

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

MAINTENANCE OF WAY DIVISION

TRACK MAINTENANCE AND SAFETY STANDARDS:



BLUE, ORANGE AND RED LINES

2008

INTRODUCTION

The HRT (Heavy Rail Transit) Track Maintenance and Safety Standards are published by the Maintenance of Way Division of the MBTA. They are published for the purpose of maintaining the rail facilities of the MBTA to a standard which will ensure the safety of the riding public and of the employees of the MBTA.

These Standards have been revised as noted in the Revision History and are supplemented by previously issued MBTA documents including the M.O.W. Division's Safety Rules, Flagging and Train Protection Policy, Right-of-Way Safety Rules, Power Switching Policy, MBTA General Rules and others contained in the MoW Division Book of Policies and Standard Operating Procedures (SoPs).

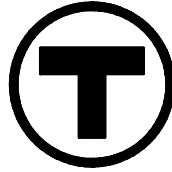
The Director, Systemwide Maintenance and Improvements is responsible for the development of the Standards. Implementation of the Standards is the responsibility of the Superintendents, Supervisors and Forepersons of the Maintenance of Way Division.

Compliance with the Standards is the responsibility of every member of the M.O.W. Division. All personnel should familiarize themselves with the requirements of the Standards and conduct themselves accordingly.

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MBTA



MAINTENANCE OF WAY DIVISION

HRT Track Safety and Maintenance Standards

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T213 – Track Maintenance and Safety Standards

PART A – GENERAL

T213.1 Scope.

This section prescribes minimum maintenance and safety requirements for transit railroad track on the MBTA's Blue, Orange and Red Lines. Standards governing MBTA Green Line are separate and distinct. The requirements prescribed in this section apply to specific track conditions existing in isolation. *Therefore, a combination of track conditions, none of which individually amounts to a deviation from the requirements of this section, may require remedial action to provide for safe operations over the affected track.*

T213.2 DPU Regulations.

Inspection and maintenance of MBTA track is regulated by the Commonwealth of Massachusetts' Department of Public Utilities under M.G.L. c. 30A. The DPU regulations will dictate inspection and maintenance standards except as modified by the MBTA standards herein to be more stringent than DPU regulations.

T213.3 Application.

The Track Maintenance and Safety Standards are designed to enable the operation of trains at the maximum safe speed for the track conditions over which the trains are operating.

Trains may be operated safely at a lower speed than that posted based upon parameters given within the Standards. Certain track defects are categorized by severity thresholds identified within the Standards. Color-coded maintenance threshold limits are used to govern reaction to detected track defects.

GREEN coded track conditions (G) are not exceptions to the MBTA Track Maintenance Standards and do not necessarily require immediate remedial action. GREEN coded conditions, which have degraded and are approaching the YELLOW level should be, at a minimum, verbally communicated to the responsible Section Foreperson and/or Supervisor. GREEN coded conditions should be monitored on an ongoing basis to prevent deterioration to the next level.

YELLOW coded track conditions (or Y) have reached or are closely approaching the maintenance limit for train operation at normal posted speed. As such, YELLOW coded conditions are classified as track defects and remedial action should be scheduled to correct the deficiency before it escalates to the next level.

RED coded track conditions (or R) are defects which in every case generate speed restrictions (slow orders) and at the most severe level are grounds for removing effected track from service until repairs can be made. In most cases, RED coded defects should be scheduled for immediate remedial action. These defects are by definition the highest repair priority.

The intent of the Standards is not to establish artificially rigid procedures governing track maintenance but rather to serve as guidelines for prudent track maintenance practice. These guidelines must be used in concert with proper exercise of judgment based upon experience and knowledge of service requirements.

The track maintenance guidelines are intended to apply to normal operating conditions. During maintenance activities or under temporary conditions, interim modifications of the Standards may be required and would be subject to existing site conditions.

T213.5 Responsibility for Compliance.

Reported defects must receive prompt investigation and corrective action as required. Emergency conditions detected which constitute or should reasonably constitute an immediate safety hazard must be acted upon.

On occasion where the responsible MoW Div. personnel knows or has responsible notice from other sources that a track condition is in violation of the Standards herein and the safe operation of trains is potentially jeopardized, the following steps must be taken:

1. Reduce the operating speed of trains to the level where track conditions are compliant with the Standards (REFER TO MoW SPECIAL ORDER #03-04 Revision 1 FOR INSTITUTING SPEED RESTRICTIONS AND ENSURE THAT PROPER NOTIFICATION FORM HAS BEEN FILLED OUT AS REQUIRED); or
2. Repair the track to support normal train operation; or
3. Remove the track from service.

T213.6 Restricted Speed Rules.

Any track condition which may interfere with the safe operation or passage of trains is considered an “obstruction”. Protection shall be provided for any track which is obstructed or not considered safe for the passage of trains at the normal, posted operating speed. Protection shall be provided as outlined in MoW Division Special Order #03-04 Revision 1. Proper notification must be given using Restricted Operation Notification form. *It is critical that the MoW person responsible for the placement of a restricted speed order remain at the scene until the appropriate ATO code has been installed, appropriate speed signs are in place and/or a Subway Operations official has arrived on the scene to provide relief.*

The limit to which speed should be restricted due to defects and/or abnormal track conditions is indicated within the Standards.

T213.7 Designation of Personnel to Supervise Track Maintenance Activities and to Inspect Track.

The minimum qualifications required by Commonwealth of Massachusetts regulations of MoW personnel involved in the supervision of track maintenance activities and track inspection are contained in the DPU regulations under section 151.08 (4).

The MoW Division has its own published qualification standards for the experience, training, certification and periodic re-certification requirements for personnel involved with the inspection of MBTA tracks. Personnel meeting these qualification standards may be referred to within the Track Maintenance Standards as Qualified Persons to inspect track

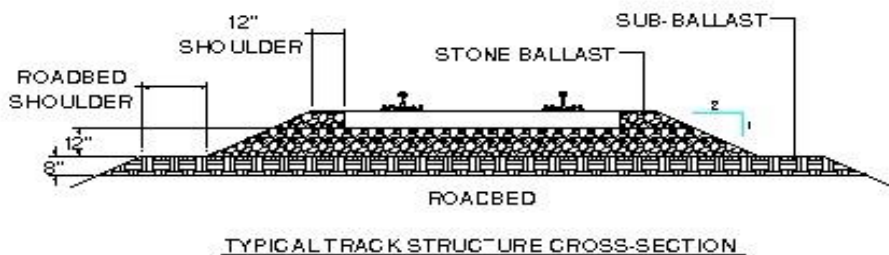
T213.13 Measuring Track Not Under Load (Manually).

When unloaded, track (static condition) is measured to evaluate compliance with the requirements of these Standards, any apparent rail movement (both vertically and horizontally) must be added to the measurements of the unloaded track. The resulting measurements (dynamic condition) will be used to determine compliance with the Standards.

PART B – ROADBED

T213.31 Scope.

This section prescribes minimum requirements for roadbed and areas immediately adjacent to roadbed. Roadbed consists of the area beneath the track structure, which supports the track structure, absorbs loads transmitted from the track structure and is subject to the deteriorating effects of cyclical traffic loads.



Periodic maintenance is required to restore roadbed shoulders to their original configuration to ensure the roadbed drains properly and supports the loads transmitted to it by the track structure. Ditches need to be kept free of vegetation and debris. Lack of ditch maintenance may lead to flooding and compromised track structure integrity.

T213.33 Drainage.

Proper drainage from the track structure is critical to the performance of the track structure. Improperly drained track becomes unstable and maintenance-intensive. Maintenance programs should be in place to keep all drainage facilities beneath and adjacent to the track free from obstructions and able to accommodate the expected water flow for the area served by the drainage facilities.

Within tunnels and/or subway structures, defects which result in water falling onto track components should be repaired as soon as possible. Water must be diverted to a drainage system or the leak sealed.

T213.37 Vegetation.

Vegetation on MBTA property which is within or immediately adjacent to the track area must be controlled. Vegetation is a deterrent to drainage and causes a wide range of problems within the right-of-way. Some consequences of failure to control vegetation are:

- (a) Fouled roadbed and ballast sections from roots and vines.
- (b) Fire hazard, especially in dry weather or in the autumn.
- (c) Obstructed visibility with respect to wayside signals, speed signs, etc.
- (d) Safety hazard due to line-of-sight interference for operating personnel.
- (e) Interference to employees performing track, power or signal duties.
- (f) Improper functioning of signal and communication equipment.

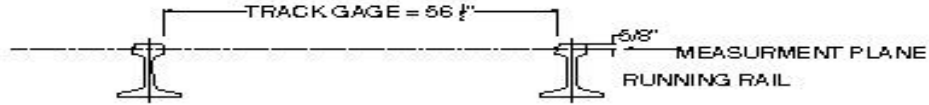
PART C – TRACK GEOMETRY

T213.51 Scope.

This section prescribes requirements for the maintenance limits for track gage, track alignment, track surface, track crosslevel, spiral track geometry, clearances and speed limitation in curved track.

T213.53 Gage and Flangeways.

For HRT track (Blue, Orange and Red Lines), gage is measured between the heads of the rails at right angles to the rails in a plane five eighths of an inch (5/8") below the tops of the railheads.



When measuring track gage, the gage dimension is the *total* of the actual distance measured plus any apparent rail movement caused by train loading and/or any sidewear to the rail(s). As gage is measured 5/8" below the tops of the railheads, sidewear to the rails is also measured 5/8" below the tops of the rail heads (HRT track only).

<p>Minimum track gage in HRT track (both curved and tangent) is 56" (loaded condition) [Except in special trackwork – see criteria on Page 10]. { Refer to Appendix A for Mattapan Line gage maintenance criteria }</p>					
<p>MAXIMUM GAGE LIMITS FOR HRT TRACK</p>					
Track Configuration	Track Gage				Flangeway
Tangent and Curves over 1000'	Design	Green	Yellow	Red	N/A
	56-1/2"	57"	57-1/4"	57-1/2"	
Curves over 125' and less than 1000'	56-7/8"	57-1/4"	57-1/2"	57-3/4"	1-7/8" <u>Maintenance threshold limits:</u> Green +1/8" Yellow +1/4" Red +3/8"
		Response Action			
		Monitor conditions	Restrict speed to 25 mph. Schedule repairs within 30 days.	Restrict speed to 10 mph. Repair within 72 hours.	

GAGE AND FLANGWAY CRITERIA FOR DOUBLE RESTRAINED TRACK

Curve Radius	Track Gage			Flangeways
<125'	Design gage = 56 3/4"			1 7/8" in 2" out Maintenance threshold limits: Green – +1/8" Yellow – +1/4" Red – +3/8" Response Action: Add shims or replace restraining rail as required
	Maintenance Thresholds			
	<u>Green</u> 57 1/4"	<u>Yellow</u> 57 1/2"	<u>Red</u> 58"	
	Response Actions			
	<u>Green</u> Monitor conditions	<u>Yellow</u> 10 mph restriction, schedule repair within 30 days.	<u>Red</u> 5 mph restriction, repair within 72 hours.	

GAGE AND FLANGWAY CRITERIA FOR SPECIAL TRACKWORK

Location	Track Gage	Flangeway
Guarded Switches	56 1/2" (straight side) Minimum: 56 1/4" Maximum: Yellow – 57 1/4" Red – 57 1/2" 56 7/8" (curved side) Minimum: 56 1/2" Maximum: Yellow – 57 1/2" Red – 57 3/4"	1 7/8" throughout switch Maintenance Thresholds and Response Actions shown for double restrained track shall apply
AREMA unguarded switches	56 1/2" both sides of switch Minimum: 56 1/4" Maximum: Yellow – 57 1/4" Red – 57 1/2"	1 7/8" opposite frog only Guard check gage maintenance limits in T213.143 apply at both guard rails

Response Actions for exceptions to gage maintenance limits within special trackwork:

Yellow – Restrict speed to 10 mph and schedule repair within 30 days

Red – Restrict speed to 5 mph and repair within 72 hours

Reference T213.143 for guard check gage requirements.

(Gage transition limit criteria on next page)

GAGE TRANSITION LIMITS

Transitions in track gage shall be at the rate of 3/4" in no less than 31', except in special trackwork, which shall be as shown in the Standard Plans. Under ordinary conditions it will not be necessary to regage track if it within limits indicated above and does not exceed standard for uniformity. Gage conditions exceeding the limits must be corrected immediately. *A combination of marginal track conditions may mandate corrective action before the maintenance limit for any individual parameter is reached.*

Deteriorating track gage conditions not corrected until maintenance limits are reached will result in increasingly accelerated degradation of the track structure. Attention to deteriorating track gage conditions will result in longer lived track and will in most cases prevent the need for critical repairs to maintain acceptable gage.

T213.54 Flangeway Depth.

Minimum flangeway depth through RBM frogs and over spacer block assemblies in curved track is 2". Flangeways less than 2" deep will result in contact with wheel flanges. As flangeway depth approaches 2" rail replacement should be scheduled.

T213.55 Horizontal Track Alignment.

Definition: horizontal track alignment consists of a series of tangent (straight) lengths of track connected by curves. Curves are either simple (same radius throughout) or compound (different radii within the same curve). Spiral curves are used to connect simple curves to tangent track or a simple curve to another simple curve. Spiral curves provide an easement or gradual transition between changes in track alignment. This is done to allow vehicle (train) trucks (sets of wheels) to gradually rotate entering or leaving curves. Spiral curves both reduce rail/wheel wear and result in a smoother, safer ride.

LIMITS OF DEVIATION FROM UNIFORM HORIZONTAL TRACK ALIGNMENT						
Measurement Parameter for Tangent Track:			Measurement Parameter for Curved Track:			
The deviation at the middle of a 62' line* may not exceed:			The deviation from a calculated mid-ordinate of a 31' chord** may not exceed:	The deviation from a calculated mid-ordinate of a 62' chord** may not exceed:		
Maintenance Threshold			Maintenance Threshold	Maintenance Threshold		
Green	Yellow	Red	Absolute Threshold	Green	Yellow	Red
1-1/2"	3"	5"	1-1/4"	1-1/4"	2-1/2"	4"
Response Action			Response Action	Response Action		
Monitor condition	Restrict speed to 25 mph. Schedule repairs within 72 hours.	Restrict speed to 10 mph. Repair immediately.	Trains may be operated at line speed up to a maximum deviation of 1-1/4". Deviations exceeding the 1-1/4" threshold make continued train operation subject to the direct supervision of a qualified MoW staff member. Repairs must be initiated immediately to restore normal train operations.	Monitor condition	Restrict speed to 25 mph. Schedule repairs within 72 hours.	Restrict speed to 10 mph. Repair immediately.
Note: * The ends of the 62' line shall be at points on the gage side of the line rail, 5/8" below the top of the railhead. Either rail may be used as the line rail provided that the same rail is used for the entire length of the tangent track segment. ** The ends of the chord shall be at points on the gage side of the outer rail (line rail on curves), 5/8" below the top of the railhead.						

T213.57 Curves; Superelevation and Speed Limitations.

Definitions: *superelevation* (or elevation) is the amount the outer rail of a curve is raised above the inner rail. Its function is to counteract the effect of centrifugal force. *Equilibrium* (or balanced elevation) is the amount of superelevation in a curve which exactly counterbalances the effect of centrifugal force in that curve for the designated speed in the curve. *Unbalanced* elevation is the amount of elevation less than that required to achieve equilibrium in a curve for the designated speed. *Overbalanced* elevation is the amount of elevation more than that required to achieve equilibrium in a curve for the designated speed.

Actual elevation equals equilibrium elevation minus unbalanced elevation, if any, or $E_a = E_e - E_u$.

The maximum superelevation (E_a) on the outside rail of a curve may not be more than 6-1/2" throughout the system. The amount of unbalanced elevation (E_u) may not be more than 3". The outside rail of a curve may not be lower than the inside except as provided in **T213.63**. To calculate equilibrium elevation required for a given curve, use the following formula:

$$E_e = 4.011V^2/R$$

E_e = Superelevation (equilibrium elevation) in inches.

V = Speed (velocity) in miles per hour.

R = Radius of curve in feet.

Track surface, including superelevation, shall be maintained so that variations in profile, runoff and crosslevel do not exceed the limits in the table at **T213.63**. Immediate speed restriction and corrective action are necessary when the limits are exceeded.

T213.59 Elevation of Curved Track; Runoff.

Elevation occurring in a curve shall be provided uniformly throughout the curve unless physical conditions do not permit. If elevation runoff is required in a curve, the actual minimum elevation shall be used to compute the maximum allowable speed for that curve under **T213.57**.

Elevation runoff shall be at a uniform rate, within the limits of track surface deviation under **T213.63**, and shall extend at least the full length of the spiral(s). If the length of spiral is limited by physical conditions, part of the SE runoff may occur on tangent track up to a limit of 1".

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T213.63 Track Surface.

LIMITS OF DEVIATION FROM UNIFORM TRACK SURFACE			
Measurement Parameter	Maintenance Threshold		
	Green	Yellow	Red
Runoff in any 31' of track at the end of a raise.	1-1/2"	2-1/2"	3"
Deviation from uniform profile on either rail at the mid-ordinate of a 62' chord.	1-3/4"	2-1/4"	2-3/4"
Variation in cross-level on spirals in any 31' maximum.	1"	1-1/2"	1-3/4"
Deviation from designated elevation on spirals.	1"	1-1/4"	1-1/2"
Deviation from zero crosslevel at any point on tangents or from designated SE on curves between spirals.	1-1/4"	1-3/4"	2-1/2"
Difference in cross-level between any two points less than 62' apart on tangents and on curves between spirals.	1-1/4"	1-3/4"	2-1/2"

Response Action to Deviations		
Green	Yellow	Red
Monitor situation on an ongoing basis.	Restrict speed to 25 mph.	Restrict speed to 10 mph.
Advise supervisory personnel of condition.	Schedule surfacing operation to be done within 72 hours.	Schedule surfacing for immediate correction.

T213.65 Clearances.

Specific minimum clearances must be maintained between trains and wayside/overhead structures and facilities. When surfacing and/or lining track or when engaged in out-of-face track reconstruction, attention shall be given to the preservation of existing clearances.

The preferred minimum horizontal clearance measured from the centerline of track on tangent alignment is 8'-6". An absolute minimum of 6'-6" on tangent alignment may be used in extreme cases where absolutely necessary. In either case, consideration of curvature, superelevation, car body roll, car body suspension related lateral displacement and vehicle overhang must be taken when calculating required clearances.

Every effort should be made to preserve existing vertical clearance when planning track maintenance or construction activities. In the event where vertical clearance will be reduced due to proposed track structure changes or for other reasons, a clearance survey of existing conditions should be undertaken using an actual vehicle if possible. Potential clearance obstructions should be located relative to vehicle's dynamic clearance envelope on reconfigured track. Under no conditions should any obstruction be allowed to encroach within 3" of the dynamic clearance envelope, a minimum of 6" is preferred.

The preferred minimum horizontal distance between HRT centerlines on tangent alignment is 13'-0". Absolute minimum is 12'-0". In any case, the clearance between dynamic envelopes of vehicles on adjacent tracks shall be no less than 6" after taking all factors (curvature, etc.) into account.

PART D - TRACK STRUCTURE

T213.101 Scope.

This section prescribes minimum requirements for ballast, crossties, fastening assemblies and the physical condition of rails including contact rail and restraining rail.

T213.103 Ballast.

Unless the track is structurally supported in another fashion (i.e., concrete slab, steel stringer, etc.), it shall be supported by material (crushed granite ballast) which will meet the following requirements:

- a) Transmit and distribute static track loads and loads from passing trains to the subgrade;
- b) Provide lateral, longitudinal and vertical restraint under dynamic loads imposed by passing trains and from thermal stress exerted by the rails during extremes in temperature;
- c) Provide proper drainage of the track structure; and
- d) Facilitate the maintenance of track line, surface and crosslevel.

Ballast used on the Blue, Orange and Red Lines shall be A.R.E.M.A. No. 4 (sieve opening 3/4" to 1-1/2") unless otherwise specified. Ballast received from suppliers which is of inferior quality, the wrong grade or contains dirt or other contaminants (fines) shall be rejected.

Refer to typical track structure cross-section under **T213.31** - Roadbed on page 4. A ballast section which provides a ballast shoulder measuring 12" from the end of tie to the top of slope and a ballast slope of 2:1 is highly desirable. Under no circumstances should the ballast shoulder measure less than 6" horizontally. The ballast level in the tie cribs (area between the ties) should be maintained even with the top of ties or no less than 1" below the tops of ties.

Insufficient or improperly sloped ballast shoulders and/or tie cribs not adequately filled with stone make track susceptible to unwanted movement including possible buckling under high stress. Track which is in improper ballast condition (<6" shoulder, more severe than 2:1 shoulder slope and/or cribs lower than 1" from top of tie level) should receive immediate attention and speed should be restricted until repairs can be made.

Track, which has been substantially disturbed through lining or especially surfacing or by any other means whereby the adhesion between ties and ballast has been broken, must be inspected prior to the resumption of train operations. The inspection must be conducted by personnel designated as a Qualified Person to inspect track and should focus on the presence of sufficient and properly placed ballast to support train operations at the posted speed.

T213.109 Crossties.

Crossties used on the Blue, Orange and Red Lines shall be 7" x 9" x 8'-6", including contact rail insulator ties (except under special circumstances), 100% hardwood and shall conform to the requirements of the AREMA Specifications for Timber Crossties. All crossties shall be equipped with approved anti-splitting devices per the AREMA Specifications.

Each 39' section of track shall have a sufficient number of crossties which in combination provide effective support which will:

- a) Hold gage within the limits prescribed in **T213.53**;
- b) Maintain track surface within the limits prescribed in **T213.63**; and
- c) Maintain horizontal alignment within the limits prescribed in **T213.55**.

Each 39' section of track shall have the minimum number of non-defective crossties as indicated in the following table. To qualify as being non-defective and satisfy the requirements set forth in the table, crossties must not be:

- 1) Broken through - a crosstie with a *vertical* break *completely through* the depth of the tie;
- 2) Split or otherwise impaired to the extent that ballast from beneath the tie has worked through or spikes may be pulled from the tie easily by hand;
- 3) Deteriorated to the extent that the tie plate or rail base (in the absence of a plate) moves laterally under dynamic loading more than ½" relative to the tie's surface; or
- 4) Cut by the tie plate (or rail base) more than 15% (nominally 1-1/8") of the tie's thickness.
- 5) Incapable of maintaining gage, horizontal and/or vertical alignment as described above.

MINIMUM NUMBER OF NON-DEFECTIVE CROSSTIES PER 39' OF TRACK					
<u>Maintenance Thresholds</u>					
<u>Green</u>		<u>Yellow</u>		<u>Red</u>	
Tangent	Curved*	Tangent	Curved*	Tangent	Curved*
9	10	8	9	5	6
*Indicates curves less than 1000' radius					
MAXIMUM NUMBER OF CONSECUTIVE DEFECTIVE TIES					
<u>Maintenance Thresholds</u>					
<u>Green</u>		<u>Yellow</u>		<u>Red</u>	
Tangent	Curved*	Tangent	Curved*	Tangent	Curved*
2	1	3	2	4	3
*Indicates curves less than 1000' radius					
MAXIMUM DISTANCE BETWEEN NON-DEFECTIVE TIES (CENTER TO CENTER BASED ON 24" TIE SPACING)					
<u>Maintenance Thresholds</u>					
<u>Green</u>		<u>Yellow</u>		<u>Red</u>	
Tangent	Curved*	Tangent	Curved*	Tangent	Curved*
72"	48"	96"	72"	120"	96"
*Indicates curves less than 1000' radius					
<u>Response Action to Deviations</u> <u>For all Three Parameters of Crosstie Criteria</u>					
<u>Green</u>		<u>Yellow</u>		<u>Red</u>	
Monitor tie conditions. Notify supervisory personnel.		Restrict speed to 25 mph. Schedule tie renewal within 10 days.		Restrict speed to 10 mph. Replace defective ties within 72 hours.	

Maintenance criteria for ties at track joints on following page.

TIE CRITERIA AT TRACK JOINTS:

To support train speed up to 25 m.p.h., track shall have one non-defective crosstie whose centerline is within 24" of each joint location. To support train speeds up to 50 m.p.h. (system speed limit), track shall have one non-defective crosstie within 18" of each joint location or, two non-defective crossties whose centerlines are within 24" either side of each joint location. Speed for track not meeting the criteria for 25 mph operation shall be restricted to 10 mph until conditions can be upgraded to meet the criteria to support higher speed.

For track constructed without crossties, such as concrete slab track, track with rails directly connected to bridge structural components or track over inspection/service pits, the track structure shall meet the requirements for gage in **T213.53**, track surface in **T213.63** and track alignment in **T213.55**.

T213.113 Defective Rails.

On the occasion where it is learned, through inspection or by other means, that a rail in track contains any of the defects listed in the following table, a MoW representative designated as a Qualified Person to inspect track shall determine whether or not trains may continue to operate over the track. If it is determined, upon personal inspection by a Qualified Person to inspect track, that the track may continue to support train operations, such operations are not permitted until:

- 1) The rail is replaced; or
- 2) The remedial action prescribed in the following tables is initiated as required.

DEFECTIVE RAILS AND REMEDIAL ACTION				
Defect	Defect Size (% of rail head cross section)		Until Defective Rail is replaced	
	From	To	Remedial action to be taken	Maximum Speed
Detected Transverse Defects in Non-control Cooled Rail and Transverse Fissure or Compound Fissure	0	99	Limit operating speed to –	10 mph
		100%	Visually inspect track after each supervised operation over rail.	3 mph

DEFECTIVE RAILS AND REMEDIAL ACTION				
(Continued)				
Defect	Defect Size (% of rail head cross section)		Until Defective Rail is replaced.	
	From	To	Remedial action to be taken.	
Maximum Speed				
	Detected Transverse Defects in Control Cooled Rail -or- Detail Fracture IMPORTANT (See note below on Detail Fractures) Defective Weld Engine Burn Fracture Broken Rail as a Result of Defects Listed Above	0	19	Apply joint bars defect within 20 days (omit middle bolt holes) Until joint bars are applied, limit speed to –
20		99	Apply joint bars to defect within 10 days (omit middle bolt holes) Until joint bars are applied, limit speed to –	10 mph
100%			Apply joint bars with two bolts on each side of defect Until the bars are installed, supervise train movements and limit speed to –	3 mph

Note:

Detail fractures developing from shelling or spalling condition at gage corner shall be treated as indicated in above table. DETAIL FRACTURES DEVELOPING IN WEB OF RAIL CALL FOR AN IMMEDIATE 10 MPH RESTRICTION TO REMAIN IN PLACE UNTIL THE DEFECTIVE RAIL IS REMOVED FROM TRACK.

DEFECTIVE RAILS AND REMEDIAL ACTION				
(Continued)				
Defect	Defect Size (In inches)		Until Defective Rail is replaced	
	From	To	Remedial action to be taken	Maximum Speed
Horizontal Split Head Vertical Split Head	0" – 2"		Inspect rail every 90 days for defect propagation	50 mph
	2" – 4"		Inspect rail every 30 days and limit speed to –	25 mph
	over 4"		Limit speed to –	10 mph
	break-out in rail head		Visually supervise each operation over rail	3 mph
Split Web Piped Rail Head & Web Separation	0" – ½"		Inspect rail every 90 days for defect propagation	50 mph
	½" – 3"		Inspect rail every 30 days and limit speed to –	25 mph
	over 3"		Limit speed to –	10 mph
	break-out in rail head		Visually supervise each operation over rail	3 mph
Bolt Hole Crack	0" – ½"		Inspect rail every 90 days for defect propagation	50 mph
	½" – 1-1/2"		Inspect rail every 30 days and limit speed to –	25 mph
	over 1-1/2"		Limit speed to –	10 mph
	break-out in rail head		Visually supervise each operation over rail and limit speed to --	3 mph

DEFECTIVE RAILS AND REMEDIAL ACTION (Continued)			
Broken Base	0" – 6"	Apply joint bars with two bolts on each side of defect and limit speed to -	25 mph
	over 6"	Replace rail	
Ordinary Broken Rail		Apply joint bars with two bolts on each side of break, speed after bars are installed to be –	50 mph
		Until joint bars are installed, supervise each operation over break and limit speed to –	3 mph
Damaged Rail	Apply joint bars to defect within 20 days, until bars are installed limit speed to – 25 mph		
	After installation of bars, limit speed to – 50 mph		

Notes:

- 1) Inspections called for in Defective Rail tables to be performed by personnel designated as a Qualified Person to inspect track.
- 2) Transverse defects, transverse and/or compound fissures can not be verified until rail is removed from track and fracture faces of the defect examined.
- 3) In temporarily repairing defects through the use of joint bars as prescribed in the Defective Rail tables, 6 hole bars are to be used and the middle 2 holes of the bar are not to be used nor is the rail to be drilled for the middle 2 holes.
- 4) It may not be possible to use conventional joint bars for temporary repair of a defective weld. The use of “bubble bars” is only permitted when conventional joint bars will not fit the rail web due to uncropped weld material. “Bubble bars” are an emergency repair only and constitute a RED-coded track condition. A speed restriction of 3 mph is required until a permanent repair has been made.
- 5) Defective rails and welds should be cut out of track using a rail saw. Torch cutting should not be done except under emergency circumstances. Torch cut rails must not be operated over at more than 10 m.p.h. and must be removed from track within 24 hours when in revenue service track.
- 6) The minimum length rail installed in track should be 18'. Field welds made in CWR shall be inspected for internal defects by a qualified inspector.

ADDITIONAL DEFECTIVE RAIL CONDITIONS AND REMEDIAL ACTION PRESCRIBED		
Condition	When a determination for replacement is made by personnel designated as a Qualified Person to inspect track:	When a determination is made by personnel designated as a Qualified Person to inspect track that replacement is not required at this time:
Shelly spots Head checks Engine burn (no fracture)	Limit speed to 25 and schedule rail replacement	Inspect rail for internal defects at intervals of at least once a year
Flaking Slivered Corrugations Corrosion	Limit speed to 25 mph and schedule rail for replacement	Inspect rail at intervals of at least once every 6 months

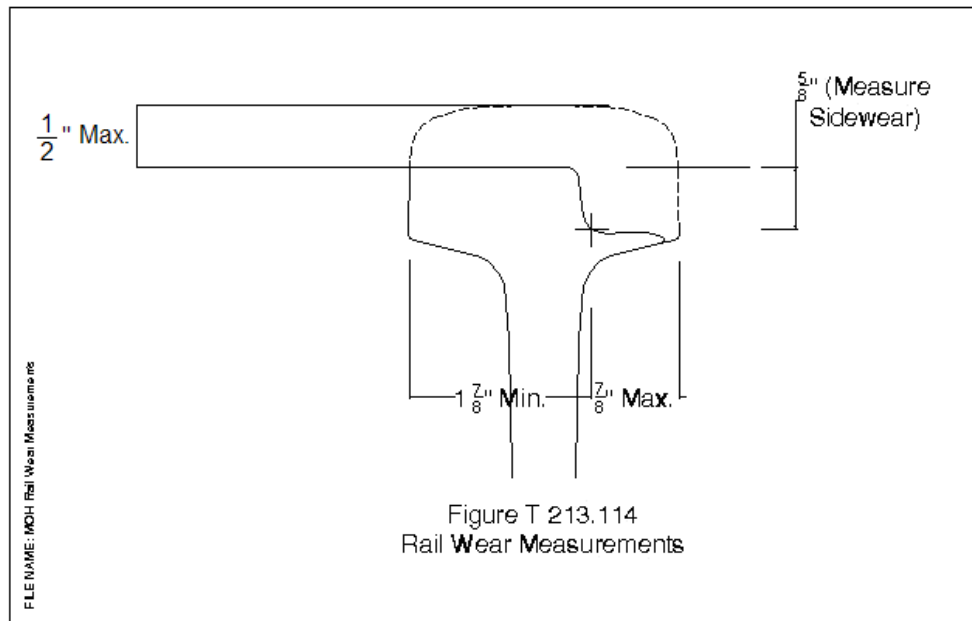
For definitions of defect conditions as outlined in **T213.113** on pages 14 through 20, refer to Appendix A.

T213.114 Rail Wear

For Section 115 RE:

Rail may remain in service until the horizontal head wear limit is reached. **The maximum amount of horizontal head wear (sidewear) allowable is 7/8"**. The resulting minimum amount of remaining rail head (measured as indicated in Figure T213.114) for rail in service is 1-7/8".

The maximum amount of vertical rail wear permissible is as shown in the diagram below.



RAIL WEAR MAINTENANCE LIMITS					
Response Action for Rail Wear Levels:					
Green		Yellow		Red	
Monitor conditions.		Restrict speed to 25 mph. Schedule renewal within 30 days.		Restrict speed to 10 mph. Remove or transpose rail within 72 hours	
Defect Description Measurement Parameters:					
Horizontal Head Wear (Sidewear)*			Vertical Rail Wear (Treadwear)		
Maintenance Thresholds					
Green	Yellow	Red	Green	Yellow	Red
1/2"	3/4"	>3/4"	3/8"	1/2"	>1/2"

T213.115 Rail End Mismatch.

Any mismatch of rails at joint locations may not be more than that prescribed in the following table. Mismatches can be due to different rail wear levels between two joined pieces of rail, rail-end batter on either or both rails or worn joint bars.

RAIL END MISMATCH MAINTENANCE LIMITS					
Response Action for Rail End Mismatch					
Green		Yellow		Red	
Monitor conditions. Notify supervisory personnel.		Restrict speed to 25 mph. Schedule repair to be done within 7 days.		Restrict speed to 10 mph. Repair within 48 hours.	
Defect Description Measurement Parameters					
Vertical Mismatch on the Tread of the Rail Ends			Horizontal Mismatch on the Gage Side of the Rail Ends		
Maintenance Thresholds					
Green	Yellow	Red	Green	Yellow	Red
1/8"	1/4"	3/8"	1/8"	3/16"	1/4"

T213.116 Restraining Rail.

DEFINITION: Head-hardened or fully heat-treated 132 RE rail mechanically fastened (bolted through the web) to the inside running rail of curves less than 1000' radius (typical installation) or to gage sides of both inside and outside rails of curves under 125' radius.

FUNCTION: Primary - to reduce rail wear to the outside rail of curves; secondary - to reduce the chance of wheel climb up the gage face and over the outside rail of curves.

Restraining rail is installed with a specified flangeway clearance (refer to **T213.53**) to the gage side of the running rail(s). The restraining face of the restraining rail(s) is toward the gage side of the running rail(s) and, when properly adjusted, maintains constant contact with the back of vehicle flange as trains travel through curves.

Restraining rail maintenance involves adjustment of the flangeway width and/or replacement of broken spacer block assembly components, particularly bolts and plate washers. Maintenance threshold limits for flangeway width are:

Green - +1/8", Yellow - +1/4" and Red - +3/8" (from original design width). Maintenance threshold limits for restraining rail bolt breakage are shown in the following table.

MAINTENANCE LIMITS FOR RESTRAINING RAIL BOLT BREAKAGE					
Response Action for Bolt Breakage					
Green Monitor breakage.		Yellow Restrict speed to 25 mph. Schedule bolt replacement within 7 days.		Red Restrict speed to 10 mph. Replace broken bolts within 24 hours.	
Defect Description – Measurement Parameters					
Consecutive Broken / loose or frozen Bolts			Total Broken Bolts in Any 39' of Track		
Maintenance Thresholds					
Green 2	Yellow 3	Red 4	Green 4	Yellow 5	Red 6

T213.119 Continuous Welded Rail (CWR).

Continuous welded rail is designated by the initials CWR in this section. CWR is defined as a group of 39' (usually or 78' rails welded together to form a rail “string”. By definition, a rail “string” of at least 400' in length is CWR. Track constructed with CWR strings is called “CWR track”.

CWR must be installed and adjusted in accordance with the Authority’s “*CWR Installation Guide and Track Buckling Countermeasures Policy*” (Book of Policies and Standard Operating Procedures). After installation of CWR, disturbance of the track structure should not take place at rail temperatures higher than the CWR installation or adjusted (de-stressed) installation temperature, except as provided in the aforementioned “*CWR Installation Guide and Track Buckling Countermeasures Policy*”.

T213.121 Rail Joints.

Bolted rail joints provide structural continuity by transferring lateral and vertical wheel loads between adjacent rails with no relative movement of abutting rail ends. Properly functioning joints permit longitudinal movement within the joint bars to accommodate expansion and contraction of rails due to thermal and/or mechanical stresses.

- a) Each rail joint, insulated joint and compromise joint shall be the proper design and dimensions for the rail section on which it is used.
- b) If a joint bar is cracked, broken or because of wear allows vertical movement of either rail when all bolts are tight, it must be replaced.
- c) If a joint bar is cracked or broken between the middle two bolt holes, it must be replaced.
- d) If both bars of a joint are cracked or broken between the middle two bolt holes or one of the bars is found to be broken completely through, a 10 mph speed restriction should be placed on the track until the bar(s) can be replaced.
- e) If both bars are found to be broken completely through between the middle two bolt holes, trains may operate over the joint only under the visual supervision of a MoW representative designated as a Qualified Person to inspect track until the bars are replaced.
- f) In conventional jointed revenue service track, each rail must be bolted with at least 2 bolts at each joint. Yard track joints must be bolted with at least one bolt on each rail.
- g) In CWR track, each rail must be bolted with at least 2 bolts at each bolted joint used to connect CWR strings or to connect CWR to conventional rail.
- h) When any of the conditions in f) or g) are not met, a speed restriction must be put in place until the condition is corrected.
- i) Each joint bar must be held in position by track bolts sized appropriately for the rail drilling – 1" bolts in 1-1/8" holes and 7/8" bolts in 1" holes. Bolts must be tightened sufficiently to provide adequate support for abutting rail

ends and to allow longitudinal movement of rails within the joint to accommodate expansion and contraction due to mechanical and thermal stresses.

j) No rail or joint bar having a torch cut hole should be used in revenue track. If, under emergency circumstances, it becomes necessary to burn a bolt hole in rail or reconfigure a joint bar by torch cutting (slotted holes), speed over the track must be restricted to 10 mph and the rail and/or joint bar removed from track within 24 hours.

Appropriate speed restrictions for the conditions indicated in f) and g) are as follows: for pull-aparts 2" or less associated with f) and g), the restriction shall be a maximum of 25 mph or less at the discretion of the Inspector (MoW representative designated as a Qualified Person to inspect track); for pull-aparts in excess of 2" associated with f) and g), the restriction shall be 10 mph and revenue service train operation only under the constant supervision of a Qualified Person to inspect track. Should the Inspector determine that the track is unsafe for passage of trains at any speed, the track should be taken out-of-service until repairs are made.

T213.122 Torch Cut Rail.

Except as a temporary repair in emergency situations, no rail having a torch cut end shall be permitted in revenue service track. When such a repair is necessary, speed over that track should be restricted to 10 mph and the torch cut rail removed from track within 24 hours. Torch cut rail in non-revenue service track should be inspected on a regular basis and removed from track within 30 days.

T213.123 Tie Plates.

Where timber crossties are used there shall be tie plates under the running rails on at least 9 out of any 10 consecutive ties.

T213.125 Rail Anchoring.

Longitudinal rail movement must be effectively controlled. Rail anchors (or elastic spring clip fasteners exerting a minimum nominal vertical force of 2000 lbs. each) must be applied to CWR track as outlined in The MoW Division Book of Policies and Standard Operating Procedures.

In jointed track, effective rail anchoring is provided by spring clip anchors in "Pandrol" type track construction. In track-spike type track construction, the recommended application of anchors is 8 anchors per 39' rail to resist longitudinal movement in the normal direction of traffic. Sufficient "backup" anchors should be provided to protect against reverse running traffic, normal temperature effects in the reverse direction and excessive joint pull apart in the event of a broken rail or failed joint.

T213.127 Rail Fastening Systems.

Rails shall be fastened by a system of components which effectively maintains gage within the limits prescribed by **T213.53**. Crossties, the minimum number of which is stipulated under **T213.109**, must have effective rail fasteners on both the gage and field sides of both rails. There shall not be more than 2 consecutive ties which do not have effective rail fasteners on both sides of both rails. Where elastic/resilient rail fasteners are used, they must meet the requirements for effective rail anchors *and* for effective track fasteners.

In slab track or in directly fixated track, at least 12 track fastener assemblies in curved track (<1000' R) and at least 9 track fastener assemblies on tangent track in any 39' of track must have effective rail fasteners on both sides of both rails. There shall be no more than 2 consecutive track fastener assemblies which do not have effective rail fasteners on both sides of both rails.

T213.129 Rail Shims.

If track geometry is out of compliance with the requirements set forth under Part C herein and the working of ballast is not possible due to weather or other natural conditions, rail shims may be used to temporarily correct the deficiencies. The shims must be removed, track resurfaced and the ties tamped to a solid bearing as soon as weather permits.

Shims must be installed directly beneath the tie plates on top of the ties. Tie plates should never be removed from ties as a means of adjusting the surface or cross level of track. The proper length track spike shall be used with shims corresponding with the shim thickness (6" up to 1" shim, 8" over 1" up to 2" shim). Special considerations, including restricted speed, must be made for shims over 2".

Shimmed track must be inspected on a greater frequency than that required for regular track. Special attention must be given to the gage holding and surface maintaining capabilities of the shims.

T213.133 Turnouts and Track Crossings.

- a) Fastenings in turnouts and track crossings must be kept tight and adjusted to keep track components securely in place and functional. All turnout components must be kept free of obstructions which might interfere with the passage of train wheels.
- b) Rail anchors (or elastic spring clip fasteners) must be installed through turnouts and crossovers and on each side of track crossings, switches, frogs and guard rails to restrain movement of rails which may affect the position of switch points and/or frogs.
- c) Flangeways through turnouts and track crossings must be a minimum of 1-1/2".

T213.135 Switches.

- a) Stock rails must be properly and securely seated within switch plates. Adjustable rail braces must not be overdriven so as to not to unseat the rail base, affect gage and cant the rail.
- b) Switch points must fit against stock rails properly with the switch thrown in either direction. Train wheels must be able to pass through switches without contacting the tip of switch points.
- c) The heel of each switch point must be secure, loose bolts tightened and missing bolts replaced.
- d) Chipped/worn switch points should be repaired or replaced according to the following schedule. Metal flow must be removed to ensure proper closure. In addition to the schedule below, gage criteria at **T213.53** and rail wear criteria at **T213.114** shall be observed in determining the wear limits of switch points. Actual gage = static gage measurement including switch point sidewear, measured 5/8" below the top of point, plus any dynamic movement of track due to lateral loading.

SCHEDULE OF SWITCH POINT MAINTENANCE CRITERIA

Immediately repair/replace a switch point and/or stock rail when:

- a. The switch point is chipped or worn 5/8" down from top of stock rail for a distance of 6" or more
- b. The switch point has an unprotected flat horizontal surface of 1/4" or more due to wear or fracturing
- c. There is a 1/8" or greater gap at the point of switch when the switch is fully thrown (closed)
- d. There is a gap between the switch point and stock rail greater than 3/8" at the #2, #3 or #4 rods
- e. There is 1/2" or more gage face wear on the stock rail within 5' of the point of switch

When a condition is discovered corresponding with a. through e. above, the switch shall be removed from service for facing point turnout moves until repairs are made or trains may be manually supervised ("walked through") at the discretion of the MoW Line Supervisor or Superintendent on site, based on their observations of train performance and their assessment of operational safety.

T213.136 Switch Cover Guards and Guarded Switch Points.

Cover guards (sometimes called “housetops”) and guarded, double switch points are designed to minimize wear to the curved, single switch points and to discourage wheel climb by a train making a turnout move. Cover guards are cast manganese steel while guarded, double switch points are rolled, heat-treated carbon steel.

1) Cover guards must be kept securely fastened to the chairs upon which they rest. Loose cover guard bolts should be tightened and missing or broken bolts replaced. Care must be taken to use the proper bolt length, bolts protruding more than minimally below the bottom of the cover guard may contact the switch point and prevent its proper throw.

2) Cover guard chairs must be kept securely fastened to the plates/ties upon which they sit. A “plow” bolt design of attaching the chair to plate has become the MBTA standard. It has replaced the previous designs in which 1) screw spikes fasten the chairs to plates and ties or 2) “through” bolts are used. Through bolts are connected to small bearing plates at the bottom of the tie. After a period of use, the older designs fail and the function of the cover guard is defeated. The cover guard lifts under the application of lateral loading imparted by train wheels and “rolls” away from the load. Switches with older design cover guard systems should be retrofit with the “plow” bolt design.

c) The contact face of cover guards should be restored to its original configuration by welding when it has worn 1/4". Care should be exercised in ensuring that the contact face of the cover guard matches well in a vertical plane to the restraining face of the attached 132# restraining rail. The rail may need to be welded and ground to achieve this match. Any weld should be “run out” in a minimum of 6" to provide a smooth transition. The nominal flangeway width between cover guard and gage line of stock rail is 1-7/8".

d) Double switch points are comprised of a length of 132# restraining rail and a length of 115# running rail. Both rails are milled and planed and then bolted together. **The design switch throw for HRT switches is 4-3/4"**. This dimension is critical with respect to the restraining capability of the double switch point. The dimension should be regularly checked at each switch and adjusted as necessary.

e) Double switch points are braced against lateral loading by switch stops. These stops are connected to switch plates in the same fashion as cover guard chairs. The plow bolt design should be used whenever possible. The restraining ability of the double switch is reduced with wear to the 132# side of the point. The point should be replaced when the wear exceeds 1/4". Replacement of the double point is generally necessary every other time the single, curved point is replaced.

T213.137 Frogs.

a) The flangeway depth of frogs, measured from a plane across the wheel-bearing area (straightedge on point and both wings), may not be less than 1-1/2".

b) Any frog point chipped, broken or worn 5/8" deep from the plane measured in T213.137 a) and *within 6" of the tip of the frog point* calls for a speed restriction of 6 mph max. over that frog.

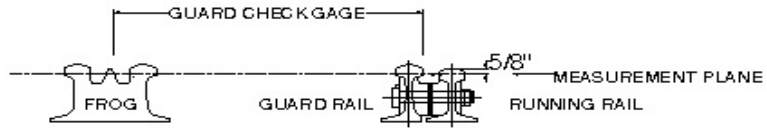
c) If the tread portion (wings) of a frog casting is worn down more than 3/8" below the original contour, operating speed over that frog is limited to 10 mph.

d) Grinding of “flowed metal” on frog points and wings at impact areas should be done *before* cracking occurs. This practice will prolong the life of frogs and help prevent breakouts. Battered frog points should be built up by welding *before* wings begin to show signs of batter.

e) Loose frog bolts should be tightened and missing/broken bolts replaced as a matter of routine maintenance. Frog fasteners should be maintained and plates should be checked during Switch Certification for signs of movement.

T213.143 Frog Guard Check Gage.

The diagram and table on the next page indicates guard check gage measurement criteria.



FROG GUARD CHECK GAGE
Scale: 1 1/2" = 1'-0"

HRT GUARD CHECK GAGE	
Maintenance Threshold	Response Action
Green 54-1/2" - 55"	No action required.
Red <54-1/2" or >55"	Restrict at 5 mph, repair immediately.

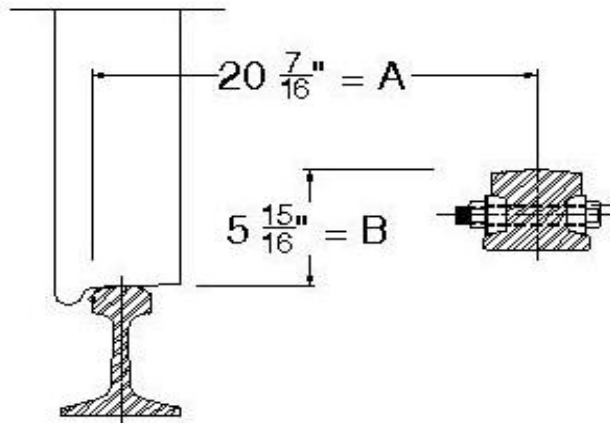
PART E – TRACK APPLIANCES AND CONTACT RAIL APPURTENANCES

T213.201 Scope.

This part prescribes minimum requirements for certain track appliances and third rail related devices.

T213.202 Contact Rail.

Ideal horizontal and vertical dimensions of contact (third) rail are as indicated in the diagram below. Maximum gage variation allowed (otherwise referred to as maintenance limits) is shown below the diagram.



THIRD RAIL GAGE VARIATION MAINTENANCE LIMITS

“A” Minimum = 19-15/16” “A” Maximum = 20-15/16”
 “B” Minimum = 5-7/16” “B” Maximum = 6-7/16”

During routine track inspection, the third rail must be inspected for unusual/abnormal collector shoe contact on head of rail. Very narrow, off-center or very wide wear is an indication that: a) the rail is out of gage due to insulator problems, insulator bracket problems, mis-seated or worn rail or other deficiencies which may need immediate repair. Any unusual wear pattern noted should be brought to the prompt attention of the Section Foreman and/or Supervisor. Track inspectors need to be aware of the propensity for cracked or broken thermite welds in 150# rail. These welds are non-structural, were designed for maximum electrical conductivity and are susceptible to fracture from rail handling during track maintenance activity and from thermal stresses during temperature extremes.

Malfunctioning third rail end approaches (risers, runoffs) are sources of major problems. Misalignment of end approaches, broken/missing insulators under end approaches and defective end approach splice bars are defects which, left unrepaired, have the potential to stop train operations and cause severe damage to trains and track alike. As with the aforementioned third rail anomalies, end approach problems should be brought to the immediate attention of supervisory personnel.

T213.203 Third Rail Insulators and Anchors.

Third rail insulators position the contact rail relative to train collector shoes, support the contact rail and prevent electrical current from the contact rail from traveling to ground. Defective insulators should be replaced as soon as is practically possible. **Immediate corrective action must be initiated if 2 consecutive insulators are defective or any insulator supporting an end approach is defective.**

Insulator support brackets on concrete ties must be inspected to ensure the integrity of the track structure. Bolts which have pulled out of the ends of duo-block ties or tops of mono-block ties must be tightened. In situations where bolts cannot be tightened or replaced due to damage to the female insert within the tie, the concrete tie should be removed from track and replaced with a wooden cross-tie with an insulator lagged to the tie.

Third rail anchors must be maintained in a functional state at all times. Anchors should be inspected to ensure that welded or bolted connections to the third rail are intact, insulated anchor arms (including clevises and cotter pins) are not defective and base angles are properly connected to the tie(s) upon which they sit.

T213.204 WEZE (Impedance) Bonds and Cable Leads.

In the course of routine track inspection, it is important that the condition of WEZE bonds and the cable connections to the running rails is checked. Although the bonds are the responsibility of the Signal Division, damage from hanging train equipment or track maintenance should be brought to the attention of supervisory personnel. Special attention should be given to the cable leads. If the insulation on the cables is damaged or the cable appears to be crushed or broken, it should be noted. Most importantly, cable connections to the running rail web should be inspected. The cadwelded connection at this location is a common site of rail defects which typically develop internally. As such, they are not detectable by eye. However, often the defects develop into cracks in the web which, if not detected, can become broken rails. Generally the break happens suddenly when the rail is subjected to a concentrated impact load such as from a flat wheel. Any unusual condition should be brought to the attention of supervisory personnel. The location of disconnected leads should be noted on the track inspection report.

T213.205 Derails.

Each derail in track must be kept clearly visible at all times. Derails must be locked when not in use. Derails found unlocked must be reported to the appropriate Dispatcher immediately. Derails must be maintained in a condition which would prevent them from being operated without removing the lock.

PART F – INSPECTION

T213.231 Scope.

This section prescribes MBTA requirements for the frequency and nature of HRT track inspection. Track inspection at the MBTA is regulated by the Commonwealth of Massachusetts' Department of Public Utilities. DPU regulations can be found in the MoW Division Book of Policies and Standard Operating Procedures.

T213.233 Track Inspections.

1) Frequency:

a) All HRT track must be inspected a minimum of once per week, yard track included, with at least three calendar days interval between inspections. This minimum inspectional frequency applies only to track which is used less than once a week.

b) All regularly operated HRT track, both yard and revenue including all switches, turnouts and track crossings, is to be inspected twice per week with at least one calendar day interval between inspections.

c) In addition, any track undergoing or awaiting repair upon which a speed restriction is assigned shall be inspected at a frequency which will ensure safe operations at all times.

d) Each switch, turnout and track crossing must be inspected on foot at least monthly. In the case of track which is used less than once a month, each switch, turnout and track crossing must be inspected before it is used.

e) In the event of fire, flood, severe storm or other occurrence which might have damaged the track structure, a special inspection must be made of the track involved as soon as possible after the occurrence.

f) The DPU may require inspections at more frequent intervals in areas of dense traffic, high operating speeds or questionable physical conditions.

2) Qualifications: the MBTA shall designate qualified persons to inspect track for defects. Each person so designated must have:

A) Experience/Education –

a) At least one year experience in track inspection, or

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

B) Ability to –

a) Understand inspection requirements;

b) Detect deviations from the inspection requirements;

c) Prescribe appropriate remedial action to correct or safely compensate for deviations; and

d) Procure written authorization from the MBTA to prescribe remedial actions to correct or safely compensate for any deviations from the inspection requirements pending review by a qualified person designated under DPU regulations 220 C.M.R. 151.08(4)(a).

3) Inspections: each inspection must be made on foot or riding over the track in a vehicle at a speed that allows the person making the inspection to visually inspect the track structure for compliance with the DPU regulations and the Standards set forth herein. Mechanical, electrical and other track inspection devices may be used to supplement visual inspection. If a vehicle is used for visual inspection, the speed of the vehicle may not be more than 5 mph when passing over grade crossings or special trackwork.

T213.235 Switch Certification.

In addition to the inspection schedule outlined in **T213.233(1)**, all turnouts at the MBTA are subject to inspection under the System Certification process. This process directs that all revenue service turnouts are thoroughly inspected on a quarterly basis. Non-revenue turnouts are subject to System Certification inspection on a four-month cycle. During the System Certification inspection, a series of specific measurements is taken and recorded to ensure that the turnout is in compliance with the Standards. Records of System Certification are maintained at Line headquarters.

T213.237 Inspection of rail.

In addition to the inspection schedule outlined in **T213.233**(1), the DPU requires that at least once a year a continuous search for internal rail defects (ultrasonic and/or induction testing) must be made of all rail in all revenue service track.

Inspection equipment must be capable of detecting defects between the joint bars, in the area of the rail enclosed by joint bars.

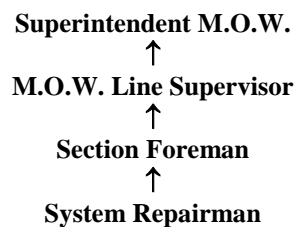
Each defective rail must be marked with highly visible marking on both sides of the web and base.

T213.241 Inspection records.

A written record of each track and/or rail inspection required to be performed shall be kept on file. The MBTA is required by the DPU to designate a location where the original record of each track inspection shall be maintained for at least one year after the date of the inspection. Original records of inspections for internal rail defects must be retained for at least two years after the date of the inspection and for one additional year after remedial action is taken. Complete details of inspection requirements can be found in the DPU regulations under Section 151.08(5)

T213.243 Duties and Responsibilities of Supervisors, Section Foremen and System Repairpersons.

The organizational reporting structure of the M.O.W. Division is as shown below:



The *Superintendent M.O.W.* oversees the activities of a Supervisor or Supervisors. The Superintendent is responsible for planning and policy making decisions.

The *M.O.W. Line Supervisor* generally is assigned to one of the four transit lines (Blue, Orange, Red or Green) and is responsible for all track/M.O.W. related issues on that line. From an inspectional standpoint, the Supv. monitors and maintains records of daily, every other monthly and bi-annual track and turnout inspections. The Supervisor must personally inspect every turnout and special trackwork location in his/her territory twice a year. Records of these inspections shall be maintained under **T213.241**.

Section Foremen are assigned a territory for which they assume responsibility for the activities of all System Repairmen (track inspectors) in that territory. The System Certification process is the direct responsibility of the Section Foreman. The Section Foreman must ensure that all track inspection and System Certification documentation is correctly completed in a timely fashion. The Section Foreman is responsible for bringing to the attention of the Line Supervisor track deficiencies noted on daily inspectional reports or discovered by him/her during System Certification.

System Repairpersons or Track Inspectors are the individuals who perform vital inspectional functions on a daily basis. System Repairpersons should not just walk track, but must be able to recognize exceptions to the Track Maintenance Standards. System Repairpersons are responsible for daily track inspection forms and must communicate any abnormalities or exceptions to the Track Maintenance Standards to their Section Foreman and/or Supervisor. System Repairpersons must be qualified per DPU regulations under Section 151.08(4)(b).

T213.245 Ancillary Responsibilities.

All employees, while on track, must be aware of and report any potentially dangerous or hazardous condition. Examples of such conditions are: fallen or loose materials from structures or buildings, downed or damaged R.O.W. fencing, washouts, catenary problems, graffiti, damaged or obstructed wayside signals or signs, etc. Any condition, which in the estimation of an individual qualified under **T213.7**, could cause damage to a train, its occupants or other personnel on track, must be addressed immediately. Response includes notification of the appropriate train dispatcher, the Maintenance Control Center and a supervisory person responsible for the line upon which the situation exists. The individual discovering the problem must remain on scene directing trains past the problem (if passage is possible) until relieved or until the problem is corrected.

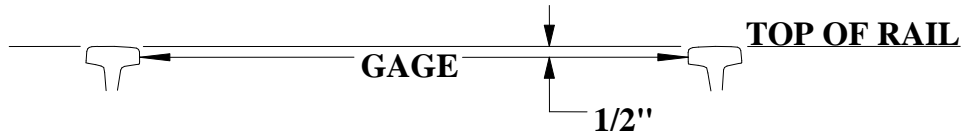
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Appendix A

Gage Maintenance Criteria for Mattapan Line.

For Tee Rail Sections Only (85 ASCE and 115 RE)

For track on the Mattapan Line and also on the Green Line, gage is measured between the heads of the rails at right angles to the rails in a plane one half of an inch (1/2") below the tops of the railheads.



GAGE MEASUREMENT FOR MATTAPAN LINE TRACK

When measuring track gage, the gage dimension is the *total* of the actual distance measured plus any apparent rail movement caused by train loading and/or any sidewear to the rail(s). As gage is measured 1/2" below the tops of the railheads, sidewear to the rails is also measured 1/2" below the tops of the railheads.

<p>Minimum track gage in Mattapan Line track is 56-1/8" (loaded condition). Train operation over track at gage less than 56-1/8" may be manually supervised (walked through) at the discretion of the M.O.W. Line Supervisor or Superintendent on site, based on their observations of train performance and their assessment of operational safety.</p>		
<p>MAXIMUM GAGE LIMITS FOR MATTAPAN LINE TEE RAIL TRACK</p>		
Track Configuration	Design Gage	Maintenance Threshold Limits Response Actions
Tangent and curves greater than or equal to 1000' Radius	56-1/2"	<p>Yellow = 57-1/8" – Restrict speed to 20 mph. Repair within 30 days.</p> <p>Red = 57-3/8" – Restrict speed to 6 mph. Repair within 72 hours.</p>
Curves less than 1000' Radius (excluding switches)	56-7/8"	<p>Yellow = 57-3/8" – Restrict speed to 20 mph. Repair within 30 days.</p> <p>Red = 57-5/8" – Restrict speed to 6 mph. Repair within 72 hours.</p>

MAXIMUM GAGE LIMITS FOR MATTAPAN LINE TEE RAIL TRACK (Continued) <u>Special Trackwork Criteria</u>			
Track Configuration	Design Gage	Maintenance Threshold Limits	Response Actions
Guarded switches over 100' Radius	56-7/8" curved side 56-1/2" straight side	Yellow = 57-3/8" - Red = 57-5/8" Yellow = 57-1/4" - Red = 57-1/2"	Yellow – Restrict speed to 10 mph. Repair before Red limit is reached.
Guarded switches 100' Radius or less	57" curved side 56-1/2" straight side	Yellow = 57-1/2" - Red = 57-3/4" Yellow = 57-1/4" - Red = 57-1/2"	Red – Supervise operations through switch until repairs are completed.
<p>Flangeway at cover guard to be 1-5/8"* (to gage line of double switch point thrown for straight move). Flangeway throughout rest of turnout to be 1-5/8" except one-piece guard rails opposite frogs that have flangeway of 1-3/8". Remedial flangeway work to be initiated at 1-7/8"** in turnouts. Refer to LRT213.143 for guard check criteria.</p> <p>* = Flangeway of 1-1/2" in turnouts 100'R or less. Flangeway may be reduced to 1-1/4" in special circumstances where wheel climb at outside switch point is an issue due to geometric design constraints of the turnout.</p> <p>** = Remedial flangeway work to be initiated at 1-3/4" through cover guard and 1-7/8" throughout rest of turnout in turnouts 100'R or less. Where flangeway opening has been reduced below typical, remedial work is to be initiated at 1/4" greater than original flangeway opening.</p>			
Track Configuration	Design Gage	Maintenance Threshold Limits and Response Actions	
Rail crossings (diamonds) with curves equal to or less than 100' Radius*	56-3/4" curved 56-1/2" straight	Yellow = 57-1/4" – Restrict speed to 10 mph. Repair before Red limit is reached. Red = 57-1/2" – Supervise operations through crossing until repairs have been completed.	
Rail crossings (diamonds) with curves greater than 100' Radius**	56-7/8" curved 56-1/2" straight	Yellow = 57-1/4" – Restrict speed to 10 mph. Repair before Red limit is reached. Red = 57-1/2" – Supervise operations through crossing until repairs have been completed.	
<p>* = Flangeways on curved side of crossing to be 1-1/2" throughout, both inside and out; flangeways on straight side to be 1-3/8" throughout, both inside and out.</p> <p>** = Flangeways on curved side of crossing to be 1-1/2" through frog castings inside rail, 1-5/8" through frog castings outside rail and 1-5/8" elsewhere, both inside and out. Flangeways on straight side to be 1-3/8" throughout, both inside and out.</p>			

Appendix B

Commonwealth of Massachusetts Regulations

CMR 151.11 Track Inspection

CMR 151.12 Track Maintenance

(Pages 35 through 39)

151.11: Track Inspection.

(1) Inspections.

(a) All inspections must be made according to the schedule set out in 220 CMR 151.11(2), by a person designated under 220 CMR 151.11(4).

(b) Each inspection must be made on foot or by riding over the track in a vehicle at a speed that allows the person making the inspection to visually inspect the track structure for compliance with 220 CMR 151.00. However, mechanical, electrical and other track inspection devices may be used to supplement visual inspection. If a vehicle is used for visual inspection, the speed of the vehicle may not be more than five miles per hour when passing over track crossings, highway crossings or turnouts.

(c) If the person making the inspection finds a deviation from the inspection requirements the inspector shall immediately initiate remedial action.

(2) Schedule for Track Inspection.

(a) Each track inspection must be made according to the following schedule:

TYPE OF TRACK	REQUIRED FREQUENCY
Light Rail Passenger-service Track	Three times per week with at least one calendar day interval between inspections
Light Rail Yard and Storage Track Heavy Rail Yard and Storage Track	Weekly with at least three calendar days interval between inspections, or before use, if track is used less than once a week.
Heavy Rail Passenger-service Track	Twice weekly with at least one calendar day interval between inspections.

(b) In addition to 220 CMR 151.11(2)(a), any track undergoing or awaiting repair that has a speed restriction placed on it shall be inspected at a frequency that will insure safe operations at all times.

(c) Each switch, turnout, and track crossing must be inspected on foot at least weekly. In the case of track that is used less than once a week, each switch, turnout and track crossing must be inspected before it is used.

(d) In the event of fire, flood, severe storm, or other occurrence which might have damaged track structure, a special inspection must be made of the track involved as soon as possible after the occurrence.

(e) The Department of Telecommunications and Energy may require inspections at more frequent intervals in areas of dense traffic, high operating speed or questionable physical conditions.

(3) Schedule for Rail Inspection.

- (a) In addition to 220 CMR 151.11(2)(a), at least once a year a continuous search for internal rail defects must be made of all rail in all passenger-service track.
- (b) Inspection equipment, including ultrasonic rail testing equipment, must be capable of detecting defects between joint bars, in the area enclosed by joint bars.
- (c) Each defective rail must be marked with highly visible marking on both sides of the web and base.

(4) Personnel.

- (a) The Transportation Authority shall designate qualified persons to supervise restorations and renewals of track under traffic conditions. Each person designated must have:
 - 1. Experience/Education
 - a. One year of supervisory experience in railroad track maintenance, or
 - b. A combination of supervisory experience in track maintenance and training from a course in track maintenance, or
 - c. A college level educational program related to track maintenance.
 - 2. Ability to:
 - a. Understand inspection requirements
 - b. Detect deviations from the inspection requirements
 - c. Prescribe appropriate remedial action to correct or safely compensate for deviations
 - d. Procure written authorization from the Transportation Authority to prescribe remedial actions to correct or safely compensate for any deviations from the inspection requirements.
- (b) The Transportation Authority shall designate qualified persons to inspect track for defects. Each person designated must have:
 - 1. Experience/Education
 - a. At least one year of experience in track inspection, or
 - b. A combination of experience in track inspection and in-house training from a course in track inspection.
 - 2. Ability to:
 - a. Understand inspection requirements
 - b. Detect deviations from the inspection requirements
 - c. Prescribe appropriate remedial action to correct or safely compensate for deviations
 - d. Procure written authorization from the Transportation Authority to prescribe remedial actions to correct or safely compensate for any deviations from the inspection requirements pending review by a qualified person designated under 220 CMR 151.11(4)(a).
- (c) Personnel Records of designees under 220 CMR151.11(4)(a) and (b)

shall show:

1. The basis for each designation
2. Records must be kept available for inspection or copying by the Department of Telecommunications and Energy.

(5) Records/Reports.

- (a) The Transportation Authority shall keep a record of each track and rail inspection required to be performed; and such record shall identify the designee who performed the inspection.
- (b) The Transportation Authority shall designate a location where each original record shall be maintained for at least one year after the track inspection covered by the track inspection record. The Transportation Authority shall retain a rail inspection record for at least two years after the rail inspection and for one additional year after remedial action is taken.
- (c) Track Inspection Records and Rail Inspection Records shall be:
 1. Prepared on the day the inspection is made
 2. Signed by the person making the inspection.
- (d) Inspection Records must specify:
 1. The track or rail inspected
 2. The date of inspection
 3. Location of any deviation
 4. Nature of any deviation from the established track standards
 5. Remedial action taken by the person making the inspection.
- (e) Records must be kept available for inspection or copying by the Department of Telecommunications and Energy.

151.12: Track Maintenance.

- (1) Unless otherwise structurally supported, all track must be supported by ballast material which will:
 - (a) Transmit and distribute the load of the track and railroad rolling equipment to the subgrade
 - (b) Restrain the track laterally, longitudinally, and vertically under dynamic loads imposed by railroad rolling equipment and thermal stress exerted by the rails
 - (c) Provide adequate drainage for the track
 - (d) Maintain proper track crosslevel, surface, and alignment.
- (2) Crossties shall be made of a material to which rail can be securely fastened.
 - (a) Each 39-foot segment of track shall have a sufficient number of crossties which in combination provide effective support that will maintain gage, surface, and alignment.
 - (b) The minimum number and type of crossties specified in 220 CMR 151.12(3) effectively distributed to support the entire segment; and at least one crosstie of the type specified in 220 CMR 151.12(3) that is located at a joint

location.

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

MAXIMUM TRACK SPEED	MINIMUM NUMBER OF TIES	
	Tangent Track*	Curved Track**
15 miles per hour	5	6
25 miles per hour	8	9
60 miles per hour	8	10

* Track that is straight or has a radius curve greater than 1000 feet.
 ** Track having a radius curve measuring less than 1000 feet.

Crossties required shall be of the type which are not:

- (a) Broken through
- (b) Split or otherwise impaired to the extent the crossties will allow the ballast to work through, or will not hold spikes or rail fasteners
- (c) So deteriorated that the tie plate or base of rail can move laterally two inches relative to the crossties, or
- (d) Cut by the tie plate (or rail base) through more than 15% (nominally 1 1/8") of a tie's thickness.
- (e) For track constructed without crossties, such as slab track, track connected directly to bridge structural components and track over servicing pits, the track structure must meet the requirements of 220 CMR 151.12(3) in regards to gage restraint, rail support, surface and alignment.

- (4) Gage is measured between the heads of the rails at right-angles to the rails in a plane 5/8 of an inch below the top of the rail head.

- (5) Gage must be within the limits prescribed in the following table:

MAXIMUM TRACK SPEED	MINIMUM TRACK GAGE	MAXIMUM TRACK GAGE
10 miles per hour	56"	58"
60 miles per hour	56"	57 3/4"

- (6) Each rail joint, insulated joint, and compromise joint must be of the proper design and dimensions for the rail on which it is applied.

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

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

(9) In the case of conventional jointed rail in passenger-service track, each rail must be bolted with at least two bolts at each joint. Yard and storage track joints must be bolted with at least one bolt on each rail.

(10) In the case of continuous welded rail (CWR) track, each rail must be bolted with at least two bolts at each joint used to connect CWR strings or to connect CWR to conventional rail.

(11) Each joint bar must be held in position by track bolts tightened to allow the joint bar to firmly support the abutting rail ends and to allow longitudinal movement of the rail in the joint to accommodate expansion and contraction due to temperature variations.

(12) When any condition in 220 CMR 151.12(9) and (10) is not satisfied, an operating restriction must be put in place immediately until the condition is satisfied. The Transportation Authority shall notify the Director of the Transportation Division of the Department of Telecommunications and Energy of the imposition or removal of an operating restriction within 48 hours of said action.

REGULATORY AUTHORITY

220 CMR 151.00: 49 U.S.C. 5330, 49 C.F.R. 659, M.G.L. c. 161A, § 3(i).

Appendix C

Definitions of Defective Rail Conditions

- a) **“Transverse Fissure”** is a progressive crosswise fracture starting from a crystalline center or nucleus inside the head from which it spreads outward as a smooth, bright or dark, round or oval surface substantially at a right angle to the length of the rail. The distinguishing features of a transverse fissure from other types of fractures or defects are the crystalline center or nucleus and the nearly smooth surface of the development which surrounds it.
- b) **“Compound fissure”** is a progressive fracture originating in a horizontal split head which turns up or down in the head of the rail as a smooth, bright or dark surface progressing until substantially at a right angle to the length of the rail. Compound fissures require examination of both faces of the fracture to locate the horizontal split head from which they originate.
- c) **“Horizontal split head”** means a horizontal progressive defect originating inside of the rail head, usually 1/4" or more below the running surface and progressing horizontally in all directions, and generally accompanied by a flat spot on the running surface. The defect appears as a crack lengthwise of the rail when it reaches the side of the rail head.
- d) **“Vertical split head”** is a vertical split through or near the middle of the head, and extending into or through it. A crack or rust streak may show under the head close to the web or pieces may be split off the side of the head.
- e) **“Split web”** is a lengthwise crack along the side of the web and extending into or through it.
- f) **“Piped rail”** is a vertical split in a rail, usually in the web, caused by failure of the shrinkage cavity in the steel ingot to unite in rolling.
- g) **“Broken base”** is any break, fracture, etc. in the base of the rail.
- h) **“Detail fracture”** is a progressive fracture originating at or near the surface of the rail head. These fractures should not be confused with transverse fissures, compound fissures or other defects which have internal origins. Detail fractures may arise from shelly spots, head checks or flaking.
- i) **“Engine burn fracture”** is a progressive fracture originating where train wheels have “spun” on the running surface of the rail head. In developing downward through the head, they frequently resemble the compound and/or transverse fissures with which they should never be confused or classified.
- j) **“Ordinary break”** is a partial or complete break in which there is no sign of a fissure and in which none of the other defects described in this Appendix are found.
- k) **“Damaged rail”** is any rail broken or rendered unfit for service in track as a result of derailments, by broken or flat wheels or by any other cause except internal defects.
- l) **“Shelly spots”** is a condition where a thin (usually 3/8" in depth or less) shell-like piece of surface metal becomes separated from the parent metal in the rail head, usually at the gage corner.

“Shelly spots” may be evidenced by a black spot appearing on the rail head over the zone of separation or a piece of metal breaking out completely, leaving a shallow cavity in the rail head. In the case of a small “shell” there may be no surface evidence, the existence of the “shell” only becoming apparent after the surface metal becomes discolored or breaks out.

m) **“Head checks”** are hair line cracks which appear at the gage corner of the rail head, at any angle to the length of the rail. Even when not readily visible, “head checks” can be felt and are distinguishable by the raspy feeling of the sharp edges.

n) **“Flaking”** is small, very thin flakes of surface metal generally not more than 1/4" in length or width. “Flaking” usually occurs at the gage corner of the rail head.

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