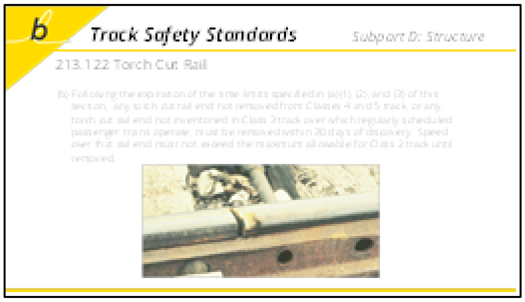
Slide 181

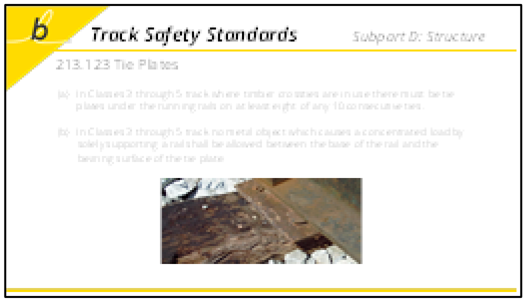


Key Message: The regulation prohibits the torch cutting of rail ends in Classes 3 through 5 track except as a temporary repair in emergency situations. In such emergency situations, train speed shall not exceed the maximum allowable for Class 2 track.

Note: These dates are not relevant to Brightline property since all track is newer. Existing torch cuts must be removed from track in the following time frames:
Class 5 track - by September 21, 1999.
Class 4 track - by September 21, 2000.
Class 3 track with passenger trains - by September 21, 1999 all torch cuts shall be inventoried by the track owner. Those torch cuts inventoried will be "grandfathered in" and any torch cuts found after the expiration of one year that are not inventoried must be slow ordered to Class 2 speed and removed within 30 days of discovery. If a railroad chooses to upgrade a segment of track to class 3, and passenger trains are operated, all torch cuts must be removed before speeds can exceed the maximum for Class 2 track. If a railroad chooses to upgrade a segment of track from any class to Class 4 or 5, it must remove all torch cuts.

Slide 182 - 183



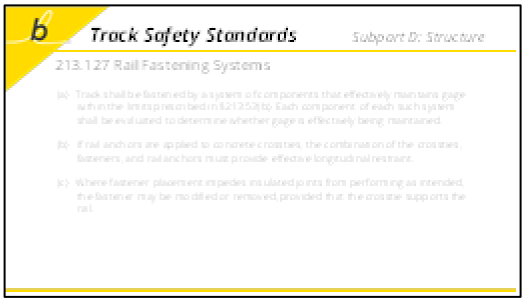


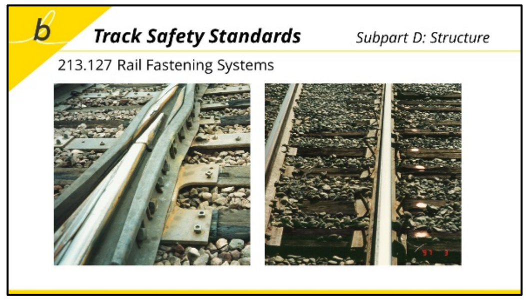
NOTE: Slide 183 is hidden in the Brightline Presentation and left only for reference.

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

In Classes 3 through 5 track, no metal object which causes a concentrated load by solely supporting a rail shall be allowed between the base of rail and the bearing surface of the tie plate. The specific reference to "metal object" is intended to include only those items of track material 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.

Slide 184 - 185

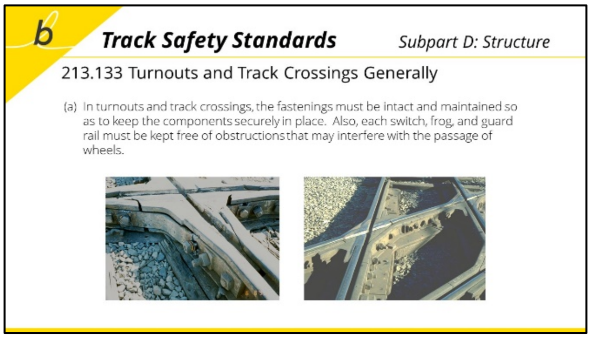




Key Message: When an Inspector identifies a gage condition where the fastener system has degraded and the condition meets the factors described below, the Inspector must examine each component of the fastener system (e.g. clip, insulating pad, bolts, spiking pattern, etc.). This section explicitly requires the Inspector to exercise judgment in evaluating the condition of fasteners. The following factors should be considered in the evaluation:

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

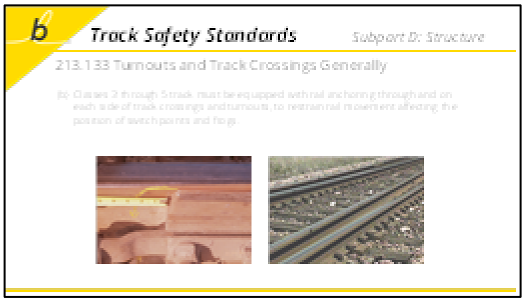
Slide 186



Key Message: Review these inspection points:

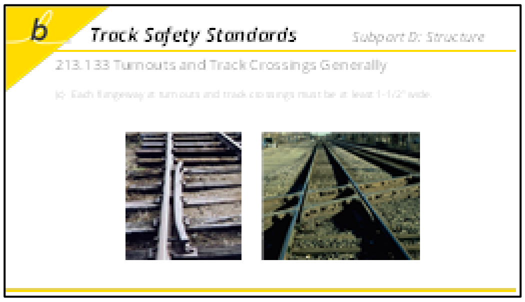
- Determine if switch points are fitting properly.
- Examine the switch point for chips, breaks or wear.
- Check the connecting rod for loose fastenings and worn oblong-shaped holes.
- Check the switch stand to determine if it is securely fastened to the ties.
- The throw lever of the switch stand should not be operable when the lock or keeper is in place.
- Switch position indicator or target must be clearly visible.
- Check the transit clips, connecting rods and fasteners for lost motion.
- Check for missing cotter keys or keepers.
- Inspect the rail braces to determine if they are tight and in place.
- Check the gage corner of the rail head for metal flow that might affect the fit of the point.
- Examine the area between the switch point and the stock rail to determine if there are obstructions that will affect the fit.
- Examine the base of the point for moon shaped base breaks that tend to occur
- Examine the gage corner of the stock rail for evidence of the outer edge of the wheel striking it.
- The heel of the switch must be examined to determine if all bolts are tight, all fastenings and components are in place, and the surface is adequate.
- All ties through the switch and turnout should be inspected and in good condition
- The switch plates should all be intact and in place.
- Determine if graduated riser plates are mixed with uniform riser plates.
- The frog should be examined to determine if all bolts are in place and tight.
- The tread portion should be checked for excessive wear.

Slide 187



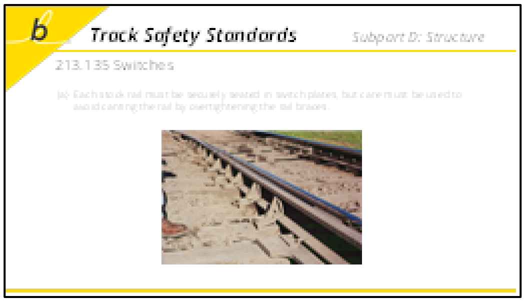
Key Message: Determine if the switch is sufficiently anchored.

Slide 188



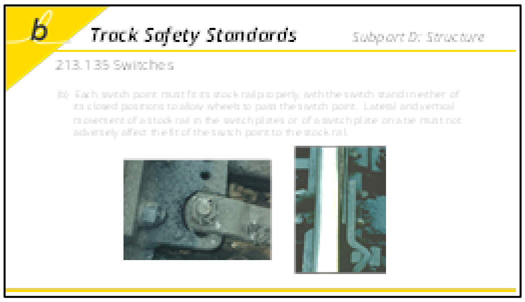
Key Message: The flangeway should show no signs of the flange making contact.

Slide 189



Key Message: The TSS under §213.135 specifies the requirements for switch restraint, movement, and fit.

Slide 190



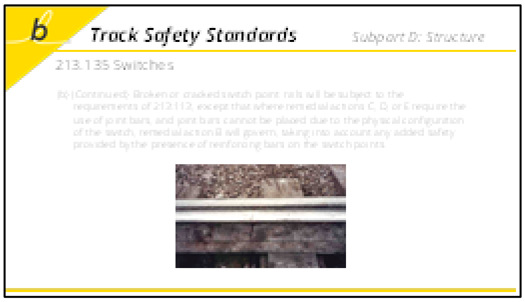
Key Message: The inspector will examine associated components such as connecting rod bolts to ensure that they are tight and do not allow lost motion.

A switch point is considered properly closed when there is no space between the back of the point and inside of its stock rail. While the tip of the point is critical, the entire milled portion of the switch rail should be up against its stock rail. Otherwise, excessive lateral bending motion of the switch rail will occur under load thereby inducing unnecessary forces into components such as switch clips, bolts, rods, etc.

An additional consideration is that there should be sufficient pressure exerted by the switch stand into the switch rod to keep the point up against its stock rail under movements.

A common condition that can cause the switch to not be fully engaged onto its stock rail is lipping (metal overflow) on the gage side of the stock rail.

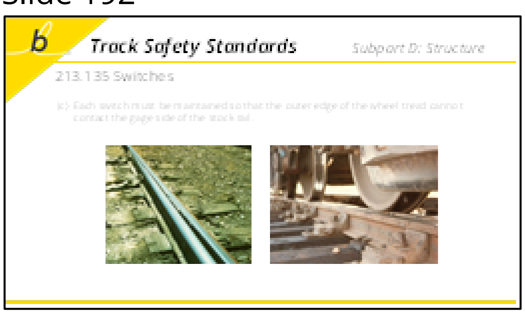
Slide 191



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

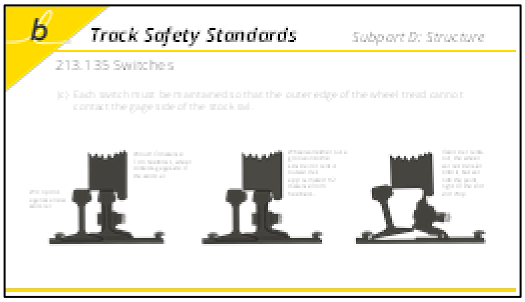
Remember from our 213.113 table:
"B" Limit operating speed over defective rail to that as authorized by a person designated under 213.7(a), who has at least one year of supervisory experience in railroad track maintenance. The operating speed cannot be over 30 mph or the maximum allowable speed under 213.9 for the class of track concerned, whichever is lower.

Slide 192

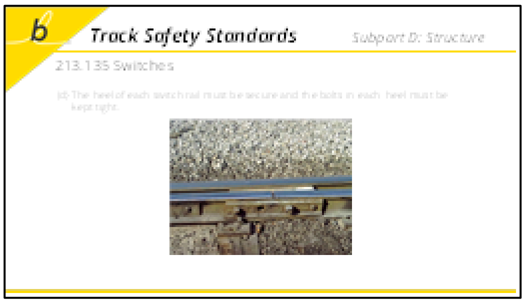


Key Message: This paragraph addresses the outer edge wheel contact of the gage side of stock rails. This defect is a concern for trailing movements when the tread of the switch rail is even or lower than the tread of the stock rail. By design the tread of the switch rail is about 1/4 inch higher than the stock rail. The left photo shows the grove worn onto the gage of a stock rail (a new stock rail was installed without replacing the worn switch point).

Slide 193



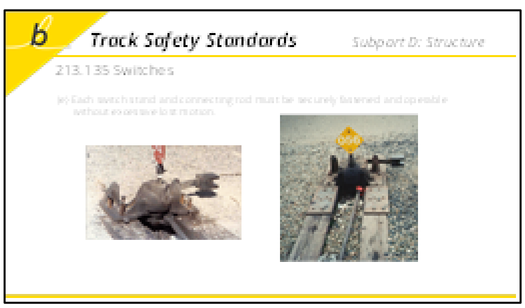
Slide 194



Key Message: An insecure switch heel can cause vertical and lateral movement at the tip of the point. Heel blocks must be fully bolted. However, in five hole or six hole heel block at a minimum there must be two bolts per rail end.

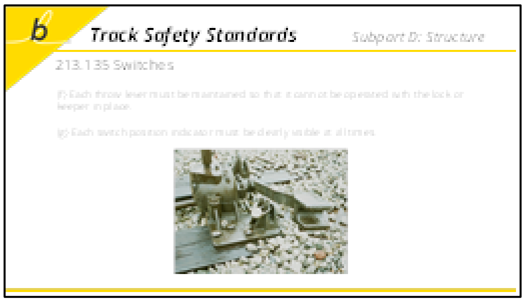
The photo above illustrates an example where 213.9(b) is the required remedial action.

Slide 195



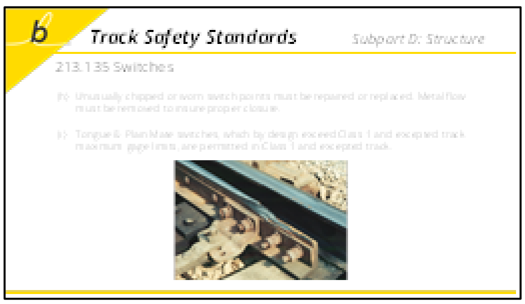
Key Message: Insecure switch stand caused by defective head block timber can cause lost motion resulting in improper fit between the switch point and stock rail.

Slide 196



Key Message: Switch stands designed with a lock or keeper must not be able to allow the switch handle to be operated when the switch handle is in keeper (latch)

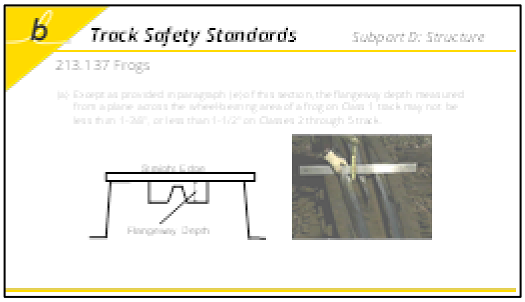
Slide 197



Key Message: The rule does not recommend specific dimensions for determining when switch points are "unusually chipped or worn," as provided for in paragraph (h). The Accident/Incident data base indicates that worn or broken switch points are the largest single cause of derailments within the general category of "Frogs, Switches, and Appliances." However, most of these derailments are related also to other causal factors such as wheel flange condition, truck stiffness, and train handling characteristics. Therefore, qualified individuals must evaluate immediate circumstances to determine when switch points are "unusually chipped or worn."

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

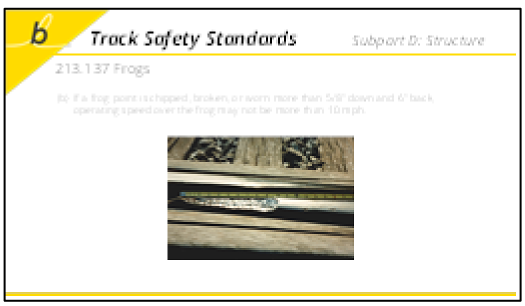
Slide 198



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

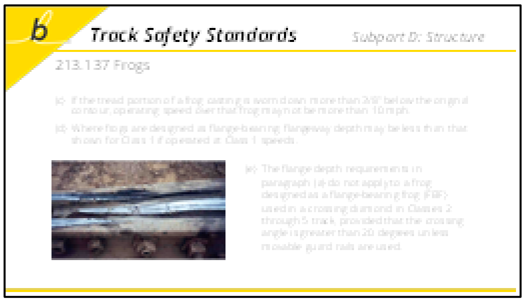
It is important to note that the depth is from the worn portion of the tread to the bottom of the flangeway. Therefore, subtract the distance from the bottom of the straight edge to the worn tread from the measurement taken from the bottom of the straight edge to the bottom of the flangeway.

Slide 199



Key Message: If a frog point is chipped, broken, or worn more than 5/8-inch down and six inches back, a collapse of the point area is possible with repeated wheel impacts. This parameter requires a defect to be more than 5/8-inch down from the original profile to a location six inches back toward the heel to be considered. For example, a frog point that is 7/8-inch below its original profile at the actual frog point and 7/8-inch below at a position 6 inches back toward the heel of the frog would be a defect. For a severe condition that would not meet this criteria such as a breakout at a frog point that is only four inches in length and greater than 5/8-inch down, Inspectors may consider using the Defect Code 213.137.99. While this may not meet the criteria, it is a method to notify a railroad of a condition that the Inspector may feel that the structural integrity of the frog may be in question. Another possible result of a severely worn frog point, especially when coupled with a worn or loose guard rail, is that a railroad wheel may "hit" the point and climb to the wrong side of the frog.

Slide 200

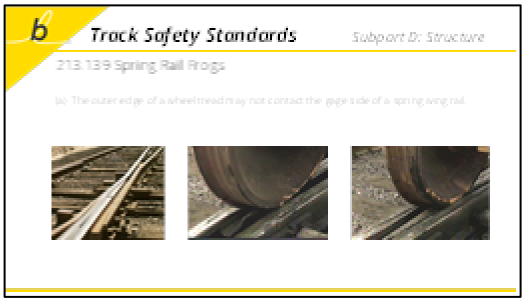


Key Message: The tread portion of the casting adjacent to a frog point of an RBM frog may be manufactured to a plane 1/8-inch above the top of the rail profile (wing wheel riser). An alternate RBM frog design incorporates an actual frog point that is 3/16-inch lower than the tread portion. Called a depressed point, the tread will taper up to the top of rail profile in the direction toward the frog heel in a distance equal to one half the frog number in inches but not less than 5 inches.

To determine tread wear, place an 18-inch long straight edge across the frog spanning both wing rails at the point of most severe tread wear. The distance from the bottom of the straight edge to the worn tread is measured. This measurement may be obtained by various types of gauges such as a folding leaf gauge with different degree of taper and a wedge-type gauge. Tape measures are also frequently used to measure tread wear.

Tread wear does not apply on the frog point in the area between the actual frog point and a position six inches back toward the frog heel. Wear in this area is addressed under §213.137(b).
If the tread is worn more than 3/8-inch, the corresponding flangeway depth may also be reaching critical limits.

Slide 201



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

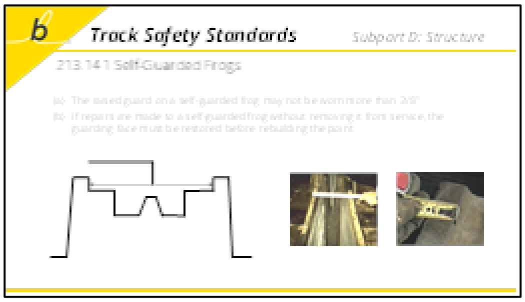
Slide 202

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

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

The spring wing rail must be held tight against the point.

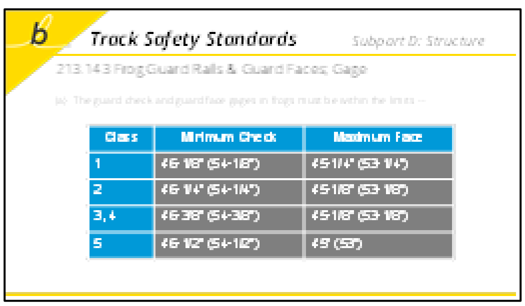
Slide 203



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

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

Slide 204



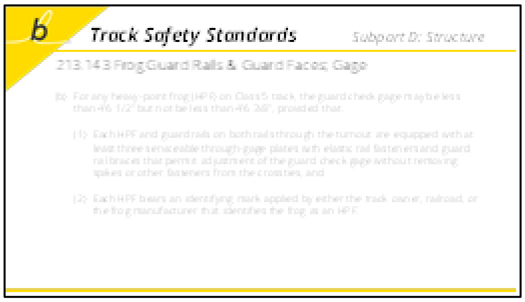
Key Message: A guard rail is installed parallel to the running rail opposite a frog to form a flangeway with the rail and thereby to hold wheels of equipment to the proper alignment when passing through the frog.

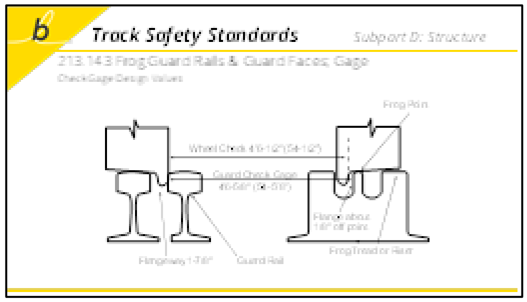
A guard rail must be maintained in the proper relative position to the frog in order to accomplish its important intended safety function. Inspectors should examine guard rails carefully to see that they are adequately fastened, and when measuring guard rail gage, fully consider any movement of guard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

Section 213.143 clearly specifies allowable tolerances for guard check and guard face gage for various classes of track.

When measuring guard check gage, it is important to consider the path of wheels through the frog because the function of a guard rail is to keep wheel flanges from striking the actual frog point.

Slide 205 - 206

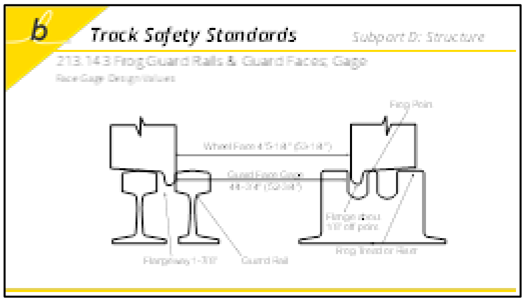




Key Message: For references purposes, this illustrates approximate design check gage values.

It is handy to remember that wheel check gage is 54-1/2 inches. Therefore, when wheel flanges just begin to strike the gage side of a frog point, the track check gage will be approximately 54-1/2 inches. Since FRA standards allows check gauge less than 54-1/2 inches, this is an excellent example where railroad maintenance standards are more prudent, when adhered to.

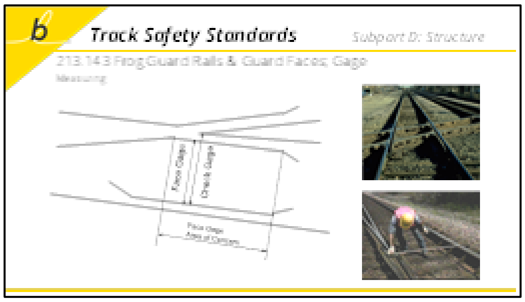
Slide 207



Key Message: For references purposes, this illustrates approximate design face gage values.

Face gage, also commonly called "back-to-back gage," is not an important consideration in relation to the maintenance of a frog point. However, face gage is a dimension that becomes critical when the distance between two opposing guard rails or a guard rail and a frog wing rail become larger than the distance between the back of wheel sets. This would occur by improper installation or a condition such as a severe alignment defect. Normally, face gage would be measured in the same vicinity as check gage. However, Inspectors should consider measuring face gage at other points in special track work where there may be an indication that wheels are being “pinched.”

Slide 208



Key Message: The critical area where guard check gage must be measured is at the actual point of frog. Inspectors must also consider any unusual wear that may exist at the actual frog point and position the track gauge or other measuring device accordingly. It is important to also include rail crossing (diamond) frogs when considering these measurements.

Instructor Guidance:

1. After reviewing all of 213.143, ask students if there are any questions
2. Navigate back to the table on Slide 192 and leave it up on the screen
3. Have students complete the 213.143 Exercise
4. Review answers with the class

Section 213.143 Exercise

Instructions: Using CFR 49 Part 213.143 decide what the class of track the following deviations are good for.

4	Guard check gage is 54 7/16”
5	Guard check gage is 54 5/8”
1	Guard check gage is 54 3/16”
1	Guard face gage is 53 ½”
4	Guard face gage is 53 1/16”
1	Guard face gage is 53 3/16”
1	Guard check gage is 54 3/8" and guard face gage is 53 3/16".
4	Guard check gage is 54 9/16" and guard face gage is 53 1/8".
1	Guard check gage is 54 1/8" and guard face gage is 53".
4	Guard check gage is 54 7/16" and guard face gage is 53 1/16".
1	Gage is 57 9/16”, guard check gage is 55 1/16” and guard face gage is 53 3/16".
2	Gage is 56 3/16”, guard check gage is 54 5/16" and guard face gage is 53 7/16".

Instructor Guidance:

1. If time allows or students need additional exercises regarding Subpart D – Track Structure, read the following scenario to the class
2. Use the white board to write out the details and encourage students to answer out loud and discuss

Additional Exercise – Subpart D.

Crossties

On an inspection trip on a 1.8 degree right hand curve, you have discovered some tie conditions that you think may be FRA defective. A walking inspection of a 39 foot track segment reveals 13 non-defective crossties. The speed at this location is 55 m.p.h. What remedial action, if any, is required at this location?

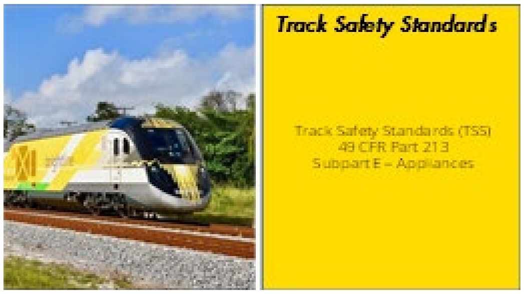
Further into the inspection, you move to another location where the track speed drops to 45 m.p.h. due to heavy curvature. On a 4 degree left hand curve you discover 9 non-defective crossties in a 39 foot segment of track. Since the speed has dropped to 45 m.p.h., you decide not to slow order the track. Are you right? If you are not right, what should you do?

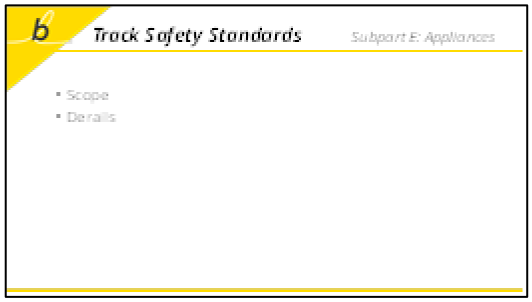
Rail

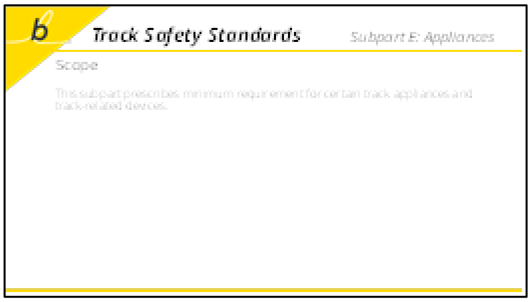
Your assigned duty for the day is riding and supervising the rail test truck that will be testing 132 pound welded rail. The track being tested is FRA Class 3 track with a posted speed of 35 m.p.h. The test truck operator has identified a rail defect and the hand test verified a compound fissure measuring 10 percent. The rail test operator tells you that since the defective condition is just 10 percent, there's no need to slow order the track. Is he right? Explain your reason for either accepting or rejecting his advice. What would you do?

SUBPART E – Track Appliances

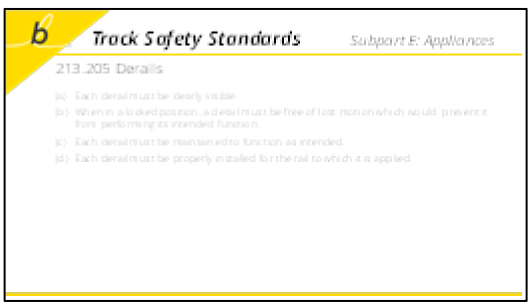
Slides 209 - 211







Slide 212

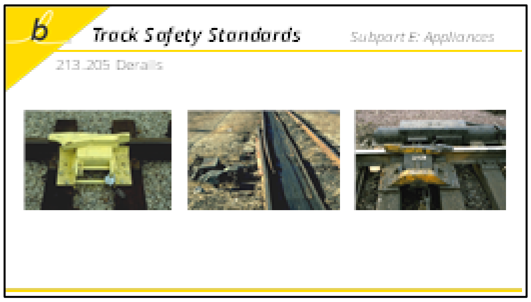


Key Message: Derails are of various designs and may be of the following types: switch point, spring switch point, sliding, hinged, and portable.

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

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

Slide 213

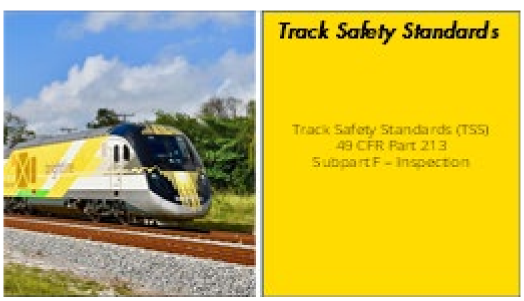


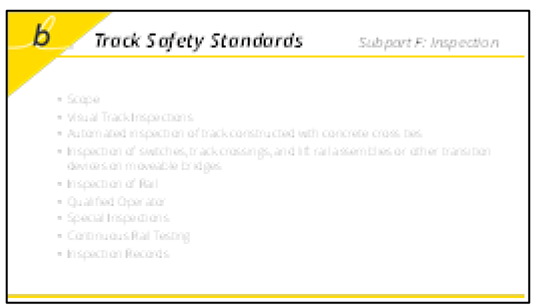
Key Message: Derails must be the proper size for the rail to which it is applied. Derails are manufactured to "sizes" based on the rail section to which they are to be applied and should be installed according to the manufacturer's instructions. Installation of a derail of incorrect size can make a derail ineffective.

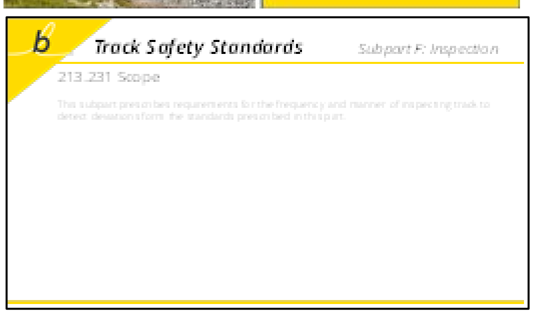
Derails are made by "hand" (right or left) to derail equipment to a specific side of the track. In addition, "universal" derails will derail equipment in either direction. A derail that is installed to derail equipment toward a main track that should otherwise be protected would constitute an improperly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

SUBPART F – Track Inspection

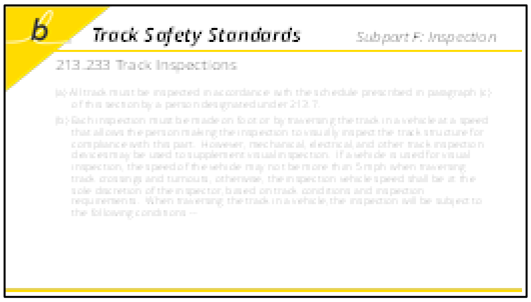
Slides 214 -216





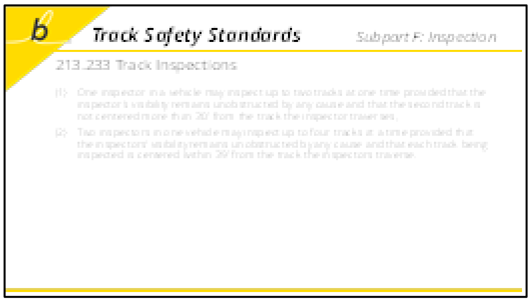


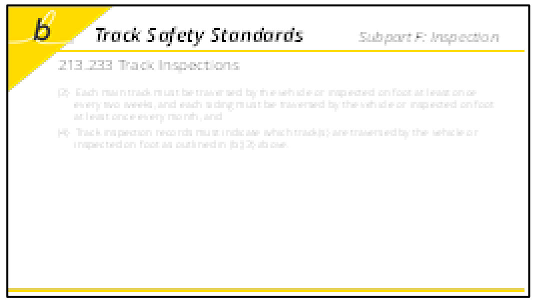
Slide 217



Key Message: Recognizing that proper inspection of track is essential to safe maintenance, Subpart F contains the minimum requirements for the frequency and manner of inspecting track. Inspectors should know that a track owner may exceed the TSS in the interest of good practice, but they cannot be less restrictive. Nor should they be held accountable for exceeding the minimum safety standards. FRA's track safety program success is dependent, to some degree, upon the adequacy of the railroad's inspection efforts and subsequent maintenance program. Monitoring and assessing a railroad's track condition, through regular inspections is integral to our safety success. To assure that railroads are providing proper inspections at the required frequency, Inspectors must periodically examine the railroad's inspection record keeping procedures (noting record keeping type defects under §213.241 only). By reviewing the track owner's inspection procedures, records, or through personal observation Inspectors will determine the number of tracks being inspected, the number of railroad inspectors performing inspections, the specific tracks inspected, and whether the railroad inspector actually traversed the track by vehicle or on foot. As specified in this section of the TSS, the track owner must assure all tracks are inspected in accordance with the prescribed schedule. Failure of the owner to comply with this schedule may constitute a violation.

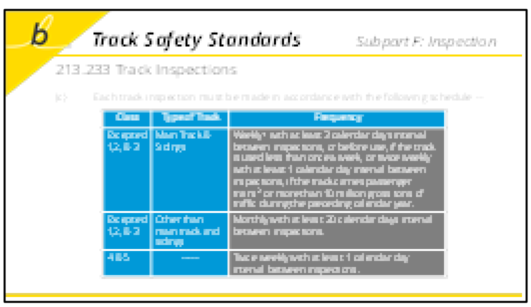
Slides 218 - 219

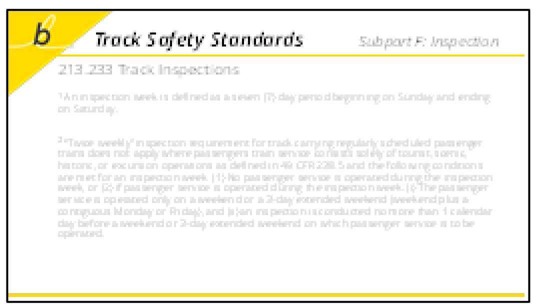




Key Message: Paragraph (b) specifies the number of additional tracks that can be inspected. Depending upon whether one or two qualified railroad inspectors are in the vehicle, and depending upon the distance between adjacent tracks (30 or 39 feet measured between track center-lines), a track owner's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

Slides 220 - 221





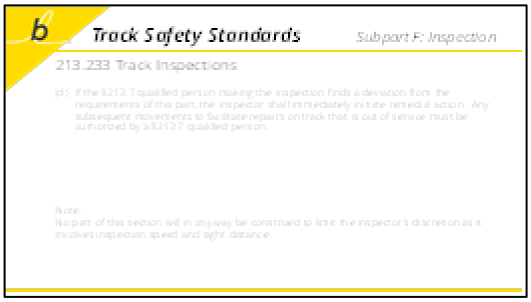
Instructor Guidance:

1. Review the table and notes with the class

[1] An inspection week is defined as a seven (7) day period beginning on Sunday and ending on Saturday.

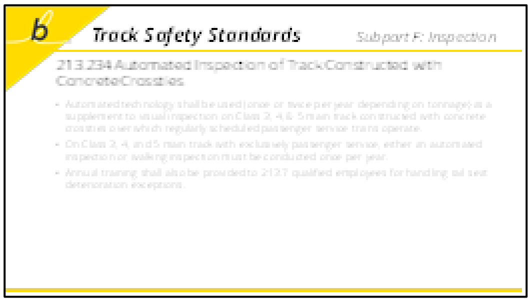
[2] "Twice weekly" inspection requirement for track carrying regularly scheduled passenger trains does not apply where passengers train service consists solely of tourist, scenic, historic, or excursion operations as defined in 49 CFR 238.5 and the following conditions are met for an inspection week: (1) No passenger service is operated during the inspection week, or (2) if passenger service is operated during the inspection week: (i) The passenger service is operated only on a weekend or a 3-day extended weekend (weekend plus a contiguous Monday or Friday), and (ii) an inspection is conducted no more than 1 calendar day before a weekend or 3-day extended weekend on which passenger service is to be operated.

Slide 222

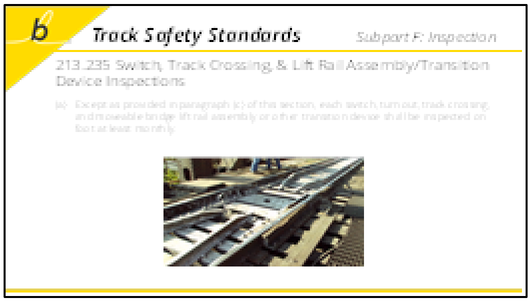


Key Message: Inspectors should monitor compliance with the intent of the "note" under paragraph (d).

Slide 223



Slide 224

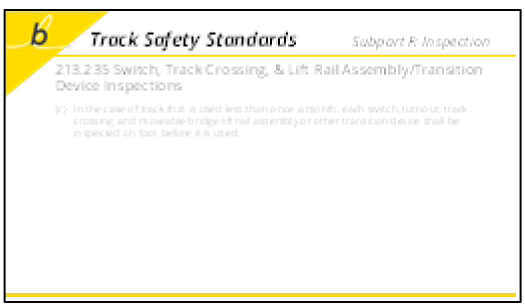


Key Message: Paragraph (a) prescribes the frequency and method of inspection for switches, turnouts, track crossings, and moveable bridge lift rail assemblies or other transition devices by a track owner's qualified persons. By examining records and conducting field investigations, FRA and State Inspectors can confirm the track owner's on-the-ground inspection of each switch, turnout, and track crossing, at least monthly.

Slide 225

Key Message: Each switch, in Classes 3-5 track, that is held in normal or reverse position by only one connecting rod is required to be operated (thrown) in all its positions during one track inspection by the track owner in every three-month period. An example of a switch that has more than one connecting rod is a switch that also has a lock rod. A rod connecting a switch to a switch circuit controller (point detector) is not considered to be a rod that holds a switch in position. This section references the operation of specified switch operating mechanisms in a separate paragraph (b). This requirement is designed to emphasize the importance of these non-redundant mechanisms.
The picture on the left shows a “foot lock” on the top left of the photo which is an acceptable auxiliary device if it is functioning properly. The picture on the right shows a switch with no second operating rod or auxiliary lock.

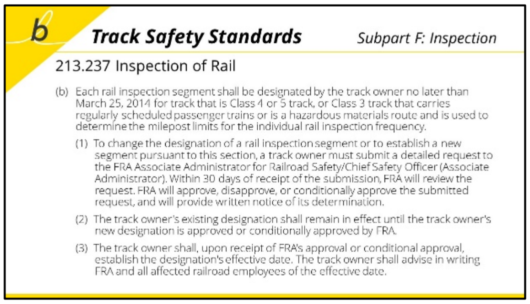
Slide 226



Key Message: "Lift Rails" have unique properties and functions. This discussion will focus on cast manganese alloy types of lift rail assemblies that provide a transition between a fixed span and a movable span on lift bridges, swing bridges, and Bascules. Lift rails are made of three pieces for swing bridges: a section on the fixed span, a section on the movable span, and the rocker which is shown raised in the figure.

The NPRM proposed to change subsection (a) by adding the word “turnout” after the word “switch” to clarify the track device and the intent of the requirement which is to inspect the entire turnout.

Slide 227 - 229

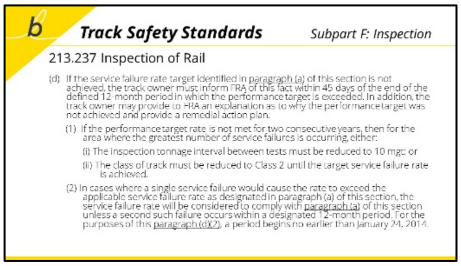


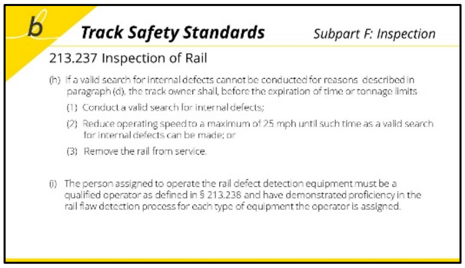
Key Message: The annual test requirement for Classes 4 and 5 track, and Class 3 track over which passenger trains operate, is based on risk factors associated with freight train speeds and passenger train operations.

The requirement states that Class 3 track, over which passenger trains do not operate, should be tested once a year or once every 30 MGTs, whichever is longer. A more frequent testing cycle or a cycle identical to that proposed for Classes 4 and 5 track would be too burdensome for the industry.

Selecting an appropriate frequency of rail testing is a complex task involving many different factors including temperature differential, curvature, residual stresses, rail sections, and cumulative tonnage. Taking into consideration all of the above factors, FRA's research suggests that 40 MGTs is the maximum tonnage that can be hauled between rail tests and still allow a safe window of opportunity for detection of an internal rail flaw before it propagates in size to service failure. FRA's Accident/Incident data point to a need for inclusion of all Class 3 trackage in a railroad's rail testing program.

Slides 230 - 233

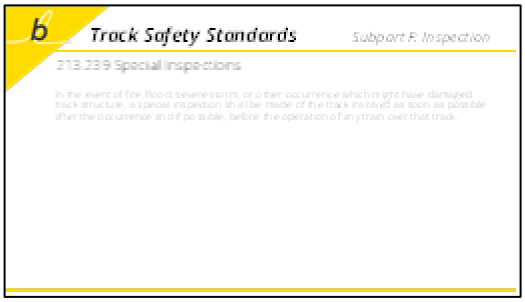




Key Message: Paragraphs (d) and (e), address a situation where a valid search for internal rail defects could not be made because of rail surface conditions. Several types of technologies are presently employed to continuously search for internal rail defects, some with varying means of displaying and monitoring search signals. A continuous search is intended to mean an uninterrupted search by whatever technology is being used, so that there are no segments of rail which are not tested. If the test is interrupted, i.e., as a result of rail surface conditions that inhibit the transmission or return of the signal, then the test over that segment of rail may not be valid because it was not continuous. Therefore, a non-test is not defined in absolute technical terms. Rather, the provision leaves this judgment to the rail test equipment operator who is uniquely qualified on that equipment.

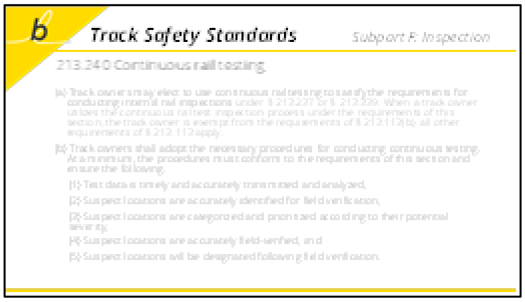
Paragraph (e) specifies the three options available to a railroad following a non-test due to rail surface conditions. These options must be exercised prior to the expiration of time or tonnage limits specified in the paragraph (a) of this section. If doubts exist concerning a defective rail's disposition, Inspectors should review the track owner's records, under §213.241(c). When conducting a record inspection, Inspectors will determine that the requirements of §§213.113(a)(2) and 213.237(e), are in compliance and assure valid inspections have been met. The expiration of time and tonnage must be determined before any compliance action is taken.

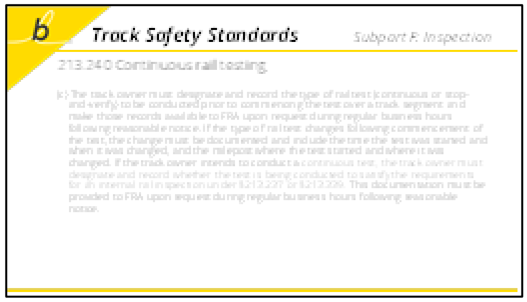
Slide 234

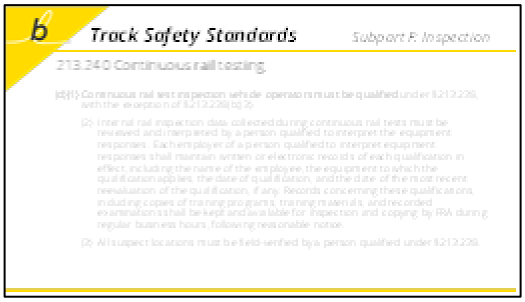


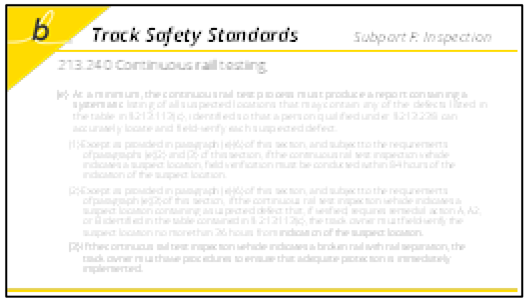
Key Message: Because a number of train derailments have been caused by unexpected track damage from moving water in the past, the FRA deemed it appropriate to issue a safety advisory recommending procedures that reflect best industry practice for special track inspections. The procedures consist of: (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 a 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 railroad track Inspectors in interpreting that Inspectors' findings. Railroads are not required by the Part to complete a written report documenting required special inspections.

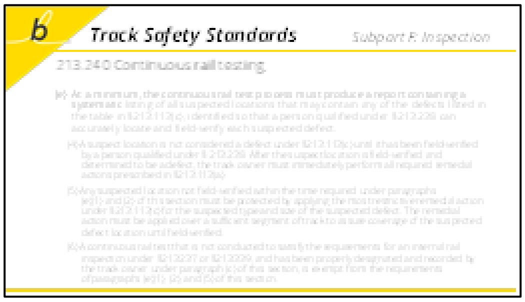
Slides 235 – 241

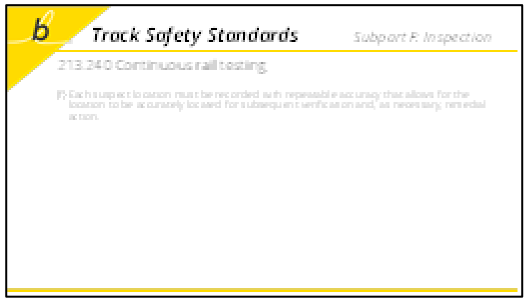


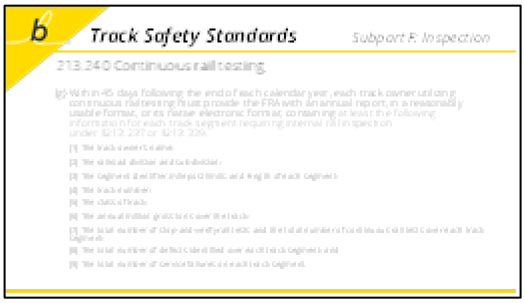










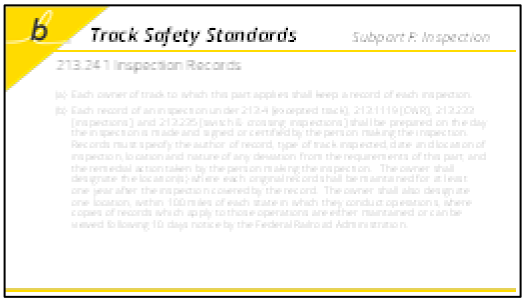


Key Message: 213.240 was added to TSS in 2020 to allow for “Continuous Rail Testing.” Generally, continuous rail testing differs from the traditional stop-and-verify rail inspection process, in that the rail is tested non-stop along a designated route, collecting the rail inspection data and transmitting it to an analyst at a centralized location for review and categorization of suspected rail flaws that are subsequently field-verified. To enable this process, 213.240 allows for entities electing to use continuous rail testing to be exempt from the requirement that certain indications of suspected rail defects be immediately verified and all other indications be field-verified within four hours. Instead, the verification period is extended to allow the data to be analyzed off-site but still require field verification within a specified period (see part (e)(1) through (e)(6) for required times).

Instructor Guidance:

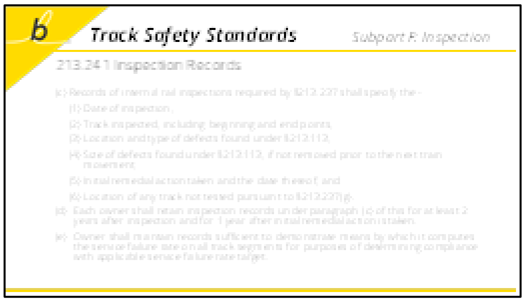
1. Review the Key Message with students
2. Highlight key points of the rule; however, it is not necessary to review the reg line-by-line

Slide 242



Key Message: Track owners are required to keep a record of each inspection according to the requirements under §§213.4, 213.233, and 213.235, prepared on the day of inspection and signed by the person making the inspection.

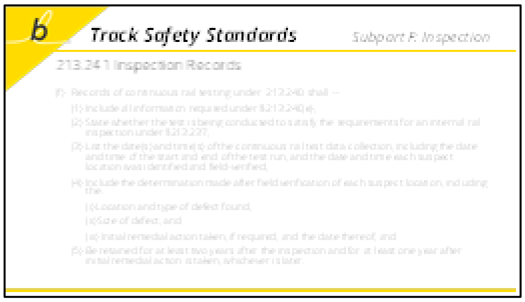
Slide 243

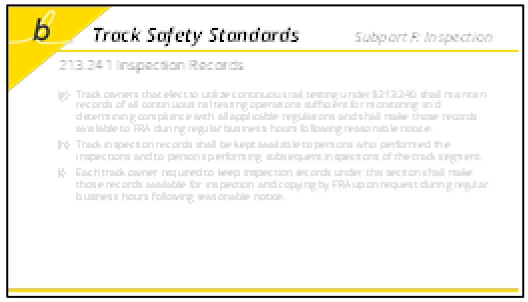


Key Message: Paragraph (c) requires a track owner to record any locations where a proper rail inspection cannot be performed because of rail surface conditions. Section §213.237(d), specifies that if rail surface conditions prohibit the railroad from conducting a proper search for rail defects, a test of that rail does not fulfill the requirements of §213.237(a) which requires a search for internal defects at specific intervals. Subsection (c) requires a record keeping of those instances.

Section 213.241(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.

Slides 244 - 246





1. After reviewing Subpart F, ask students if there are any questions
2. Have students complete the Final Exercises
3. Review answers with the class

Section 213.233 Exercise

Instructions: Using CFR 49 Part 213.233 provide the required frequency of inspection and interval. Traffic is daily unless otherwise noted.

Frequency/Interval

Monthly – 20 Days Yard thoroughfare track; freight only; 15 mph

Weekly – 3 Days Branch line; freight only; 20 mph; operations once every 10 days

Weekly – 3 Days Main line; freight only; 30 mph

Weekly – 3 Days Branch line; freight only; 20 mph; tri-weekly operation

Weekly – 3 Days Branch line; excepted status

2XPer Week – 1 Day Main line; tri-weekly passenger service; 59 mph

Weekly – 3 Days Branch line; weekend excursion service; 25 mph

Monthly – 20 Days Industrial lead; operation every 14 days; excepted status

Weekly – 3 Days Branch line; weekly freight train of 10,000 gross tons; 25 mph

Monthly Turnout in yard track; 10 mph speed limit; freight only

Weekly – 3 Days Passing siding of 10 mph along freight only mainline of 49 mph

2XPer Week – 1 Day Mainline; freight only; 50 mph

Weekly – 3 Days Mainline; freight only; 35 mph

2XPer Week – 1 Day Depot track; passenger trains; 10mph

Monthly Turnout; through route of 50mph, diverging route of 25 mph; freight only

Weekly – 3 Days Mine lead; 15 mph; 1,000-unit coal trains a year, each weighing 10,000 tons

2XPer Week – 1 Day Yard bypass track; 45 mph speed limit; freight only

Monthly – 20 Days Engine servicing track; 5 mph

Monthly – 20 Days Granary lead; 10 mph; operated daily July-October

2XPer Week – 1 Day Branch line; 35 mph; regular excursion type passenger service

2XPer Week – 1 Day Main track; 40 mph; freight only; 15 million gross tons of freight traffic per year

Monthly Track crossing between two class 3 main tracks

Monthly Track crossing between main track of 10 mph and main track of 49 mph

Monthly – 20 Days 10 mph storage track along 49 mph main track; freight only

Combination of Defects – Final Exercise

Instructions: The following conditions are found during a routine track inspection. Assume all gaps indicate movement which must be included. Using the 49 CFR 213 book and your training from this week, calculate the total measurement for each scenario and determine the class of track.

1. At a joint in tangent track, the west rail is 1-1/2 inches lower than the east rail. There is a 3/8-inch gap visible between the bottom of the rail and the top of the tie plate.

   (213.63) 1-4/8 + 3/8 = 1 7/8 Class of Track 2

2. At a location in curved track, the outside rail is 2-1/2 inches higher than the inside rail. There is a visible gap and markings to indicate that the outside end of the tie sinks 3/4 inches when a train passes over that spot.

   (213.63) 2 ½ - ¾ = 1 ¾ Class of Track 4

3. At a point on a tangent, the west rail is 1/2-inch low. There is a 3/4-inch gap between the bottom of the tie under the west rail and the ballast. The tie end under the east rail has a 2-inch gap between the bottom and the ballast.

   (213.63) WR ½ + ¾ = 1 ¼ " ER 2" = ¾ " Class of Track 5

4. The measured track gage at a joint in a curve is 56-13/16 inches. The tie shows fresh wear marks of 3/8 inch along the field side of the outside rail's tie plate. The single shoulder tie plates show a 1/8-inch gap between the rail base and plate shoulder.

   (213.53) 56 13/16" + 3/8 + 1/8 = 57 5/16 Class of Track 5

5. At a soft spot in the track bed, the inspector stretches a 62-foot string between two points on the rail head. Measurement shows a 2-1/2-inch gap between the string center and the top of the rail. Mud below the rail base is flattened, indicating contact by the rail when a train passes. The distance between the rail base and mud surface is 1-1/4 inches.

   (213.63) 2-1/2 + 1-1/4 = 3 ¾ Class of Track OOS or 213.9B

6. Gage of 56-3/4 inches is measured in a switch. The switch plates under the straight stock rail show outward lateral movement of 3/8 inch. There is a 1/8-inch gap between the adjustable rail braces and the field side of the rail.

   (213.53) 56 ¾ + 3/8 + 1/8 = 57 ¼ Class of Track 5

7. A curve is checked for alignment. The mid-ordinate is measured to be 6- 1/2 inches. However, the ties show gaps averaging 1-3/4 inches between the outside ends and the ballast.

   (213.63) 1 ¾" = Class 4

8. A joint shows 5/16 inch of tread mismatch on the rail tread. Both" rails are new and of the same section, and the joint bars are correct, but very loose.

   (213.115) 5/16" OOS or tighten

FINAL EXAM

Materials Required

For the final exam, you will need:

1. A copy of the Exam Questions for each participant
1. Pencils

Instructions

Distribute Exam Questions.

Instruct participants to legibly print their name on the Exam in the space provided, and to write in the correct answer for each question on the space provided.

NOTE: Each student must complete the Final Examination individually.

Time Allowed

Allow students approximately 30 minutes to complete the examination, and approximately 30 minutes for scoring and review.

Passing Score

A passing score for this test is 80%. Review all questions answered incorrectly with the students.

Following the review, check their understanding by asking similar questions to the ones they answered incorrectly.

If they demonstrate understanding they may receive a passing score.

After the Test

After the exam, including scoring and review, has been completed, collect all Exams from the participants.

Maintain the Answer Sheets for recordkeeping purposes.

Log each participants' final exam grade on your Sign-In Sheet and retain this log for recordkeeping purposes.

Track Safety Standards (TSS)

49 CFR Part 213

Classes 1 - 5

Final Exam

Do not write on this test.

Use the accompanying answer sheet for your answers by darkening in the correct selection:

example 1. [A] [B] [C] [D]

Be careful to completely read each question.

Do not answer any question before fully reading the question and all the possible answers.

Select only the answer that most correctly answers the question.

Use your copy of the Federal Regulations to help answer each question. If you still have any indecision about a question or answer(s), ask for clarification from the instructor before selecting an answer. The instructor may be able to "re-word" the question in such a way as to be clearer.

Directions: Read each question carefully. Darken in the one best answer on your answer sheet. Use the FRA Track Safety Standards (TSS) book as a reference.

1. Track owners have responsibilities to comply with TSS. Once a track owner knows that track is not in compliance with the TSS, the owner must?

   a. Notify the track inspector to file a report.
   b. Bring track into compliance by repairing/removing the defect, restricting the speed, or removing the track from service.
   c. Contact the FRA using appropriate letterhead.

2. Each qualified person designated by the track owner to inspect track for defects must?

   a. Demonstrate knowledge and understanding of the TSS requirements.
   b. Be able to detect deviations.
   c. Initiate immediate remedial actions.
   d. All of the above.

3. Track inspector Ray Uhls has a single track freight only main line with an annual tonnage of 4 million gross tons, in Class 2 territory. He's going to inspect today. Today is Saturday, January 12. When is the next inspection due?

   a. Sometime between Wednesday the 15th and Saturday the 19th.
   b. At least on the following Tuesday the 14th.
   c. The next inspection is due on Friday the 25th.

4. Inspector Fritz Boyd works in Class 2 territory. On Wednesday, he measured and recorded a gage reading of 57- ¾ inches. Is the gage reading a defect for Class 2?

   a. Yes
   b. No

5. Inspector Boyd notices a ¼ inch tie plate movement on the tie at the same location where the gage reading was 57- ¾ inches. What is the remedial action, if any, for this situation?

   a. Restore the gage to standards for Class 2 track and leave speed limits unchanged.
   b. Issue a 10 MPH slow order.
   c. No defect in this situation.
   d. Either A or B.

6. What is the minimum gage reading for Class 2 track?

   a. 56 inches
   b. 56- ½ inches
   c. 57 inches
   d. 58 inches

7. A 25 MPH curve averaged 3 ½" after checking over 9 stations using a 62' chord. The mid-ordinate reading taken at the point of concern measured 6 ¾". What remedial action, if any, is required?

   a. Take track out of service.
   b. Slow order to 25 MPH.
   c. Slow order to 10 MPH.
   d. No slow order required.

8. What is the maximum crosslevel permitted on the outside rail of a curve with a speed of 25 MPH?

   a. 4"
   b. 6"
   c. 7"
   d. 8"

9. How much runoff in any 31' of rail at the end of a raise is permitted when the timetable speed is 30 MPH Passenger and 25 MPH freight?

  a. 1 ½"
  b. 2"
  c. 3"
  d. 1 ¼"

10. A rail profile measurement of 2 ¼" is taken at the mid-offset of a 62' string on tangent. There is an indication that the rail is moving downward another ¼" under load. What is the maximum Class of track permitted?

  a. Class 1
  b. Class 2
  c. Class 3
  d. Class 4

11. What would the maximum difference in crosslevel within 62' measure in the diagram below where all the readings were taken within 62'?

-1 ¼"		-1"		- ¾"
	-1"		-1 ½"	

  a. 2 ¾"
  b. 2 ¼"
  c. 1 ½"
  d. 2 ½"

12. A track owner may designate a segment of track as excepted?

  a. Provided the segment of track is not used to move occupied passenger equipment.
  b. Provided no train exceeds 10 MPH on the segment of track.
  c. Provided the segment of track is not located within 30' of an adjacent track which can be subjected to simultaneous use at a speed greater than 10 MPH.
  d. All of the above.

13. What would the remedial action be for the following level board readings taken at joints 15'6" apart on 30 MPH Passenger and 25 MPH frt. tangent jointed track?

-1" - ¾" -1" - ¾"

- ¾" -1" -¾"

a. No remedial action needed.
b. Slow order to 15 MPH.
c. Slow order to 10 MPH.
d. Take track out of service.

14. How is lateral, longitudinal, and vertical stability maintained in the track?

a. Through visual inspections.
b. Through a proper ballast section.
c. Through vegetation control.

15. Each 39' segment of track shall have the minimum number and type of crossties. According to the FRA TSS, for Class 1, 1° 30" curved track, the minimum number of crossties is?

a. 6
b. 8
c. 5
d. 14

16. According to FRA TSS 213.109, each 39' segment of track shall?

a. Have a sufficient number of ties that are effectively distributed.
b. Hold gage, surface, and alinement.
c. Have at least one effective crosstie within a specified distance at joint locations as determined by Class of track.
d. All of the above.

17. You are inspecting two mismatched rails joints on Class 1 track. The tread of the rail ends measures 3/16" and the gage side of the rail ends measures 1/4". What action should you take?

    a. No remedial action required.
    b. Note the item as a defect in your inspection report and assign a team to repair.
    c. Place a slow order on track, note the item as a defect in your inspection report and request repair.

18. One early morning during your inspection, you find a 2" pull-apart with all the bolts sheared on one end of the joint. What is the appropriate remedial action?

    a. No action necessary
    b. Note on inspection report and issue 213.9(b) 10 MPH slow order
    c. Supervise movement over pull-apart until it is repaired
    d. Either B or C

19. Each switch shall be maintained so that the outer edge of the wheel tread cannot contact?

    a. The tie plate.
    b. The gage side of the stock rail.
    c. The field side of the stock rail.
    d. The rail fastening system.

20. While inspecting a switch, he notices that a couple of cotter pins are missing. All other fasteners are tight and in place. What action should he take?

    a. No action is necessary.
    b. Replace the missing cotter pins.
    c. Make a mental note to inspect next week.

21. Joe continues his inspection through the turnout to the frog section. He finds a frog point that is battered ¾"down and 8" back from the frog point. What is the remedial action?

a. Monitor the conditions for signs that the frog point is cracking.
b. Put a 10 MPH slow order on it.
c. No action necessary.

22. Joe measures the guard rail flangeway at 1 ¾". Is this a defect?

a. Yes
b. No

23. Joe records a guard check gage measurement of 54- 1/4" on Class 2 track. According to the FRA TSS 213.143, what is the remedial action?

a. No action necessary.
b. Slow to Class 1 speed.
c. Slow to Class 1 speed. Apply 213.9(b).

24. What is the inspection frequency required by the FRA for a switch?

a. Once a week.
b. Once a month.
c. Once every three months.
d. Once a year.

25. Each 39' segment of track shall have the minimum number and type of crossties. According to the FRA TSS, for Class 2 and 3, 1° 30" curved track, the minimum number of crossties is?

a. 6
b. 8
c. 5
d. 14

26. What information must Joe and all other inspectors provide on their inspection reports?

a. The date of the inspection
b. The track inspected and location of all defects
c. The nature of the defects and the remedial action taken
d. The inspector's signature
e. All of the above

Track Safety Standards (TSS) 49 CFR Part 213 A - F
FINAL EXAM ANSWER KEY
(Darken in the Correct Answer)

1. (A) **(B)** (C)
2. (A) (B) (C) **(D)**
3. **(A)** (B) (C)
4. (A) **(B)**
5. (A) (B) (C) **(D)**
6. **(A)** (B) (C) (D)
7. (A) (B) **(C)** (D)
8. (A) (B) (C) **(D)**
9. (A) (B) **(C)** (D)
10. (A) **(B)** (C) (D)
11. **(A)** (B) (C) (D)
12. (A) (B) (C) **(D)**
13. **(A)** (B) (C) (D)
14. (A) **(B)** (C)
15. (A) (B) **(C)** (D)
16. (A) (B) (C) **(D)**
17. **(A)** (B) (C)
18. (A) (B) (C) **(D)**
19. (A) **(B)** (C) (D)
20. (A) **(B)** (C)
21. (A) **(B)** (C)
22. (A) **(B)**
23. **(A)** (B) (C)
24. (A) **(B)** (C) (D)
25. (A) **(B)** (C) (D)
26. (A) (B) (C) (D) **(E)**

NAME: ______________________________ DATE: ______________

SCORE: __________% TEST ADMINISTRATOR: ______________________________

PASS	FAIL
0 = 100%	6 = 76%
1 = 96%	7 = 72%
2 = 92%	8 = 68%
3 = 88%	9 = 64%
4 = 84%	10 = 60%
5 = 80%	

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