Metro-North Railroad

TRACK DEPARTMENT MW-4

METRO-NORTH RAILROAD RECOMMENDED PRACTICE FOR THE INSPECTION, MAINTENANCE AND CONSTRUCTION OF TRACK

Office of The Assistant Vice President -
Maintenance of Way
Metro-North Railroad
Engineering Department
420 Lexington Ave.
New York, New York 10017

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Office of The Assistant Vice President -
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THE USE OF THE MNR MW-4

The MW-4 is written for use by MNR Maintenance of Way forces in the inspection, maintenance and construction of track and associated trackwork components. Materials presented in this handbook establish and define MNR recommended practice. These practices have been developed to meet the needs of the Railroad and may be used exactly as presented or be modified as is necessary and desirable to meet the present and future needs of MNR. Other practices may be found to be equally acceptable and, as a result, the materials contained in the MW-4 may be modified to promote the understanding of and efficiency and economy of inspection, maintenance, construction and location of the MNR.

The MW-4 has three parts:

Part I Recommended Practice for the Inspection and Restoration of Track, Special Trackwork and Miter Rails

Part II Recommended Practice for the Maintenance of Track, Special Trackwork and Miter Rails

Part III Recommended Practice for the Construction of Track, Special Trackwork and Miter Rails

The limits in Part I are those generally found in Part 213, Track Safety Standards, Subpart A to F, as given in the U.S. Department of Transportation, Code of Federal Regulations, provided by the Federal Railroad Administration – Office of Safety.

In all cases inspection and the restoration of track in Part I must be performed in accordance with FRA Part 213, Track Safety Standards.

It should be understood that Parts II and III provide the latest recommended practices approved by the Assistant Vice President - Maintenance of Way of Metro-North Railroad and are subject to revisions as new technology and improved techniques are established.

The limits in Parts II and III are unique and are intended to supersede the inspection and restoration limits given in Part I. For example, the track gage limits given in Parts II and III are more restrictive than the track gage limits found in Part I.

Track maintenance limits and recommended practices in Part II are to be used for everyday maintenance activities. The limits act as a triggering mechanism to prompt the maintenance or reconstruction of track. Wherever possible, track shall be maintained so that the track structure does not fall to minimum track maintenance limits established in Part II.

Track construction limits found in Part III are more restrictive than the inspection and maintenance limits. These limits are to be used when constructing track, and if possible, when performing track maintenance.

When maintaining track it may not be possible to reach construction limits because of the condition of the track material and track structure being repaired.

In all cases, MNR Maintenance of Way forces will strive to restore track, make track repairs, maintain track and construct track at or above the respective limits given in Parts II and III.

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Part or Appendix

Metro-North Railroad

PART I

RECOMMENDED PRACTICE FOR THE INSPECTION AND RESTORATION OF TRACK, SPECIAL TRACKWORK AND MITER RAILS

(Includes FRA Track Safety Standards Part 213)

SUBPARTS A–F

RECOMMENDED PRACTICE FOR THE INSPECTION AND RESTORATION OF TRACK

(Includes FRA Track Safety Standards Part 213)

RECOMMENDED PRACTICE FOR THE INSPECTION AND RESTORATION OF TRACK SUBPARTS A-F

Subparts A—F
Track Classes 1-5

Subpart A — General

§213.1 Scope

(a) Inspection limits are limits, when exceeded, would require the immediate repair of track, slow orders on the track, removal of the track from service, or operation of the track under the authority of a person designated in Part I, §213.7(a).

(b) It is the desire of the MNR to have track that never reaches these limits.

(c) Subparts A through F of Part I apply to Track Classes 1-5 with operating speeds for passenger equipment to 90 MPH and operating speeds for freight equipment to 50 MPH (MNR maximum authorized speed (MAS)).

(d) The Inspection subpart prescribes minimum inspection requirements and limits for control of the condition of tracks, owned or leased, that are maintained by the MNR.

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

§213.2 Preemptive Effect

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

§213.3 Application

(a) Except as provided in paragraph (b) below, this subpart applies to all tracks maintained by MNR.

(b) This part does not apply to track -

    (1) Located inside an installation which is not part of the general railroad system of transportation; or

    (2) Used exclusively for rapid transit operations in an urban area that are not connected with the general railroad system of transportation.

§213.4 Excepted Track

As a standard practice, MNR does not have or allow excepted track.

§213.5 Responsibility for Compliance

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

(1) Bring the track into compliance;

(2) Halt operations over that track; or

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

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

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

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

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

(4) A precise identification of the track;

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

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

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

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

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

§213.6 Protection (MNR)

(a) Protection shall be provided for any track that is considered not satisfactory for the passage of trains at the MAS. Protection will be provided in accordance with Part I, §213.5(a)(1)(2)(3) and with the appropriate notification to the Rail Traffic Controller (R.T.C.).

(b) The placement of temporary speed signs is given in Appendix E.

§213.7 Designation of Qualified Persons to Supervise Certain Renewals and Inspect Track

(a) Competent persons shall be designated to supervise maintenance, restorations and renewals of track under traffic conditions. Each person designated by MNR must have -

(1) At least:

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

(ii) A combination of supervisory experience in track maintenance and training from an approved course in track maintenance, or from a college educational program related to track maintenance.

(2) Demonstrated to MNR that they:

(i) Know and understand the requirements of this part; and

(ii) Can detect deviations from those requirements; and

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

(3) Written authority to prescribe remedial actions to correct or safely compensate for deviations from the requirements of this Part.

(b) Competent persons shall be designated to inspect track for deviations and defects. Each person designated by MNR must have -

(1) At least:

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

(ii) A combination of experience in track inspection and training from a course in track inspection, prescribed by MNR or from a college level educational program related to track inspection.

(2) Demonstrated to MNR that they:

(i) Know and understand the requirements of this Part;

(ii) Can detect deviations from those requirements; and

(iii) Can prescribe appropriate remedial action to correct or safely compensate for deviations from the requirements of this Part, pending review by a person designated under paragraph (a) of this section.

(3) Written authorization to prescribe remedial actions to correct or safely compensate for deviations from the requirements of this Part.

(c) With respect to designations under paragraphs (a) and (b) of this section, written records must be maintained of:

(1) Each designation in effect;

(2) The basis for each designation; and

(3) Track inspections made by designated persons as required by Part I, §213.241. These records must be kept available for inspection or copying by the Federal Railroad Administration (FRA) during regular business hours.

§213.9 Classes of Track: Operating Speed Limits

(a) Maximum allowable operating speeds for designated classes of track are:

Over track that meets all of the requirements prescribed in this Part for:	The maximum allowable operating speed for freight trains (MPH):	The maximum allowable operating speed for passenger trains (MPH):
Class 1 track	10	15
Class 2 track	25	30
Class 3 track	40	60
Class 4 track	50*	80
Class 5 track	50*	90

*Maximum authorized speed (MAS) of 50 MPH for freight trains is designated by timetable.

Passenger train speeds are designated as (PAS).
Freight train speeds are designated as (FRT).

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

(c) Maximum operating speeds will be designated by the Assistant Vice President - Maintenance of Way.

§213.11 Restoration or Renewal of Track Under Traffic Conditions

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

§213.13 Measuring Track Not Under Load

When unloaded track is measured to determine compliance with requirements of Part I of the MW-4, the amount of rail movement, if any, that occurs while the track is loaded must be added to the measurements of the unloaded track.

§213.15 Penalties

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

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

§213.17 Waivers

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

(b) Each petition for a waiver under this section shall be filed in the manner and contain the information required by part 211 of this chapter.

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

§213.18 Quality Control

(a) It is the policy of the MNR Engineering Department to provide complete and timely track inspection reports which appropriately describes the condition of track.

(b) The Foreman-Track Patrol is responsible for the overall quality and completeness of the inspection performed and the inspection report prepared.

(c) Track inspections shall be performed in accordance with the MW-4 Part I, §213.233.

(d) The Track Supervisor or Assistant Supervisor-Track shall review all track inspections and conduct track inspection audits to ensure quality, consistency and adherence to MNR Engineering Practices.

(e) Track inspection reports that are reviewed and found deficient shall be brought to the attention of the individual(s) making the inspection.

(f) The Track Supervisor or Engineer of Track Maintenance shall provide necessary guidance and direction to correct any deficiencies noted in MNR track inspection reports.

(g) The Track Supervisor or Assistant Supervisor-Track shall make additional spot checks or audits, as required, to ensure that track inspections are being performed and track inspection reports reflect existing track conditions.

(h) Track Foremen are encouraged to make recommendations to the Track Supervisor or Engineer of Track Maintenance as to required modifications to the methods, procedures and practices to improve the overall quality of track inspection.

§213.19 Information Collection

For complete information see the FRA Track Safety Standards, §213.19.

§213.20 Taking Track Measurements

(a) The Foremen-Track Patrol, when making an inspection of track, must take measurements to ensure that the track meets or exceeds the Inspection Limits given in this Part.

(b) When the measurements taken do not comply with the requirements of Part I, then the inspector must take the action as given in Part I, §§213.5(a) and 213.9(b).

(c) Deviations in track that do not comply with the limits in this Part are track defects and are to be recorded on the front of the MNR Daily Track Inspection Report (MW-49).

(d) Deviations that do not comply with the limits in this Part are classified as class-specific or non-class-specific defects.

§213.21 Class-Specific Defects

(a) Paragraphs found in Subparts B, C, D, E and F of this Part may or may not have specific limits or conditions that are directly associated with a class of track.

(b) Deviations from this Part that are both categorized by track class, and exceed the allowable limits for that track class, are class-specific defects.

(c) Class-specific defects in track that are identified by the inspector shall be dealt with by that inspector in accordance with Part I, §213.5(a).

§213.22 Non-Class-Specific Defects

(a) Paragraphs found in Subparts B, C, D, E and F may not have specific limits or conditions that are directly associated with a class of track.

(b) Generally there are two types of non-class specific defects, those that are non-hazardous and those that present a hazard.

(c) Although both types of defects are reported on MNR Track Inspection Card, the remedial action as required in Part I, §213.5(a) will be different depending on severity and circumstance of the defect.

(d) Hazardous non-class-specific defects require appropriate remedial action be taken immediately which is based on the specific circumstances involved or any other limiting track conditions.

(e) Non-hazardous defects normally require no restriction but remedial action should be taken within 24 hours of initial reporting.

(f) Under no circumstances may FRA Non-Class Specific Defects exist longer than 30 calendar days without remedial action being taken.

(g) The inspector must consider all non-class specific defects in the context of the specific circumstances involved at the time of inspection. The existence of a non-class-specific defect under one set of circumstances may not be serious, while the identical condition under other circumstances may constitute a serious safety concern and require immediate protection.

(h) Although some non-class-specific defects may not present an immediate hazard, they may become more hazardous with additional train traffic. Therefore, it is important for the inspector to record these defects so that they will not be left unrepaired.

(i) FRA defects must be reported on the Track Inspection Report and Monthly Switch Inspection Report as defects and reported to the Track Supervisor immediately.

(j) Examples of possible non-class-specific defects are given below:

    (1) Drainage: Drainage or water carrying facilities obstructed by debris, vegetation and/or silt may not require immediate action other than reporting the defect. Uncontrolled water undercutting a track

structure or embankment requires prompt remedial action.

(2) Vegetation: Patches of vegetation that brush the sides of rolling stock may not be an immediate hazard, but more severe vegetation overgrowth might obstruct the view of signals and wayside signs.

(3) Turnouts and track crossings: One or two loose braces, if not at the point of switch, are usually not considered to be an immediate hazard, provided that all other braces are securely in place and supporting the stock rail. On the other hand, three or more consecutive loose braces, especially in high speed territory, must be considered more serious and may necessitate remedial action.

(4) One missing cotter pin in a clip bolt, gage plate bolt or switch rod bolt is usually not considered an immediate hazard, but one missing cotter pin in a critical location such as in a connecting rod could have serious consequences and is considered a non-class-specific defect.

(5) One loose, worn or missing clip bolt or nut may not be an immediate hazard. On the other hand one missing nut on a connecting rod is an imminent hazard.

(6) Frog bolts: Any loose frog bolt is considered an FRA non-class specific defect. However, one or two loose, worn or missing frog bolts out of several would seldom constitute an immediate hazard, provided that all the other frog bolts are secure.

Subpart B — Roadbed

§213.31 Scope

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

(a) A good roadbed condition is critical to the safe operation of trains as it supports and distributes the vehicle loads to the sub-grade. An adequate roadbed helps maintain track stability.

§213.33 Drainage

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

(b) Adequate drainage is recognized as first in importance in maintaining a track structure that provides support for the movement of trains and prolongs the life of track components.

(c) Track inspectors should examine areas where there are apparent problems with surface and alignment to determine if drainage is a contributing factor.

§213.37 Vegetation

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

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

(b) Obstruct visibility of railroad signs and signals:

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

  (2) At highway-rail crossings;

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

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

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

Subpart C — Track Geometry

§213.51 Scope

This Subpart prescribes the minimum requirements for the gage, alignment, and surface of track, and the superelevation and speed limits for curved track.

§213.53 Gage

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

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

Class of Track	The gage must be at least (inches):	But not more than (inches):
1	56	58
2	56	57-3/4
3, 4 and 5	56	57-1/2

§213.55 Alinement

Alinement may not deviate from uniformity[(1)] more than the amount prescribed in the following table:

	Tangent Track	Curved Track	
Class of Track	The deviation of the mid-ordinate from a 62' chord[(1)] may not be more than (inches):	The deviation of the mid-ordinate from a 31' chord[(2)] may not be more than (inches):	The deviation of the mid-ordinate from a 62' chord[(2)] may not be more than (inches):
1	5	N/A[(3)]	5
2	3	N/A[(3)]	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 shall be at points on the gage side of the line rail, 5/8" below the top of the rail head. Either rail may be used as the line rail, however, the same rail shall be used for the full length of that tangential segment of track.
[(2)] The ends of the chord shall be at points on the gage side of the outer rail, 5/8" below the top of the rail head.
[(3)] N/A - Not Applicable.

§213.57 Curves: Elevation and Speed Limitations

(a) The maximum superelevation on the outside rail of a curve may not be more than 8" on Track Classes 1 and 2 and may not be more than 7" on Track Classes 3-5. Except as provided in Part I, §213.63, the outside rail of a curve may not be lower than the inside rail.

(b) (1) Maximum allowable operating speeds for various degrees of curvature is determined by the following formula:

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

V max = Maximum allowable operating speed (MPH)

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

E_u = Underbalance (inches)

D = Degree of curvature (degrees)[2]

(2) Appendix C gives the maximum allowable operating speed computed in accordance with this formula for various elevations (E_a) and degrees of curvature (D) for underbalance (E_u) of 1-1/2" or 3".

Notes:

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

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

(c) Example: Find the maximum allowable operating speed for a 3^o curve, using MNR underbalance of 3" (E_u) and given 10 readings of superelevation (E_a) in the curve.

Superelevation readings (E_a) measured in the field at 10 locations are given as follows: 3-5/8", 3", 2-3/4", 3", 3-1/4", 2-7/8", 3-1/8", 3", 2-5/8" and 3".

The average actual superelevation is obtained by averaging the readings taken for the 10 points as given above in paragraph (b), note 1.

The actual superelevation (E_a) is 3".

Calculate the maximum operating speed in the curve with a superelevation of 3" (E_a) and MNR underbalance (E_u) of 3".

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

Where: V_{max} = maximum allowable operating speed in miles per hour

E_a = superelevation of the outside rail in inches.

E_u = underbalance in inches.

D = degree curve as a decimal.

$$V_{max} \text{ using MNR } E_u = \sqrt{\frac{3.0+3.0}{0.0007(3)}}$$

$$= \sqrt{\frac{6.0}{0.0021}}$$

$$= \sqrt{2857.14}$$

V_{max} = 53.45 mph

Say 53 mph.

Or refer to Appendix C using the 3" underbalance (E_u) table with an elevation of 3" (E_a), and

V_{max} using MNR E_u table = 53 mph.

(d) The maximum allowable design speed in curves on MNR is to be calculated using an underbalance of 3" unless otherwise directed by the Assistant Vice President - Maintenance of Way.

(e) The maximum allowable operating speed in curves, in accordance with FRA limits, is to be calculated using an underbalance of 3".

(f) The Office of the Director of Track & Structures shall maintain a list of curves and curve related data.

§213.59 Elevation of Curved Track; Runoff

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

(b) Superelevation runoff must be at a uniform rate, within the limits of track surface deviation prescribed in Part I, §213.63 and it shall extend at least the full length of the spirals. If physical conditions do not permit a spiral long enough to accommodate the minimum length of runoff, part of the runoff may be made on tangent track.

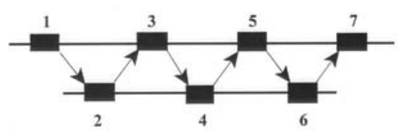
§213.63 Track Surface

The surface of track shall be maintained within the limits prescribed in the following table:

Track Surface	Class of Track				
	1	2	3	4	5
The runoff in any 31' of rail at the end of a raise may not be more than (inches):	3-1/2	3	2	1-1/2	1
The deviation from uniform profile on either rail at the mid-ordinate of a 62' chord may not be more than (inches):	3	2-3/4	2-1/4	2	1-1/4
The deviation from zero crosslevel at any point on a tangent or the reverse elevation on curves may not be more than (inches):	3	2	1-3/4	1-1/4	1
The difference in crosslevel between any two points less than 62' apart may not be more than (inches):*(1, 2)	3	2-1/4	2	1-3/4	1-1/2
*Where determined by engineering decision prior to the promulgation of this rule, due to physical restrictions on spiral length and operating practices and experience, the variation in crosslevel on spirals per 31' may not be more than (inches):	2	1-3/4	1-1/4	1	3/4

(1) Except as limited by Part I, §213.57(a), where the elevation at any point in a curve equals or exceeds 6", the difference in crosslevel within 62' between that point and a point with greater elevation may not be more than 1-1/2".

(2) However, to control harmonics on Track Classes 2-5 jointed track with staggered joints, the crosslevel differences shall not exceed 1-1/4" in all of six consecutive pairs of joints, as created by seven low joints (see diagram below). Track with joints staggered less than 10' shall not be considered as having staggered joints. Joints within the seven low joints outside of the regular joint spacing shall not be considered as joints for purposes of this footnote.



Subpart D — Track Structure

§213.101 Scope

This Subpart prescribes the minimum requirements for ballast, crossties, track components, and the physical conditions of rails.

§213.103 Ballast; General

Unless it is otherwise structurally supported, all track must be supported by material which will:

(a) Transmit and distribute the load of the track and railroad rolling equipment to the sub-grade;

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

(c) Provide adequate drainage for the track; and

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

(e) Where there is insufficient ballast to provide a stable track see Appendix A, Continuous Welded Rail (CWR) Procedures.

§213.105 Disturbed Track

If track is raised or otherwise disturbed so as to lift the ties off the tie beds, the track must be inspected by a person designated under §213.7 (a or b), so that it is known to be in safe condition for the speed permitted before a train is allowed to pass over that track.

§213.109 Crossties

(a) Crossties shall be made of a material to which rail can be securely fastened. The material must be capable of holding the rails to proper gage, surface, alignment, and of transmitting wheel loads from the rails to the ballast and roadbed.

(b) Each 39' segment of track shall have:

- (1) A sufficient number of crossties which in combination provide effective support that will:
  - (i) Hold gage within the limits prescribed in Part I, §213.53(b);
  - (ii) Maintain surface within the limits prescribed in Part I, §213.63; and
  - (iii) Maintain alignment within the limits prescribed in Part I, §213.55.
- (2) The minimum number and type of crossties specified in paragraph (c) and (d) of this section effectively distributed to support the entire segment; and
- (3) At least one crosstie of the type specified in paragraph (c) and (d) of this section that is located at a joint location as specified in paragraph (f) of this section.

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

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

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

(1) Broken through;

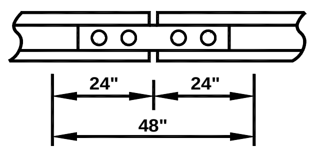
(2) Split or otherwise impaired to the extent the crossties will allow the ballast to work through, or will not hold spikes or rail fasteners;

(3) So deteriorated that the tie plate or base of rail can move laterally 1/2" relative to the crossties; or

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

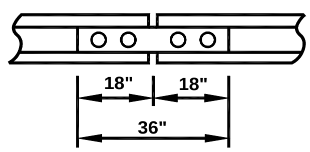
(5) Not fastened as required by Part I, §213.127.

(e) Track Classes 1 and 2 shall have one effective crosstie whose centerline is within 24" of the center of joint, and Track Classes 3-5 track shall have one effective crosstie whose centerline is within 18" of the center of joint or two crossties whose centerlines are within 24" either side of the center of joint. The relative position of these ties is described in the following diagrams.



Classes 1 and 2

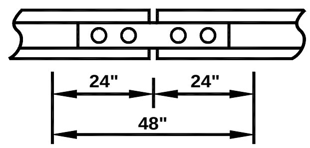
Each rail joint in Track Classes 1 and 2 shall be supported by at least one effective crosstie specified in paragraphs (c), (d) and (e) of this section whose centerline is within 48" shown above.



Classes 3 through 5

Each rail joint in Track Classes 3-5 shall be supported by either at least one effective crosstie specified in paragraph (c), (d) and (e) of this section whose centerline is within 36" shown above, or;

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



(f) A concrete crosstie which satisfies the requirements of paragraph (c) above shall not:

(1) Be broken transversely under one or both rail seats.

(2) Be broken transversely between rail seats showing crumbling or the exposure of pre-stressing wires.

(3) Be broken longitudinally.

(4) Have loose shoulder inserts.

(5) Not fastened as required by Part I, §213.127.

(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)(h), (ii), and (iii) of this section.

(h) Damaged ties will require frequent close inspection.

§213.113 Defective Rails

When it is known that a rail in a track contains any of the defects listed in the following table, a person designated under Part I, §213.7(a) or (b) shall not permit operations over that rail until:

(a) The defective rail is replaced; or

(b) The remedial action prescribed in the table is initiated.

REMEDIAL ACTION TABLES Rail Defects Defined By Cross-Section Area			
Defect	**Percent of rail head cross-sectional area weakened by defect**		**If defective rail is not replaced, take the remedial action prescribed in notes**
	Less than	**At least**	
Transverse fissure	70 100	5 70 100	B A2 A
Compound fissure	70 100	5 70 100	B A2 A
Detail fracture. Engine burn fracture Defective weld	25 80 100	5 25 80 100	C D (A2) or (E and H) (A) or (E and H)

Rail Defects Defined By Length

Defect	Length of defect (inches)		Percent of rail head cross-sectional area weakened by defect		If defective rail is not replaced, take the immediate remedial action prescribed in notes
	More than	**But not more than**	**Less than**	**At Least**	
Horizontal split head Vertical split head Split web Piped rail Head web separation	1 2 4 breakout in rail head	2 4 -- breakout in rail head	 breakout in rail head		H and F I and G B A
Bolt hole crack	½ 1 1-1/2 breakout in rail head	1 1-1/2 -- breakout in rail head	 breakout in rail head		H and F H and G B A
Broken base	1 6	6 --			D (A) or (E and I)
Ordinary break					A or E
Damaged rail					D
Flattened rail	Depth equal to or greater than 3/8" Length equal to or greater than 8"				H

Notes:

A. Assign person designated under Part I, §213.7(a) to visually supervise each operation over defective rail at a speed not exceeding 10 MPH.

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

B. Limit operating speed over defective rail to that as authorized by a person designated under Part I, §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 Part I, §213.9 for the class of track concerned, whichever is lower.

C. Apply joint bars bolted only through the outermost holes to defect within 20 days after it is determined to continue the track in use. In the case of Track Classes 3-5, limit operating speed over defective rail to 30 MPH until joint bars are applied; thereafter, limit speed to 50 MPH or the maximum allowable speed under Part I, §213.9 for the class of track concerned, whichever is lower.

When a search for internal rail defects is conducted under Part I, §213.237, and defects are discovered in Track Classes 3-5 which require remedial action C, the operating speed shall be limited to 50 MPH, or the maximum allowable speed under Part I, §213.9 for the class of track concerned, whichever is lower, for a period not to exceed four days. If the defective rail has not been removed from the track or a permanent repair made within four days of the discovery, limit operating speed over the defective rail to 30 MPH until joint bars are applied; thereafter, limit speed to 50 MPH or the maximum allowable speed under Part I, §213.9 for the class of track concerned, whichever is lower.

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

E. Apply joint bars to defect and bolt in accordance with Part I, §213.121(a) and (e).

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

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

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

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

Small (5-19%)   (Medium (20-39%)   Large (40-99%)
"CO" – Cracked Out

Examples of size classification

(c) Rail test companies that search for internal defects sometimes classify and abbreviate the defective rails.

(d) Defective rail abbreviations are as follows:

(1) Defects classified by area of rail head affected:

EBF – Engine burn fracture

TDD – Transverse detail fracture

TDT – Transverse detail true fissure

TDC – Transverse detail compound fissure

DWP – Defective weld plant

DWF – Defective weld field

DWG – Defective weld gas

DWE – Defective weld electric

TDW – Transverse defect welded burn

(2) Defects classified by length in inches:

BHJ – Bolt hole crack within the joint

BHO – Bolt hole crack-outside of joint

HWO – Head web-outside of joint

HWJ – Head web at joint

HSH – Horizontal split head

VSH – Vertical split head

PRO – Piped rail in the open

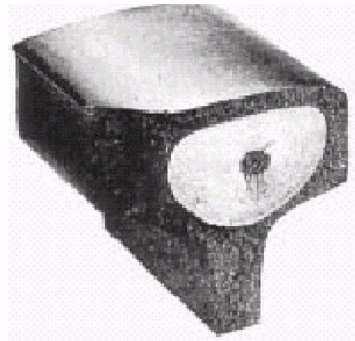
SWO – Split web in the open

BRO – Broken rail in the open

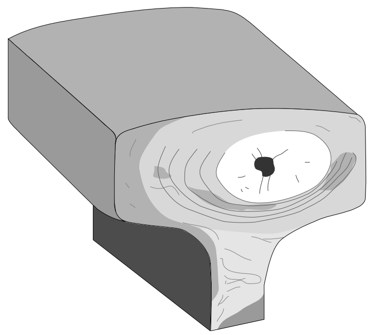
§213.114 Defective Rail Information (MNR)

The following rail defect information and applicable defect code is provided for users of the MW-4.

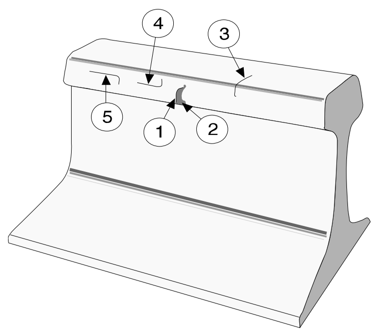
(a) "Transverse Fissure" (TD) means a progressive cross-wise fracture starting from a crystalline center or nucleus inside the head from which it spreads outward as a smooth, bright, or dark, round or oval surface substantially at a right angle to the length of the rail. The distinguishing features of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



Large Transverse Fissure, Showing Normal Growth Around Cucleus



Transverse Fissure, Showing Rapid Growth



Appearance of Transverse Defects (Except Engine Burn Fracture) in Track

No evidence of a transverse defect is visible in track until the separation has reached the rail surface (cracks out). A transverse defect may then be recognized by one or more of the following:

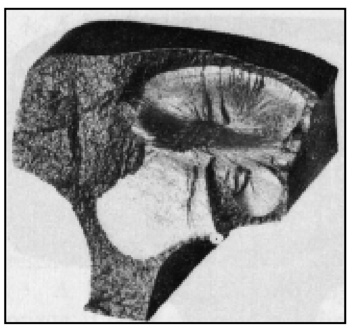
1. A hairline crack at right angles to the running surface, usually on the field or gage side of the head or at the fillet under the head.
2. Bleeding around the crack.
3. A hairline crack at the gage corner of the rail head. A rail which has been turned may have a crack on the field side. Numerous cracks on the gage corner are often present but should cause no suspicion unless a single crack extends much further down the side and across the running surface.
4. A horizontal hairline crack in the side of the rail head which turns upward or downward at one or both ends and is usually accompanied by bleeding. A flat spot will generally be present on the running surface of the rail.
5. A hairline crack extending downward at right angles from a horizontal crack caused by shelling (see definition and description of <u>shelly spots</u> (p)).

   Transverse defects may be classified after the rail is broken for examination as follows:

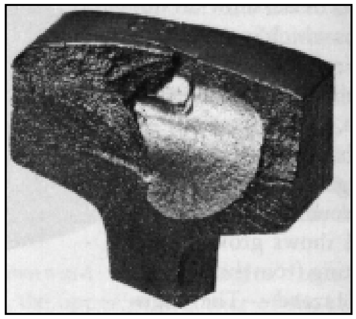
   - Transverse Fissure
   - Compound Fissure
   - Detail Fracture from Shelling or Head Check
   - Engine Burn Fracture

6. In non-control-cooled rail a transverse defect (TD) commonly is caused by shatter crack from hydrogen. If one crack is found there are likely to be many others in the same rail.

(b) "Compound Fissure" means a progressive fracture originating in a horizontal split head that turns up or down in the head of the rail as a smooth, bright, or dark surface progressing 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 the fracture originated.

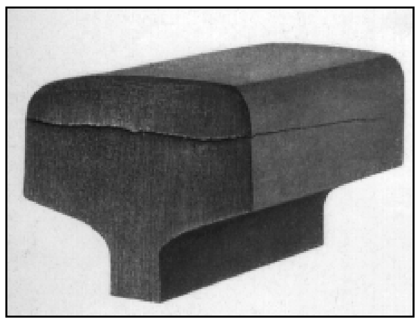


Compound Fissure, Showing Horizontal Separation and Several Planes of Transverse Separation

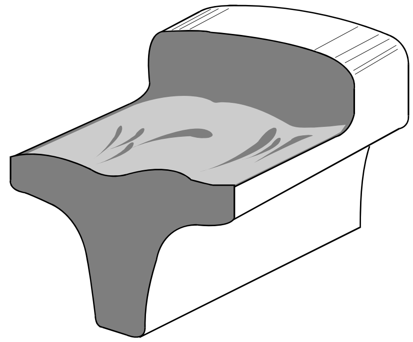


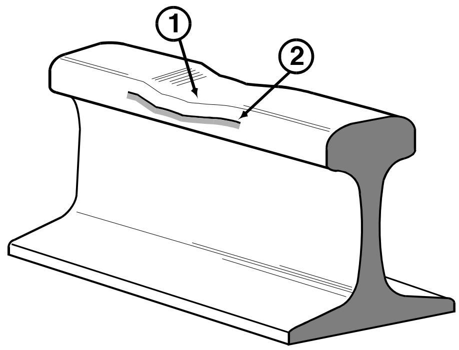
Compound Fissure With Very Slight Horizontal Separation

(c) "Horizontal Split Head" (HSH) 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.



Horizontal Split Head With Separation Extending Across Most of The Head





Horizontal Split Head (HSH)

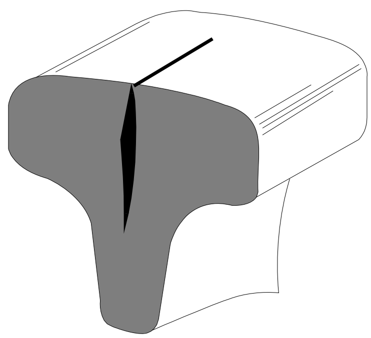
A rail with a horizontal split head may exhibit the following characteristics:

1. Before cracking out, a horizontal split head will cause the appearance of a flat spot on the running surface. There may be a slight widening of the rail head.
2. After cracking out, a horizontal split head will appear as a hairline crack in the side of the head on one or both sides of the rail at least 1/3 of the depth of head below the top of the rail. In rail laid without tie plates, the crack will usually appear on the gage side and in rail laid with tie plates, on the field side.

   This type of failure is usually caused by a manufacturing defect.

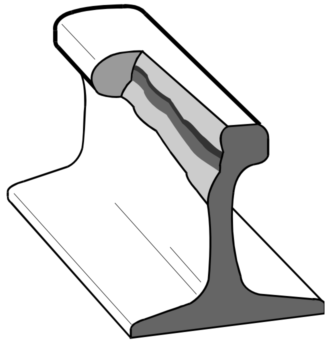
(d) "Vertical Split Head" (VSH) means a vertical split through or near the middle of the head, and extending into or through it. A crack or rust streak may show under the head close to the web or pieces may be split off side of the head.

Vertical Split Head



In track a rail with a vertical split head will exhibit the following characteristics:

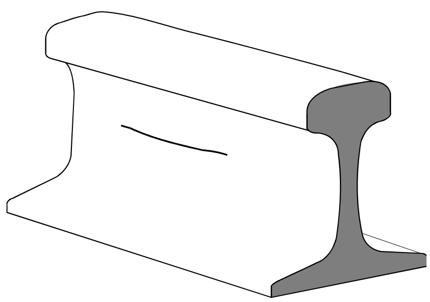
1. A dark streak in the running surface.
2. Widening of the head for the length of the split.
3. One side of the head may show signs of sagging, causing a rust streak to appear on the fillet under the head.
4. In advanced stages a bleeding crack will appear at the fillet under the head.



The Vertical Split Head is usually caused by a defect in the rail as rolled. (Not to be confused with Piped Rail which has the defect in the web).

(e) “Split Web” means a lengthwise crack along the side of the web and extending into or through it.

Section of Rail Containing a Split Web



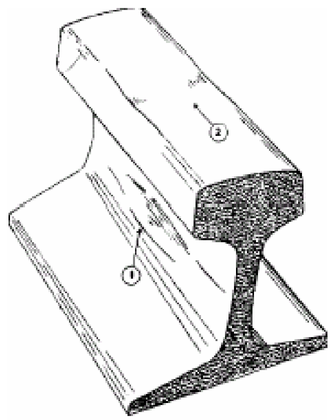
A rail with a split web will have bleeding cracks in the web.

This type of failure is frequently caused by bruises on the web resulting from striking the web with a spike maul or other object.

Long splits in the web of new or nearly new rail are likely to be a manufacturing defect from roller straightening.

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

Piped Rail



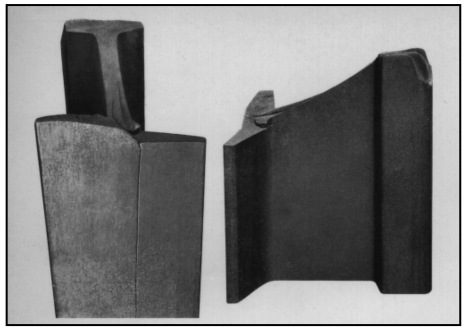
Appearance of Piped Rail in Track

A piped rail in track may exhibit the following characteristics:

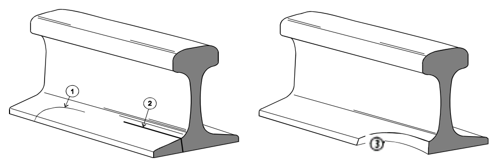
1. Bulging of the web on either or both sides. There may be shallow cracks apparent on the sides of the bulge.
2. A slight sinking of the rail head in the area above the pipe with no other deformation of the head.

This type of failure is due to a manufacturing defect.

(g) “Broken Base” means any break in the base of a rail.



Broken Base

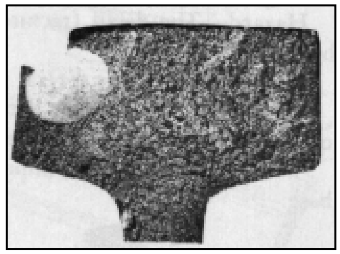


In track, a rail with a broken base may be characterized by:

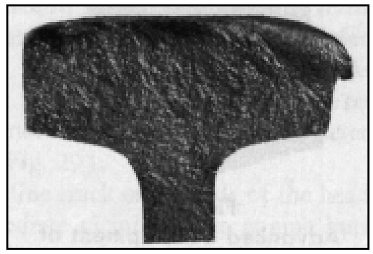
1. A crack starting near the junction of the base and the web extending outward to the edge of the base.
2. A longitudinal crack along the junction of the base and the web.
3. A half moon break in the base.

This type of failure usually is due to a manufacturing defect but may be caused by uneven bearing of rail on the tie plates, as when plates are bent or plates of different slopes are mixed in track.

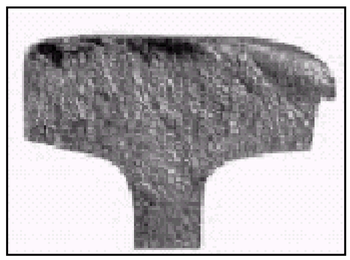
(h) “Detail Fracture” means a progressive fracture originating at or near the surface of the rail head. These fractures should not be confused with transverse fissures, compound fissures, or other defects which have internal origins. Detail fractures may arise from shelly spots, head cracks, or flaking.



Detail Fracture From Shelling

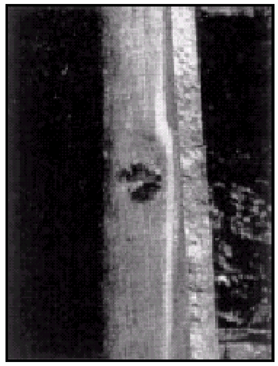


Detail Fracture From Shelling,
With Part of Shell Chipped Off

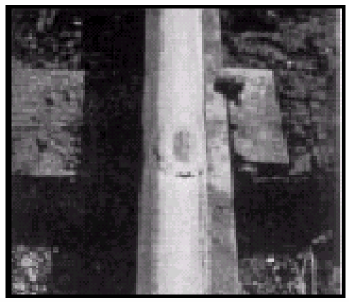


Detail Fracture Originating From
Head Check on Gage Side (Turned Rail)

(i) "Engine Burn Fracture" (EBF) means a progressive fracture originating in spots where driver wheels have slipped on top of the rail head. In developing downward they frequently resemble the compound or even transverse fissure with which they should not be confused or classified.



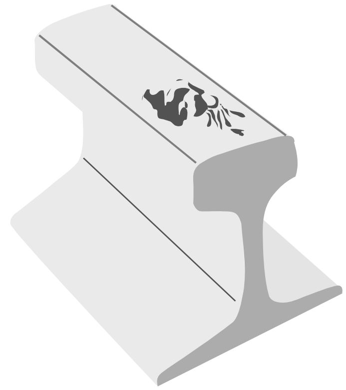
Engine Burn, With Slight Flattening of Rail Head



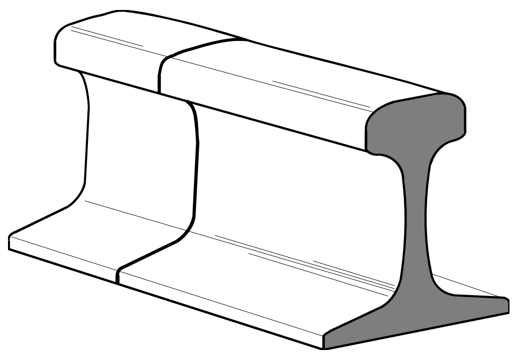
Engine Burn, Showing Small Thermal Cracks

Engine Burn Fracture, Showing Small Transverse Separation

An engine burn in track may appear as an oval or round dark area on the running surface of the rail where damaged metal breaks out forming a cavity. There are usually several wheel slip marks. Sometimes the marks match on both rails. Often, marks are located on the same rail and spaced at a distance corresponding to the spacing of the locomotive wheels.



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



Ordinary Break

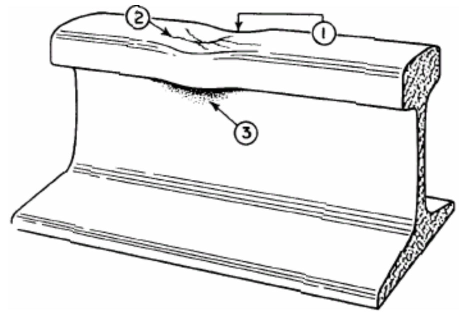
A rail with an ordinary break may be characterized by:

1. A hairline crack running completely around the rail, usually accompanied by bleeding.
2. A separation of rail at the break with one or both ends battered.
3. The faces of the rail are rough and granular with no sign of a defect.

Unless struck by a broken or damaged wheel, an ordinary break in a rail less than ten years old may result from a manufacturing defect.

(k) “Damaged Rail” means any rail broken or damaged by wrecks, derailments, broken or flat wheels, or similar causes.

(l) "Flattened Rail" means a short length of rail, not at a joint, which has flattened out across the width of the rail head to a depth of 3/8" or more below the rest of the rail. Flattened rail occurrences have no repetitive regularity and thus do not include corrugations, and have no apparent localized cause such as a weld or engine burn. Their individual length is relatively short, as compared to a condition such as head flow on the low rail of curves.



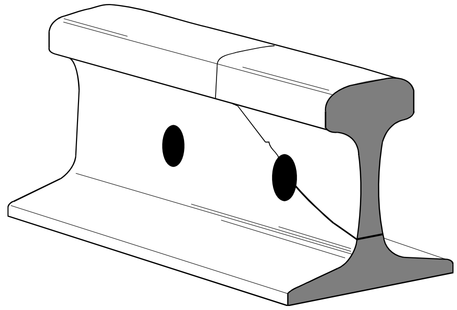
Appearance of a Crushed Head in Track (Exaggerated)

A crushed head in track may be characterized by:

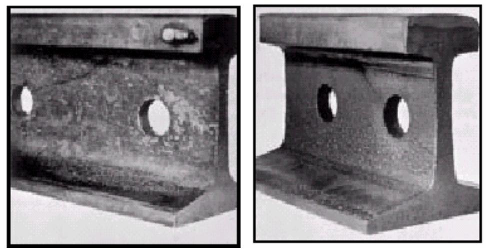
1. A flattening and widening of the head with the entire head sagging, with no cracks in the bottom of the head in the early stages.
2. Small cracks in the depression of the running surface.
3. In advanced stages, a bleeding crack may appear in the fillet under the head.

A crushed head at the end of a rail is not to be confused with a battered end. A crushed head must have sagging of the entire head.

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



Bolt Hole Crack or Break (BHJ or BHO)

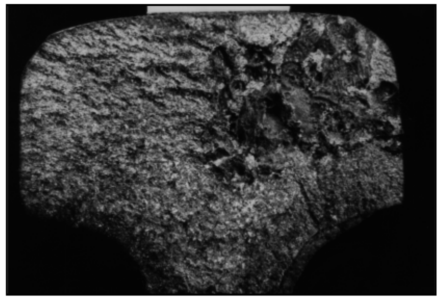


Bolt Hole Crack

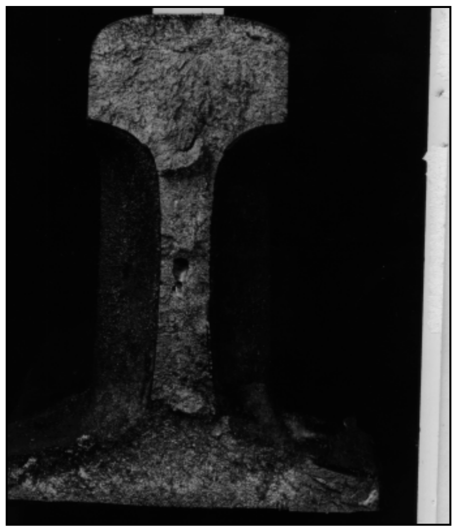
In track, a bolt hole crack or break extends radially from the bolthole.

This type of failure is frequently caused by loose bolts in the joint or inadequate anchoring of the track causing the bolts to strike the sides of the hole and damage the metal.

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

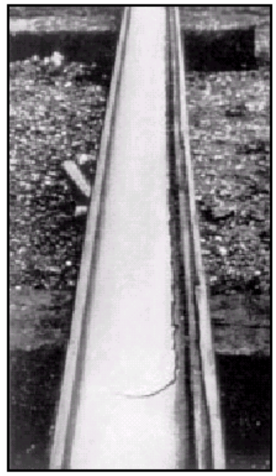


Appearance After Breaking of a Defective Weld Caused by an Inclusion

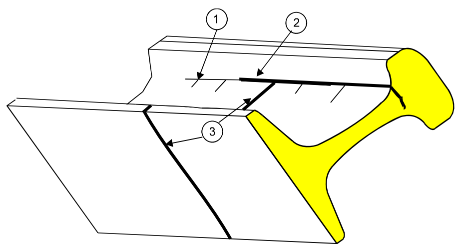


Defective Electric Flashbutt Weld from Iron Oxide Entrapment

(o) “Head-Web Separation” (HWJ or HWO) means a progressive fracture, longitudinally separating the head from the web of the rail in the head fillet area.



Length of Rail Containing a Head and Web Separation



A rail with a head-web separation may exhibit the following characteristics:

1. In earlier stages, wrinkled lines appear along the gage side fillet under the head.
2. In later stages, a small crack appears along the fillet under the head on either side. These cracks grow longitudinally with slight irregular turns upward and downward.
3. In advanced stages, bleeding cracks will extend downward from the longitudinal crack.

This type of defect frequently occurs in rails through crossings, in tunnels and other wet locations.

(p) “Shelly Spots” (SR) is a condition where a thin (3/8" in depth or less) shell-like piece of surface metal exists in the rail head and is generally found at the gage corner. It 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 being apparent only after the rail is broken or sectioned.

Shelly Spots on Gage Side of Rail Head

A Detail Fracture Caused by a Shell

In track, shelly rail is characterized by:

1. Dark spots irregularly spaced on the gage side of the running surface.
2. Longitudinal separations at one or more levels in the upper gage corner, with discoloration from bleeding.

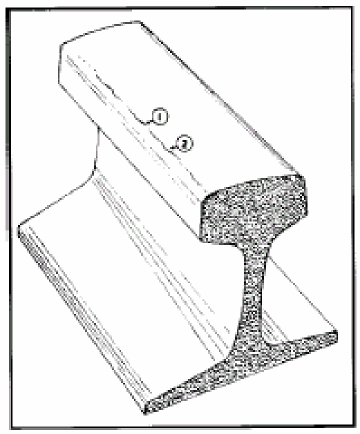
If rail is turned, shelly spots will appear on the field side with an irregular overhanging lip of metal. This should not be confused with flowed rail.

Shelly rail occurs most frequently on curves.

(q) "Head Checks" (HC) mean hairline cracks that appear in the gage corner of the rail head, at any angle with the length of the rail. When not readily visible, the presence of the checks may often be detected by the raspy feeling of their sharp edges.

(r) “Flaking” means small shallow flakes of surface metal generally not more than 1/4" in length or width breaking out of the gage corner of the rail head.

Section of Rail Showing Flaking



Appearance of Flaking in Track

1. Shallow flakes of surface on metal.
2. Break out of gage corner of rail head.

(s) Cadweld Induced Damage – A Cadweld is an exothermic welded connection. Exothermic is a chemical term describing a chemical reaction, which gives off heat as the reaction takes place. This method is used by the Signal and Third Rail Departments to permanently bond either signal wires or negative return wires to the rail. Practice for many years was to apply the wires to the head of the rail. This is still the accepted practice at joint locations. Recent practice encourages web bonding where bending stresses in the rail are at a minimum instead of bonding on the rail head. Web bonding may be done at impedance bond and negative return locations. Heat damage may be produced during cadweld welding. A damaged rail is pictured below. The damage due to the heat appears to occupy about 15% of the rail head area. With this type of damage, a combination of circumstances such as cold weather, flat wheels, etc., could cause a break to propagate quickly.

Below is shown a 15" breakout of rail at an impedance box location due to a cadweld at a third rail return on the head of a 119 RE rail.

(t) Electric Burn Damage - Most rail burns occur due to metallic debris either being placed by vandals or being struck by trains resulting in contact between the third rail, running rail and the object. In this case the rail was considered “damaged rail” and joint bars were applied until the damaged rail could be removed from track.

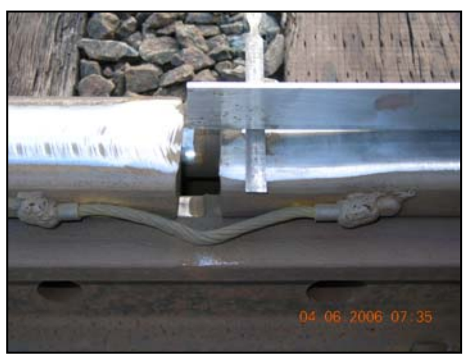
§213.115 Rail End Mismatch

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

Class of Track	Any mismatch of rails at joints may not be more than the following:	
	On the tread of the rail ends (inch)	**On the gage side of the rail ends (inch)**
1	1/4	1/4
2	1/4	3/16
3	3/16	3/16
4 and 5	1/8	1/8

§213.117 Rail End Batter and Secondary Batter

(a) Rail end batter and secondary batter on MNR is a depression in the rail head usually found from 1/2" to 12" from a joint. Batter may be caused from the impact of the wheel passing over the joint. It is measured by placing an 18" straightedge on the head of the rail end, without bridging the joint and measuring the distance between the bottom of the straightedge and the top of the railend.



(b) Rail end batter may not be more than that prescribed by the following table:

Class of Track	Rail end batter may not be more than (inch):
1	1/2
2-3	3/8
4	1/4
5	1/8

§213.119 Continuous Welded Rail (CWR); General

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(i) Specify the timing of the inspection; and

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

(g) Procedures which prescribe the scheduling and conduct of inspections to detect cracks and other indications of potential failures in CWR joints. In formulating the procedures under this paragraph, the track owner shall:

(1) Address the inspection of joints and the track structure at joints, including, at a minimum, periodic on-foot inspections;

(2) Identify joint bars with visible or otherwise detectable cracks and conduct remedial action pursuant to §213.121;

(3) Specify the conditions of actual or potential joint failure for which personnel must inspect, including, at a minimum, the following items:

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

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

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

(4) Specify the procedures for the inspection of CWR joints that are imbedded in highway-rail crossings or in other structures that prevent a complete inspection of the joint, including procedures for the removal from the joint of loose material or other temporary material;

(5) Specify the appropriate corrective actions to be taken when personnel find conditions of actual or potential joint failure, including on-foot follow-up inspections to monitor conditions of potential joint failure in any period prior to completion of repairs.

(6) Specify the timing of periodic inspections, which shall be based on the configuration and condition of the joint:

(i) Except as provided in paragraphs (g)(6)(ii) through (iv), track owners must specify that all CWR joints are inspected, at a minimum, in accordance with the intervals identified in the following table on next page.

(ii) Consistent with any limitations applied by the track owner, a passenger train conducting an unscheduled detour operation may proceed over track not normally used for passenger operations at a speed not to exceed the maximum authorized speed otherwise allowed, even though CWR joints have not been inspected in accordance with the frequency identified in paragraph (g)(6)(i), provided that:

(A) All CWR joints have been inspected consistent with requirements for freight service; and

(B) The unscheduled detour operation lasts no more than 14 consecutive calendar days. In order to continue operations beyond the 14-day period, the track owner must inspect the CWR joints in accordance with the requirements of paragraph (g)(6)(i).

(iii) Tourist, scenic, historic, or excursion operations, if limited to the maximum authorized speed for passenger trains over the next lower class of track, need not be considered in determining the frequency of inspections under paragraph (g)(6)(i).

Minimum Number of Inspections Per Calendar Year[1]					
Class of Track	**Freight Trains Operating Over Track with an Annual Tonnage of:**			**Passenger Trains Operating over Track with an Annual Tonnage of:**	
	Less than 40 mgt	**40 to 60 mgt**	**Greater than 60 mgt**	**Less than 20 mgt**	**Greater than or equal to 20 mgt**
5 & Above	2	3[2]	4[2]	3[2]	3[2]
4	2	3[2]	4[2]	2	3[2]
3	1	2	2	2	2
2	0	0	0	1	1
1	0	0	0	0	0
Excepted Track	0	0	0	N/A	N/A

4 = Four times per calendar year, with one inspection in each of the following periods: January to March, April to June, July to September, and October to December; and with consecutive inspections separated by at least 60 calendar days.

3 = Three times per calendar year, with one inspection in each of the following periods: January to April, May to August, and September to December; and with consecutive inspections separated by at least 90 calendar days.

2 = Twice per calendar year, with one inspection in each of the following periods: January to June and July to December; and with consecutive inspections separated by at least 120 calendar days.

1 = Once per calendar year, with consecutive inspections separated by at least 180 calendar days.

[1] Where a track owner operates both freight and passenger trains over a given segment of track, and there are two different possible inspection interval requirements, the more frequent inspection interval applies.

[2] When extreme weather conditions prevent a track owner from conducting an inspection of a particular territory within the required interval, the track owner may extend the interval by up to 30 calendar days from the last day that the extreme weather condition prevented the required inspection.

(iv) All CWR joints that are located in switches, turnouts, track crossings, lift rail assemblies or other transition devices on moveable bridges must be inspected on foot at least monthly, consistent with the requirements in §213.235; and all records of those inspections must be kept in accordance with the requirements in §213.241. A track owner may include in its §213.235 inspections, in lieu of the joint inspections required by paragraph (g)(6)(i), CWR joints that are located in track structure that is adjacent to switches and turnouts, provided that the track owner precisely defines the parameters of that arrangement in the CWR plans.

(7) Specify the record keeping requirements related to joint bars in CWR, including the following:

(i) The track owner shall keep a record of each periodic and follow-up inspection required to be performed by the track owner's CWR plan, except for those inspections conducted pursuant to § 213.235 for which track owners must maintain records pursuant to §213.241. The record shall be prepared on the day the inspection is made and signed by the person making the inspection. The record shall include, at a minimum, the following items: the boundaries of the territory inspected; the nature and location of any deviations at the joint from the requirements of this Part or of the track owner's CWR plan, with the location identified with sufficient precision that personnel could return to the joint and identify it without ambiguity; the date of the inspection; the remedial action, corrective action, or both, that has been taken or will be taken; and the name or identification number of the person who made the inspection.

(ii) The track owner shall generate a Fracture Report for every cracked or broken CWR joint bar that the track owner discovers during the course of an inspection conducted pursuant to §§213.119(g), 213.233, or 213.235 on track that is required under §213.119(g)(6)(i) to be inspected.

(A) The Fracture Report shall be prepared on the day the cracked or broken joint bar is discovered. The record shall include, at a minimum: the railroad name; the location of the joint bar as identified by milepost and subdivision; the class of track; annual million gross tons for the previous calendar year; the date of discovery of the crack or break; the rail section; the type of bar (standard, insulated, or compromise); the number of holes in the joint bar; a general description of the location of the crack or break in bar; the visible length of the crack in inches; the gap measurement between rail ends; the amount and length of rail end batter or ramp on each rail end; the amount of tread mismatch; the vertical movement of joint; and in curves or spirals, the amount of gage mismatch and the lateral movement of the joint.

(B) **The track owner shall submit the information contained in the Fracture Reports to the FRA Associate Administrator for Safety (Associate Administrator) twice annually, by July 31 for the preceding six-month period from**

January 1 through June 30 and by January 31 for the preceding six-month period from July 1 through December 31.

(C) After February 1, 2010, any track owner may petition FRA to conduct a technical conference to review the Fracture Report data submitted through December of 2009 and assess whether there is a continued need for the collection of Fracture Report data. The tracker shall submit a written request to the Associate Administrator, requesting the technical conference and explaining the reasons for proposing to discontinue the collection of the data.

(8) In lieu of the requirements for the inspection of rail joints contained in paragraphs (g)(1) through (7) of this section, a track owner may seek approval from FRA to use alternate procedures.

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

(ii) If the Associate Administrator finds that the proposed alternate procedures provide an equivalent or higher level of safety than the requirements in paragraphs (g)(1) through (g)(7) of this section, the Associate Administrator will approve the alternate procedures by notifying the track owner in writing. The Associate Administrator will specify in the written notification the date on which the procedures will become effective, and after that date, the track owner shall comply with the procedures. If the Associate Administrator determines that the alternate procedures do not provide an equivalent level of safety, the Associate Administrator will disapprove the alternate procedures in writing, and the track owner shall continue to comply with the requirements in paragraphs (g)(1) through (7) of this section.

(iii) While a determination is pending with the Associate Administrator on a request submitted pursuant to paragraph (g)(8) of this section, the track owner shall continue to comply with the requirements contained in paragraphs (g)(1) through (7) of this section.

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

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

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

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

(3) Information on inspection of rail joints as specified in paragraph (g)(7) of this part.

(j) As used in this section the definition of the following terms is given in Appendix F:

(1) Action Items

(2) Adjusting/De-stressing

(3) Buckling Incident

(4) Continuous Welded Rail (CWR)

(5) Corrective Actions

(6) CWR Joint

(7) Desired Rail Installation Temperature Range

(8) Disturbed Track

(9) Mechanical Stabilization

(10) Rail Anchors

(11) Rail Temperature

(12) Remedial Actions

(13) Tight/Kinky Rail (nervous rail)

(14) Tourist, Scenic, Historic, or Excursion Operations

(15) Train-induced Forces

(16) Track Lateral Resistance

(17) Track Longitudinal Resistance

(18) Unscheduled Detour Operation

§213.121 Rail Joints

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

(b) If a joint bar in Track Classes 2-5 is cracked, broken or because of wear allows excessive vertical movement of either rail when all bolts are tight, it shall be replaced.

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

(d) If both joint bars are found to be broken entirely through between the middle two bolt holes, trains may be operated only under the visual supervision of a person designated under Part I, §213.7(a) at a speed not exceeding 10 MPH.

(e) In conventional jointed track, each rail must be bolted with at least two bolts at each rail end in Track Classes 2-5, and at least one bolt in each rail end in Track Class 1.

(f) In CWR, each rail must be bolted with at least two bolts at each rail end used to connect CWR strings or CWR to conventional rail.

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

(h) Where less than two bolts in a rail end are found to exist, the track must be protected by an appropriate speed restriction not to exceed 10 MPH (FRT) and 15 MPH (PAS).

(i) For one rail end unbolted and pull-aparts, the class of track shall be reduced to Class 1 speed not to exceed 10 MPH (FRT) and 15 MPH (PAS). Operation of equipment over this portion of track may be made only under the authority of a qualified person designated under Part I, §213.7.

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

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

CRITICAL DEFECT POLICY

CONDITION	ILLUSTRATION	ACTION
ONE BROKEN JOINT BAR – NOT BETWEEN MIDDLE HOLES		30 MPH*
ONE BROKEN JOINT BAR – BETWEEN MIDDLE HOLES; JOINT CONDITION GOOD		15 MPH*
ONE BROKEN JOINT BAR – BETWEEN MIDDLE HOLES; JOINT CONDITION POOR		10 MPH* AND VISUALLY SUPERVISE**
BOTH JOINT BARS BROKEN – NOT BETWEEN MIDDLE HOLES		15 MPH*
BOTH JOINT BARS BROKEN – BETWEEN MIDDLE HOLES		10 MPH* AND VISUALLY SUPERVISE**
UNBOLTED RAIL END PULLED APART 0" – 2"		15 MPH*
UNBOLTED RAIL END PULLED APART 2" – 4"		5 MPH*
UNBOLTED RAIL END PULLED APART > 4"		OUT OF SERVICE

* – ALL SPEEDS SHOWN ARE MAXIMUM ALLOWABLE
** – VISUALLY SUPERVISE MEANS THAT AN EMPLOYEE QUALIFIED UNDER FRA 213.7 MUST OBSERVE EACH OPERATION OVER THE DEFECT.

§213.122 Torch Cut Rail

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

§213.123 Tie Plates

(a) There must be tie plates on at least eight of any ten consecutive ties, in Track Classes 3-5.

(b) In Track Classes 3-5, no metal object that causes a concentrated load by solely supporting a rail shall be allowed between the base of the rail and the bearing surface of the tie plate Examples include tie plate shoulders, spikes, field welds, etc.

§213.127 Rail Fastening Systems

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

§213.129 Track Shims and Planks (MNR)

If track does not meet the geometric limits and the working of ballast is not possible due to weather or natural conditions, track shims and/or planks may be installed to temporarily correct the track surface (Part I, §213.63) and elevation (Part I, §213.59). See Part II, §§129.0(M) and 131.0(M).

§213.133 Turnouts and Track Crossings; General

See Part I – Special Trackwork.

§213.135 Switches

See Part I – Special Trackwork.

§213.137 Frogs

See Part I – Special Trackwork.

§213.139 Spring Rail Frogs

See Part I – Special Trackwork.

§213.141 Self-Guarded Frogs

See Part I – Special Trackwork.

§213.143 Frog Guard Rails and Guard Faces; Gage

See Part I – Special Trackwork.

Subpart E — Track Appliances and Track Related Devices

§213.201 Scope

See Part I – Track Appliances: Special Trackwork.

§213.205 Derails

See Part I – Special Trackwork.

Subpart F — Inspection

§213.231 Scope

This Subpart specifies the minimum frequency and manner of inspecting track to detect deviations from the limits and requirements prescribed in this Part.

§213.233 Track Inspections

(a) All track must be inspected in accordance with the schedule prescribed in paragraphs (c) and (d) of this section by a person designated under Part I, §213.7(b).

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

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

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

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

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

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

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

§213.235 Inspection of Switches, Track Crossing and Lift Rail Assemblies or Other Transition Devices on Moveable Bridges

See Part I, Special Trackwork §213.235(ST) and Miter Rails §213.235(MR).

§213.237 Inspection of Rail

(a) In addition to the track inspections required by Part I, §213.233, a continuous search for internal defects must be made of all rail in Track Classes 4-5, and Track Class 3 over which passenger trains operate, at least once every 40 million gross tons or once a year, whichever interval is shorter. On Track Class 3 over which passenger trains do not operate, such a search must be made at least once every 30 million gross tons or once a year, whichever interval is longer.

(b) Inspection 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 a highly visible marking on both sides of the web and base.

(d) If the person assigned to operate the rail defect detection equipment being used determines that, due to rail surface conditions, a valid search for internal defects could not be made over a particular length of track, the test on that particular length of track cannot be considered as a search for internal defects under Part I, §213.237(a).

(e) If a valid search for internal defects cannot be conducted for reasons described in paragraph (e) of this section, the Assistant Vice President - Maintenance of Way shall, before the expiration of time or tonnage limits:

(1) Reduce operating speed to a maximum of 25 MPH until such time as a valid search for internal defects can be made; or

(2) Remove the rail from service.

§213.239 Special Inspections

In the event of fire, flood, temperature extremes, severe storm, or other occurrence that might damage the track structure, a special inspection and report must be made of the track involved as soon as possible after the occurrence and, if possible, before the operation of any train over that track.

§213.241 Inspection Records

(a) Each owner of track to which this part applies shall keep a record of each inspection required to be performed on that track under this subpart.

(b) Each record of an inspection under Part I, §§213.4, 213.119, 213.233, and 213.235 shall be prepared on the day the inspection is made and signed by the person making the inspection. Records shall specify the track inspected, date of inspection, location and nature of any deviation from the requirements of this part, and the remedial action taken by the person making the inspection. The owner shall designate the location(s) where each original record shall be maintained for at least one year after the inspection covered by the record. The owner shall also designate one location, within 100 miles of each state in which they conduct operations, where copies of records which apply to those operations are either maintained or can be viewed following 10 days notice by the Federal Railroad Administration.

(c) Rail inspection records must specify the date of inspection, the location and nature of any internal defects found, the remedial action taken and the date thereof, and the location of any intervals of track not tested per Part I, §213.237(d). The rail inspection record shall be retained for at least two years after the inspection and for one year after remedial action is taken.

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

(e) For purposes of compliance with the requirements of this section, an owner of track may maintain and transfer records through electronic transmission, storage and retrieval provided that:

    (1) The electronic system be designed so that the integrity of each record is maintained through appropriate levels of security such as recognition of an electronic signature, or other means, which uniquely identify the initiating person as the author of that record. No two persons shall have the same electronic identity;

    (2) The electronic storage of each record shall be initiated by the person making the inspection within 24 hours following the completion of that inspection;

    (3) The electronic system shall ensure that each record cannot be modified in any way, or replaced, once the record is transmitted and stored;

(4) Any amendment to a record shall be electronically stored apart from the record which it amends. Each amendment to a record shall be uniquely identified as to the person making the amendment;

(5) The electronic system shall provide for the maintenance of inspection records as originally submitted without corruption or loss of date;

(6) Paper copies of electronic records and amendments to those records, that may be necessary to document compliance with this part shall be made available for inspection and copying by the Federal Railroad Administration at the locations specified in paragraph (b) of this section; and

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

§213.242 Responsibilities for Inspection and Reporting

(a) Track Supervisors or Assistant Supervisor-Track will review, initial and date all Daily Track Inspection Reports (MW-49) for their territory.

(b) Track Supervisors or Assistant Supervisor-Track will review a copy of Monthly Switch Inspection Forms (MW-41) for their territory.

(c) A designated Track Foreman will conduct a monthly yard switch inspection using the Yard Switch Inspection Report.

(d) Track Supervisors or Assistant Track Supervisors will spend at least one day per month with the Foremen-Track Patrol inspecting their assigned territory in accordance with their normal inspection practices. This is to be done in rotation, on a monthly basis, until the entire territory is inspected.

(e) Designated Track Foreman will perform special inspections as required using the Daily Track Inspection Reports (MW-49).

§213.243 Track Inspection Reports

(a) MNR Engineering Department requires that a number of inspection reports be filled out for scheduled and special inspections.

(b) Track inspection reports as required by the MW-4 or by Engineering Practice are listed below:

Report	MNR Form Number	Reference	Copies To*
Daily Track Inspection Report	MW-49	MW-4, Part I, §§213.233, and 213.7(b)	Track Supervisor (original), Foreman Track Patrol (copy)
Monthly Switch Inspection Report	MW-41	MW-4, Part I, §213.233	Track Supervisor (original), Switch Inspection Foreman (copy)
Annual Switch Inspection	MW-41 Marked as Annual	MW-4, Part I, §213.233	Track Supervisor (original), Assistant Director - Track Maintenance (copy)
Yard Switch Inspection	Designated by Yard & Date Inspected	MW-4, Part I, §213.233	Track Supervisor (original), Inspection Foreman (copy)
Monthly Miter Rail Inspection	MW-45	MW-4	Track Supervisor (original), Inspection Foreman (copy)
Periodic Joint Inspection	MW-43	MW-4, Part I, §213.119(g)	Track Supervisor (original), Track Foreman (copy)
Special Inspection	MW-49	MW-4, Part I, §213.239	Track Supervisor (original), Track Foreman (copy)
Track Disturbance Report	Report A and/or B and/or C	MW-4, Appendix A	Track Supervisor (original)
Track Geometry Car (TGC)	Geometry Run	MW-4, Part I, §213.233	Track Supervisor (original), Assistant Director - Track Maintenance (copy)
*Original documents must be forwarded to Assistant Director of Track Coordination			

§213.250 Tool Requirements

(a) The Foreman Track Patrol or some specific person who is responsible for performing the track/switch inspection shall plan ahead and coordinate with the Track Supervisor to ensure that inspection tools are available when the inspection is made.

(b) The Foreman Track Patrol or some specific person who is responsible for performing the inspection shall notify the Track Supervisor when tools become in disrepair so that a tool can be fixed or replaced.

(c) Specified numerical limits given in all Parts are to be confirmed during the track/switch inspection with the appropriate tool. Values are not to be estimated or approximated. Only measured values are to be recorded.

(d) The Foreman Track Patrol or some specific person who is responsible for performing inspections are encouraged to make periodic recommendations for improvements in existing tools or gauges and changes in tools that are needed to make the required inspection measurements.

§213.251 Inspection Tools

(a) Marking crayon (keel) may be used to mark stations, tie lengths, dimensional data, and other information that will be made part of the inspection.

(b) A mirror to be used to view difficult areas, especially the base or fillet of the rail or connections to the moveable point frog and switch point area.

(c) A cloth measuring tape or folding wooden ruler may be used to measure track components and ties in the turnouts. The tape or ruler shall be non-conducting. The tape or folding wood ruler can also be used to measure switch point throw, frog guard face and guard check, stations for alignment measurements, rail flow, tie spacings, offsets, and other key dimensional data.

(d) A standard combination track gauge with level shall be used so that gage, flangeway, crosslevel and superelevation measurements can be made.

(e) A machined straightedge (minimum of 18" in length) shall be used to measure batter and chipping of rail ends, wear, soft spots, and engine burns on frogs and rail heads.

(f) A 36" machined straightedge shall be used to measure the straightness of field and plant welds.

(g) A taper gauge shall be used in conjunction with the straightedge to measure the depth of engine burns, soft spots, batter, and other anomalies in the rail head. In addition, the taper gauge shall be used to measure switch point/stock rail gap, and the gap at the moveable point frog.

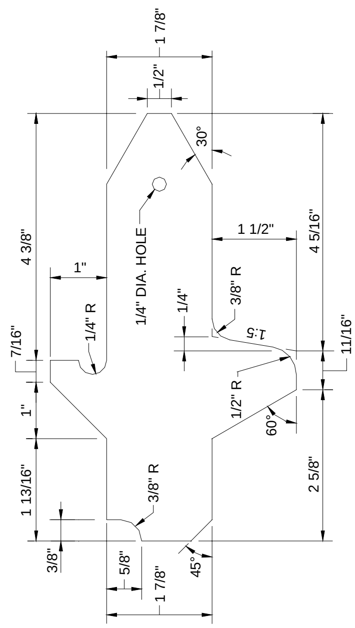
(h) Stringline equipment capable of measuring 31' and 62' chords shall be used to check “alignment” spots. A discussion of stringlining curves is given in §55.2(M).

(i) The following gauges may be used to check critical dimensions in and around frogs:

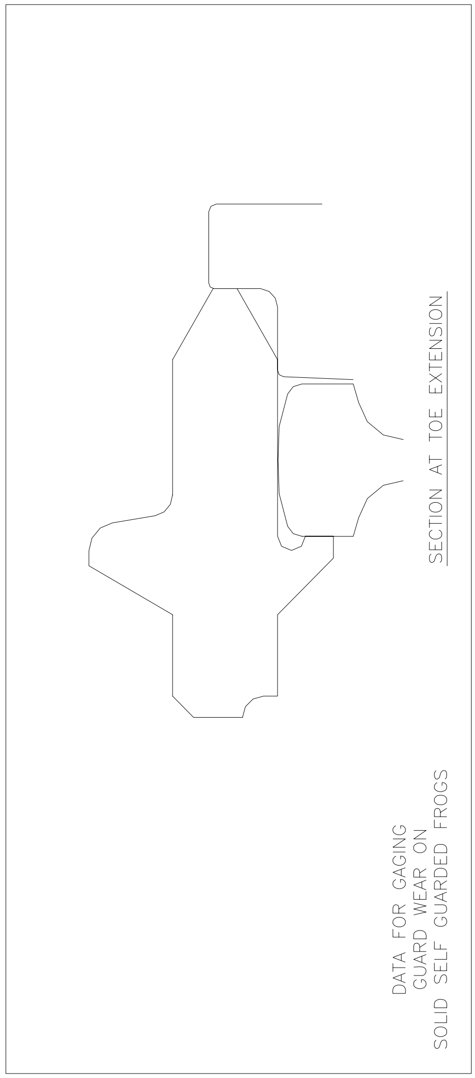
   (1) Flangeway gauge: the gauge is designed to measure the flangeway in worn frogs so that grinding and welding repairs can be programmed. The gauge to be used by the track inspector shall conform to American Railway Engineering and Maintenance Association (AREMA) Plan No. 790-94.

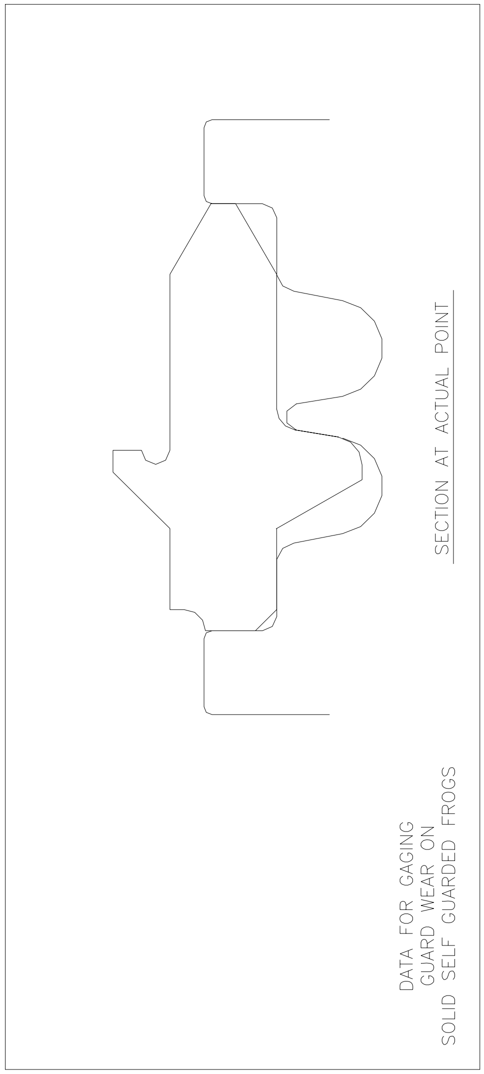
   (2) The check gauge is used to test the flangeways in worn frogs and crossings for grinding or for welding repairs when necessary. It is designed for normal 1-7/8" flangeways and proper allowance should be made when used with wider flangeways. Standard contour gauge for self guarded frogs is shown on the next page.

   (3) Guard wear gauge: the gauge is designed to measure the wear on the guarding faces on a self-guarded frog. The gauge to be used by the track inspector shall conform to AREMA Plan No. 790-94 shown below.



DATA FOR GAGING
GUARD WEAR ON
SOLID SELF GUARDED FROGS

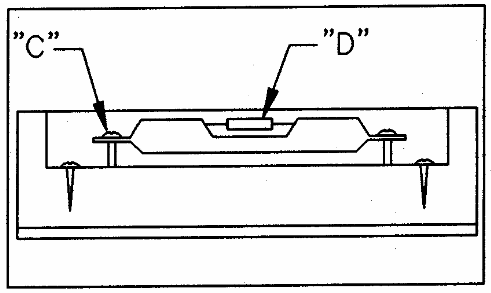

SECTION AT TOE EXTENSION
DATA FOR GAGING
GUARD WEAR ON
SOLID SELF GUARDED FROGS


SECTION AT ACTUAL POINT
DATA FOR GAGING
GUARD WEAR ON
SOLID SELF GUARDED FROGS

(j) Approved rail thermometer.

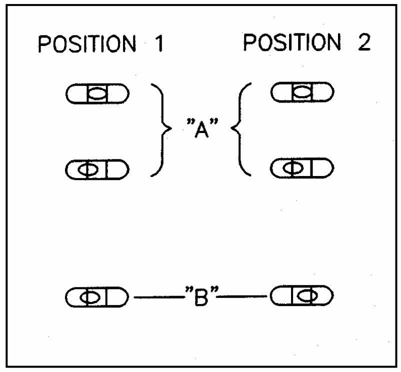
(k) Level board: the track inspector shall ensure that the level board is checked and maintained to measure correct crosslevel readings.

(l) Adjusting a Level Board



1. Set the level board on the tangent track where accuracy was checked and the difference in elevation between the two rails is known.
2. If required, turn the adjusting screw "C" to return the bubble "D" halfway between the readings for the known elevation. Center the bubble if possible.
   - Turning the adjusting screw to the right moves the bubble away from the screw. (Memory Aid: "Turn screw right away")
   - Turning the screw to the left moves the bubble toward the screw.
3. Turn the level board end for end and place it at the same point on the track.
4. See if the bubble is centered or the same. If the bubble rests at the same place, the board is adjusted.
5. If the bubble readings are not the same, or not centered, continue steps 2 through 4. When the bubble is always at the same location (and centered) and level board is adjusted.

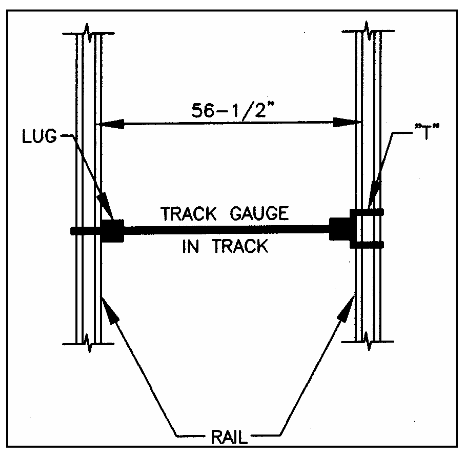
(m) Adjusting a level board by bubble positions.



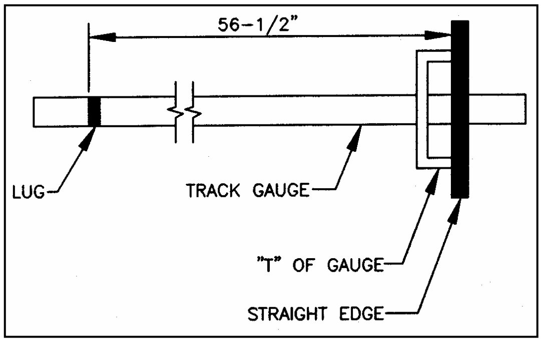
1. Place level board on the rails
2. Note position of the bubble.
3. Turn level board end for end and place it at the same point on the track.
4. Note position of the bubble again.
5. If the bubble comes to rest in the same position both times "A", the board is in adjustment.
6. If the bubble comes to rest in different positions "B", adjustment of the board is necessary. See "Adjusting a Level Board" (k).

(n) The track inspector shall check and verify daily prior to use that standard track gauges are correctly measuring track gage.

(o) Checking a non-adjustable track gauge.



1. Turn the gauge upside down.
2. Place a straightedge along the “T” of gauge.
3. Measure the distance between the nearest face of straight edge and the lug.
   - If the measurement is 56-1/2", the track gauge is accurate.
   - If the measurement is not 56-1/2", the track gauge is inaccurate. DESTROY AND DO NOT USE IT!



Track Gauge Check

SUBPARTS A–F

RECOMMENDED PRACTICE FOR THE INSPECTION AND RESTORATION OF SPECIAL TRACKWORK

RECOMMENDED PRACTICE FOR THE INSPECTION AND RESTORATION OF SPECIAL TRACKWORK SUBPARTS A-F

Subpart A — General

§213.1(ST) Scope

(a) This subpart includes the general requirements for turnouts, slips, crossings (diamonds), and other special trackwork. Miter rails and expansion joints are found in Part I.

(b) Part I provides information that is not found in other parts.

(c) Inspection of special trackwork shall be made monthly. The results of these inspections shall be reported on the appropriate inspection forms. These inspections shall be made to ensure the integrity and safety of all components and systems that make up special trackwork.

(d) These requirements and limits apply where one of the described track conditions is found to exist at a single location. Where a combination of two or more of these conditions is found to exist at the same location, even though none are individually beyond the inspection limits, judgment must be used to determine the extent to which such combinations may require remedial action to provide for safe operations.

§213.3(ST) Application

(a) This subpart applies to all special trackwork inspected and maintained by MNR.

§213.5(ST) Responsibility for Compliance

(a) Primary responsibility for inspection of special trackwork is delegated to the Track Department.

(b) When it is known by a person qualified under Part I, §213.7(b) that a track does not comply with the requirements of this Part, the following action must be taken:

- (1) Bring the track into compliance;
- (2) Halt operations over that track; or
- (3) Operate under the authority of a person designated under Part I, §213.7(a), who has at least one year of supervisory experience in railroad track maintenance, subject to conditions set forth is this part.

§213.7(ST) Designation of Qualified Individuals

(a) MNR shall designate qualified individuals responsible for the inspection and restoration of special trackwork as prescribed in Part I, §213.7(b).

(b) Individuals making inspections of track and special trackwork shall be trained by and have met the requirements of MNR Track Department Training Program.

(c) The Assistant Vice President - Maintenance of Way shall approve the training program for the inspection and maintenance of special trackwork.

(d) Inspectors shall be thoroughly familiar with the nomenclature, procedures, techniques, and equipment required to perform inspection in accordance with this Part.

(e) Designated inspectors and persons responsible for the sign-off and review of inspections, as prescribed in this Part, are given in Part I, §213.235(ST).

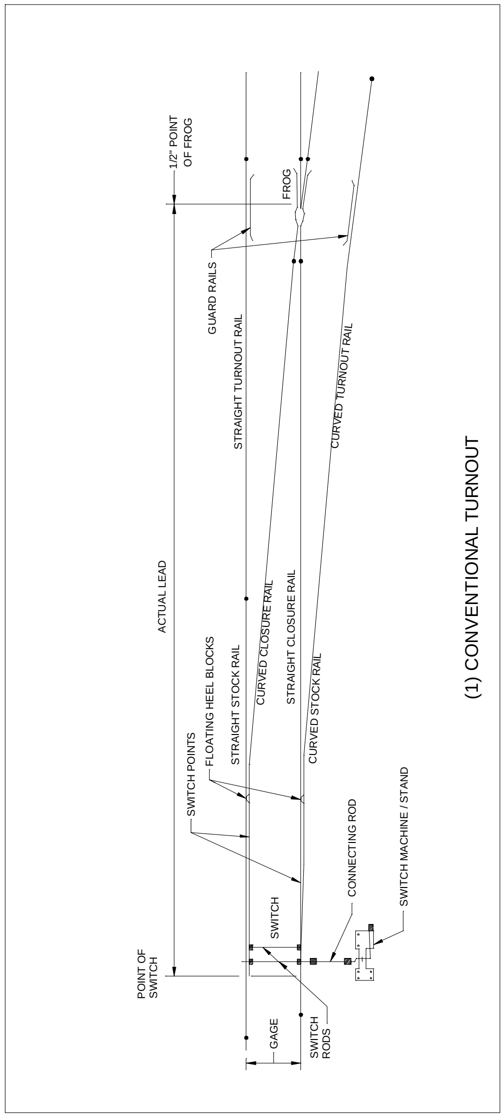
§213.8(ST) Definitions

Definitions of major systems and components of special trackwork are provided in Appendix F to establish standard nomenclature that shall be used throughout this Part.

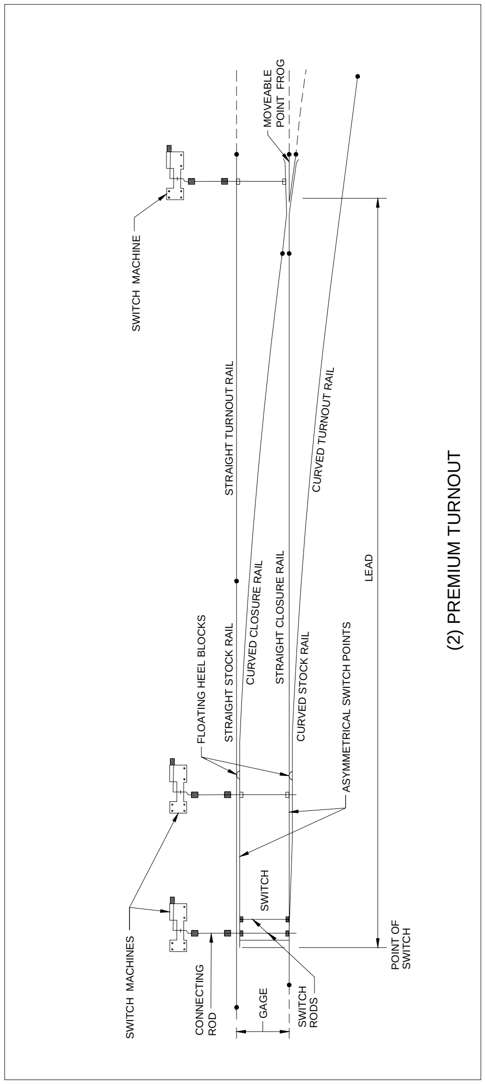
§213.8.1(ST) Drawings/Photos (General)

(a) Schematics of special trackwork are provided in MW-4 to illustrate the placement, location, and general arrangement of more common major special trackwork components. The major special trackwork types and components are illustrated in the following drawings and photos:

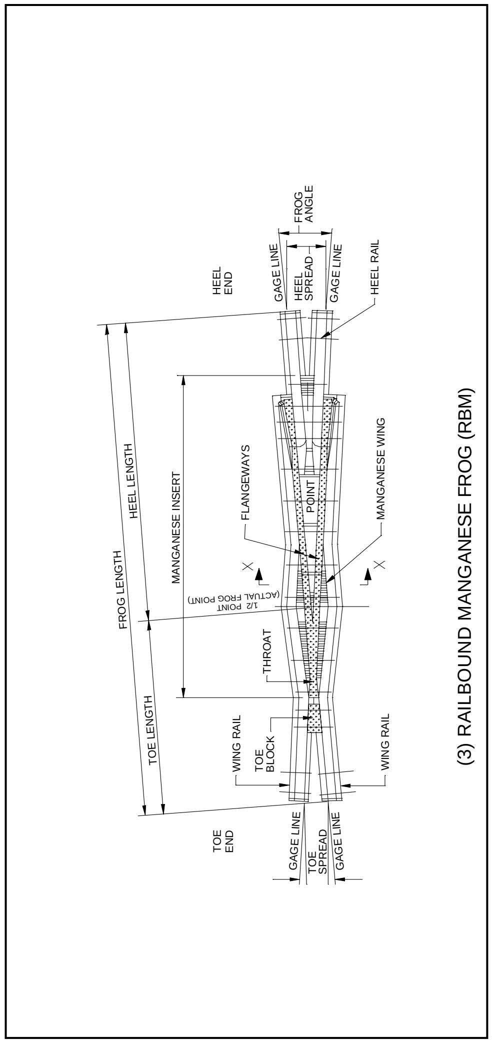
(1) Conventional Turnout
(2) Premium Turnout
(3) Railbound Manganese Frog (RBM)
(4) Railbound Manganese Frog – Section X-X
(5) Self-Guarded Manganese Frog (SGM)
(6) Self-Guarded Manganese Frog – Section Y-Y
(7) Spring Frog Details
(8) Spring Frog
(9) Spring Frog Turnout
(10) Moveable Point Frog
(11) Guard Rail – Hook Flange Type
(12) Guard Rail – Hook Flange Type – Section A-A
(13) 29' Guard Rail with Spring Frog
(14) Double Slip Switch Parts
(15) No. 10 Double Slip
(16) Moveable Center Point Assembly for a Double Slip or As A Low Angle Crossing
(17) Bolted Rail Crossing 2 - Rail Design
(18) Bolted Rail Crossing 2 - Rail Design – High Angle
(19) Bumping Post – Fixed
(20) Bumping Post with Hydraulic Ram
(21) Sliding Block Derail
(22) Single Point Switch Point Derail
(23) Hinged Block Derail



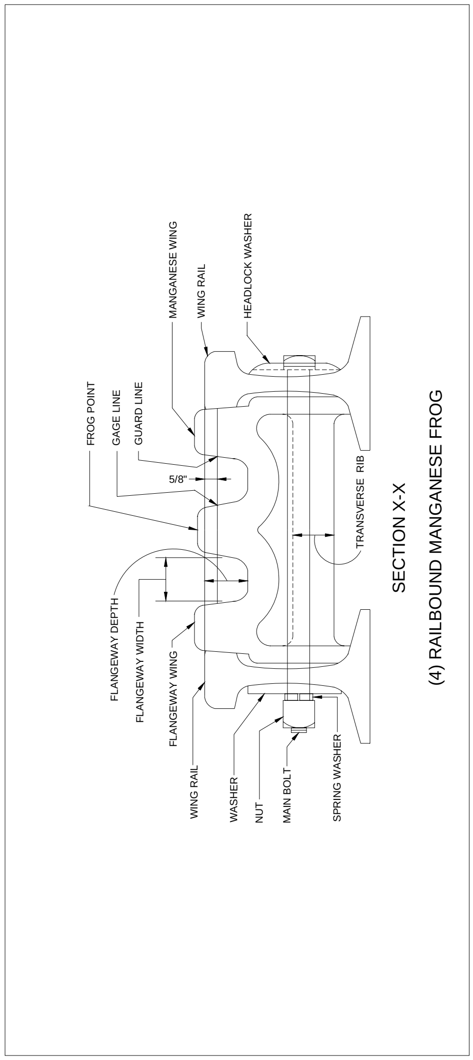
(1) Conventional Turnout



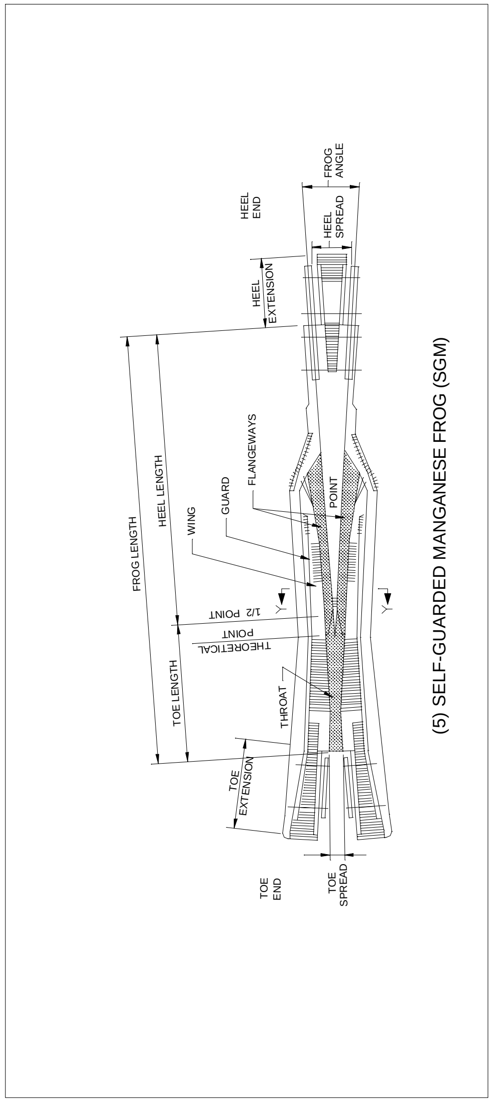
(2) Premium Turnout



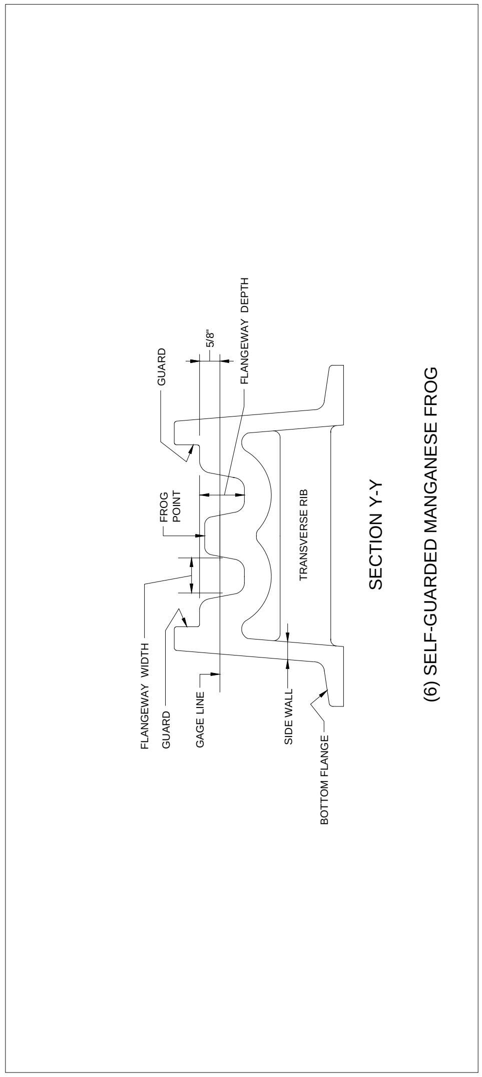
(3) Railbound Manganese Frog (RBM)



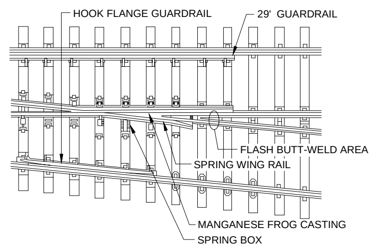
(4) Railbound Manganese Frog – Section X-X



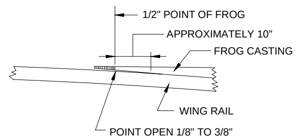
(5) Self-Guarded Manganese Frog (SGM)



(6) Self-Guarded Manganese Frog – Section Y-Y

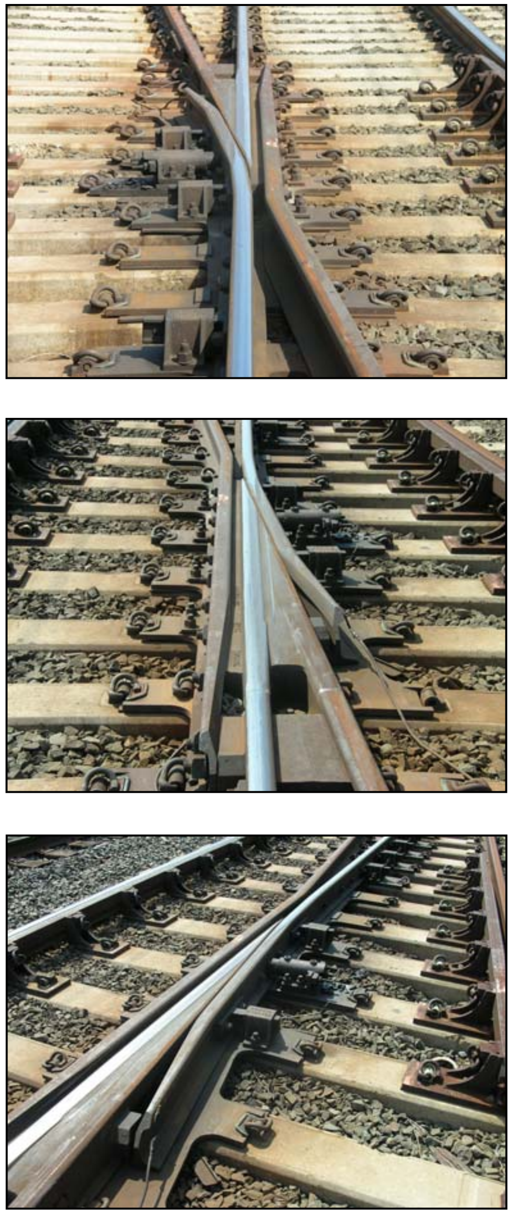


MANGANESE SPRING FR0G LAYOUT (8)



DETAIL OF SPRING FROG POINT AREA (9)

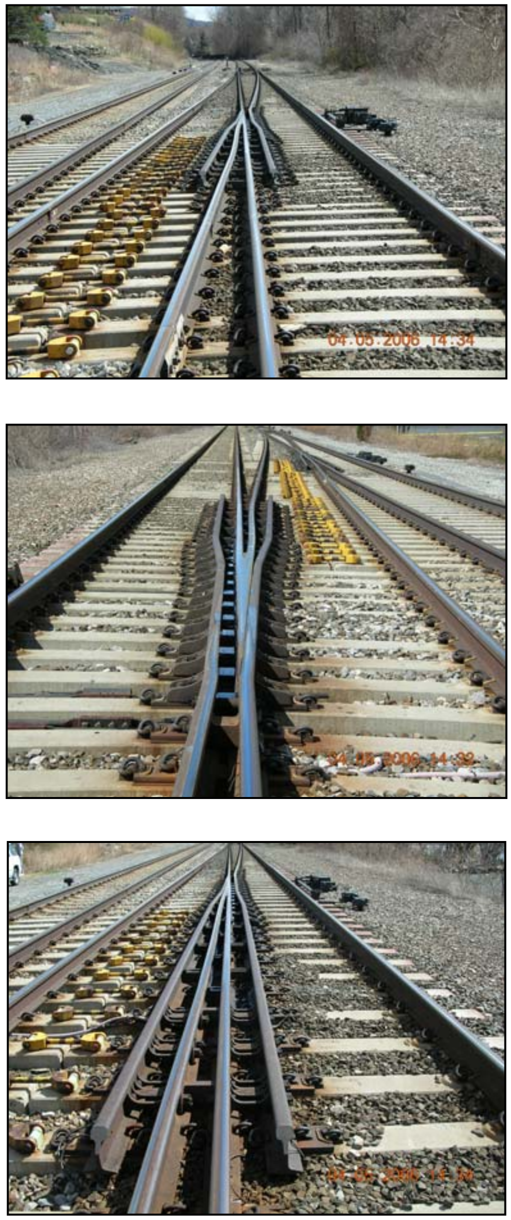
(7) Spring Frog Details



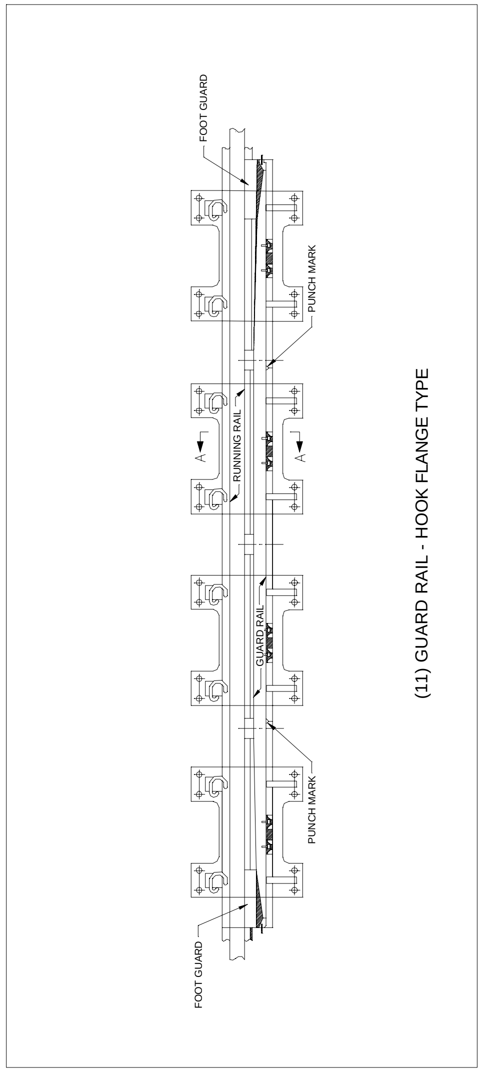
(8) Spring Frog

***Safety Reminder – Hi-Rail and Track car moves are restricted to 1 MPH in any direction over the diverging route of a spring frog**

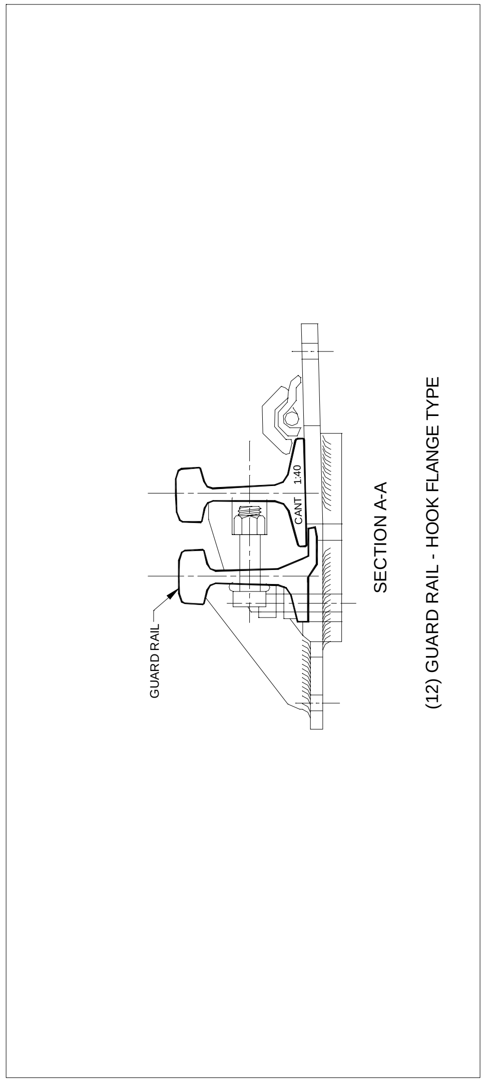
(9) Spring Frog Turnout



(10) Moveable Point Frog

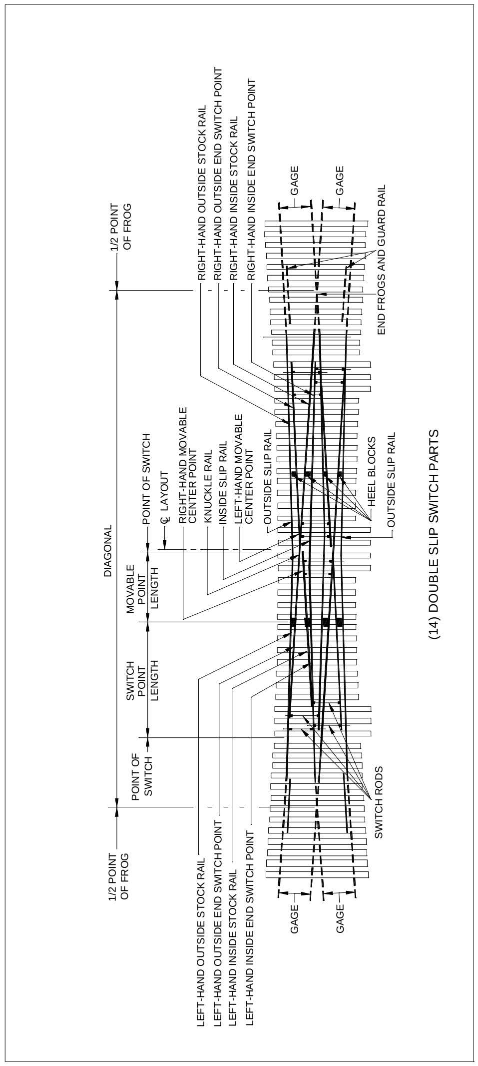


(11) Guard Rail – Hook Flange Type

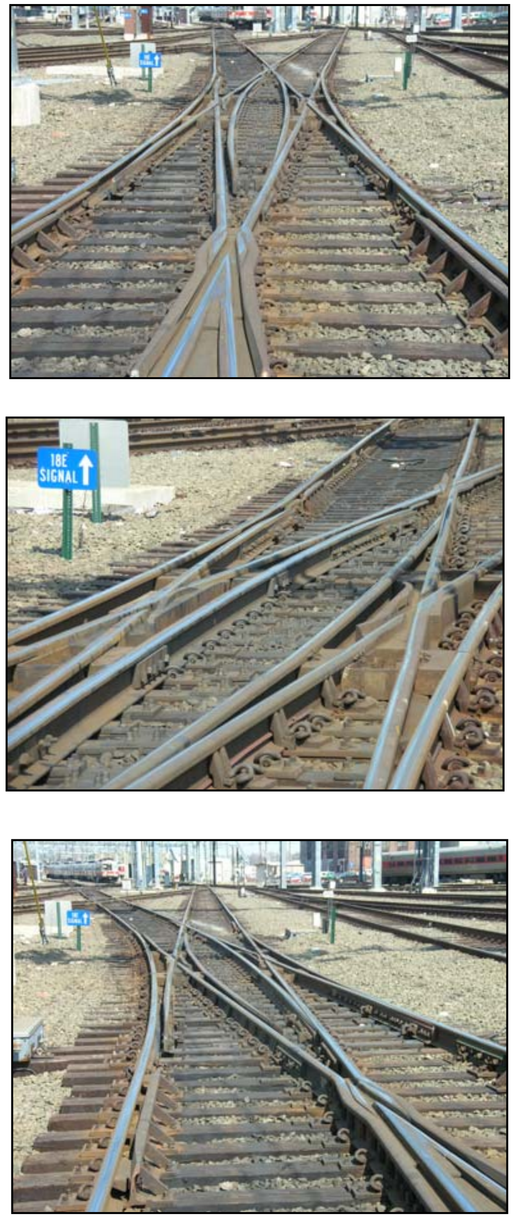


(12) Guard Rail – Hook Flange Type – Section A-A

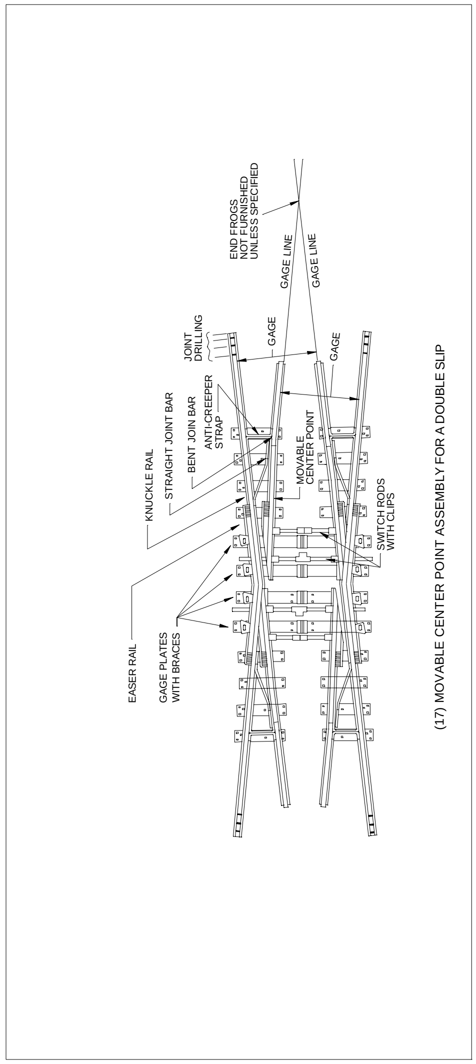
(13) 29' Guard Rail with Spring Frog



(14) Double Slip Switch Parts

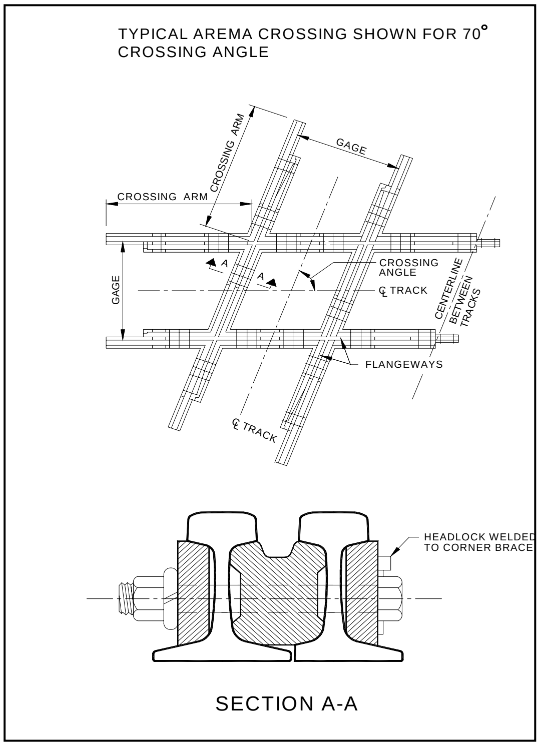


(15) No. 10 Double Slip



(16) Moveable Center Point Assembly for a Double Slip or As A Low Angle Crossing

(17) Bolted Rail Crossing 2 - Rail Design



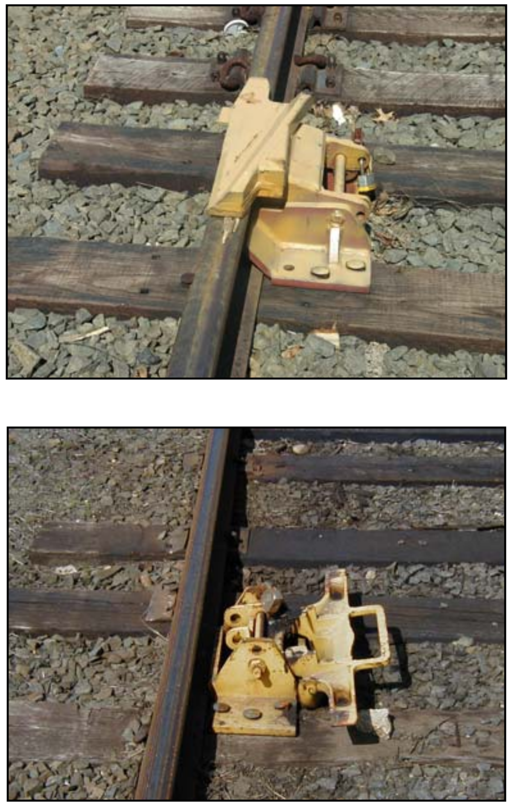
(18) Bolted Rail Crossing 2 - Rail Design – High Angle

(19) Bumping Post - Fixed

(20) Bumping Post with Hydraulic Ram

(21) Sliding Block Derail

(22) Single Point Switch Point Derail



(23) Hinged Block Derail

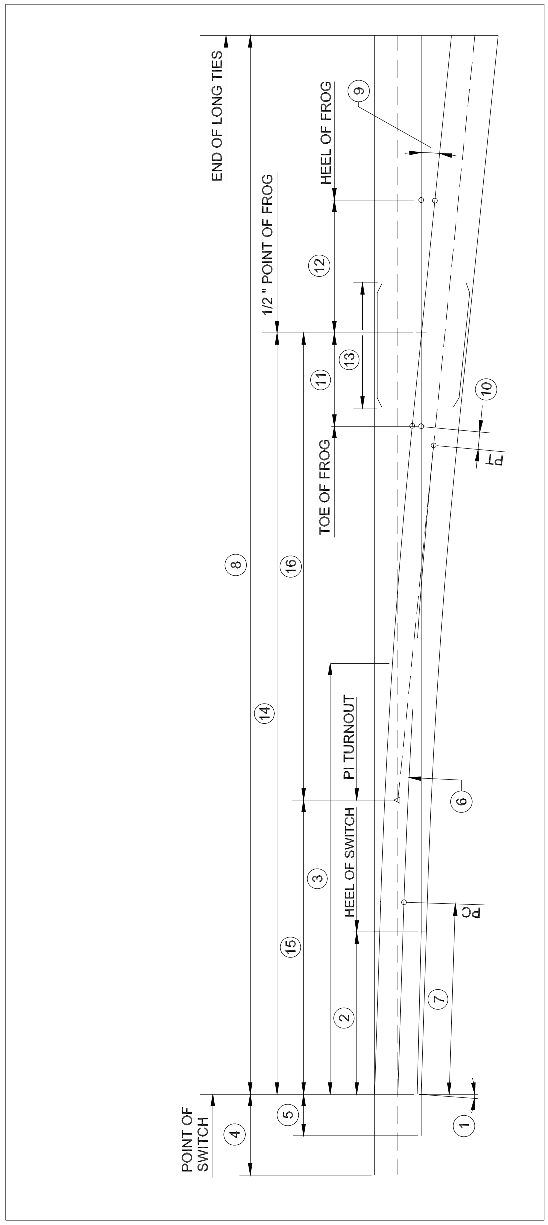
§213.8.2(ST) Types

(a) Standard turnouts currently being purchased and installed by MNR are included in the following table:

Standard or Conventional Turnouts	
Turnout Description	**Turnout Classification**
No. 6.5 welded[(1)] turnout with RBM (wood ties)	6.5 RBM
No. 7 welded[(1)] turnout with RBM (wood ties)	7 RBM
No. 8 welded[(1)] turnout with RBM (wood ties)	8 RBM
No. 10 welded turnout with RBM (wood and concrete ties)	10 RBM
No. 15 welded turnout with RBM (wood or concrete ties)	15 RBM
No. 20 welded turnout with RBM (wood ties)	20 RBM
Premium Turnouts	
No. 10 welded[(1)] turnout with spring frog (concrete ties)	10 SF
No. 15 tangential turnout with moveable point frog and asymmetrical switch points (concrete ties)	T 15 MPF
No. 20 tangential turnout with moveable point frog and asymmetrical switch points (concrete ties)	T 20 MPF
No. 26.5 tangential turnout with moveable point frog and asymmetrical switch points (wood ties)	T 26.5 MPF
No. 32.75 tangential turnout with moveable point frog and asymmetrical switch points (concrete ties)	T 32.75 MPF
[(1)] A turnout with a floating heel block is designated as a "welded turnout."	

§213.8.3(ST) Turnout Characteristics

(a) A list of the major standard types of turnouts currently in service on the MNR system along with general turnout information is given in the following table:



Key to Dimensions Found In Following Table

Turnout Data Table

(1) FROG NO.	SWITCH ANGLE ①	PS TO HEEL OF SWITCH ②	EXTENDED SWITCH LENGTH ③	STOCK RAIL LENGTH BENT	STOCK RAIL LENGTH STR	STRAIGHT STAGGER ④	BENT STAGGER ⑤	CENTERLINE RADIUS ⑥	DEGREE OF CURVE (ARC)	(2) PS TO PC ⑦	PS TO END OF LONG TIES ⑧	FROG ANGLE ⑨	(2) TOE OF FROG TO PT ⑩	TOE LENGTH ⑪	HEEL LENGTH ⑫	GUARD RAIL LENGTH ⑬	ACTUAL LEAD ⑭	PS TO PITO ⑮	PITO TO 1/2 " POINT OF FROG ⑯	DIVERGING SPEED CIVIL (Eu = 3")	DIVERGING SPEED SIGNAL
LATERAL TURNOUTS, RIGID FROG (4)																					
8	1°48'32"	16'-6"	27'-0"	39'-0"		8'-2 1/2 "	4'-2 1/2 "	446.100'	12°50'37"	19'-4 1/2 "	92'-10"	7°09'10"	0'-0"	7'-0"	11'-0"	13'-0"	68'-0"	30'-0"	38'-0"	18	15
10	1°48'32"	16'-6"	27'-0"	39'-0"		8'-2 1/2 "	4'-2 1/2 "	706.872'	8°06'20"	19'-7 1/8 "	109'-0 3/4 "	5°43'29"	0'-0"	9'-6"	13'-6"	13'-0"	77'-4 3/4 "	29'-10 3/4 "	47'-6"	23	15
15	0°44'47"	26'-0"	38'-0"	60'-0"		10'-7 1/2 "	6'-7 1/2 "	1853.415'	3°05'29"	0'-0"	159'-11 7/16 "	3°49'06"	1'-6"	10'-4"	16'-4"	20'-0"	111'-2 3/4 "	39'-11 3/4 "	71'-3"	37	30
20	0°25'30"	39'-0"	59'-6"	60'-0"		10'-7 1/2 "	6'-7 1/2 "	3289.332'	1°44'31"	0'-0"	220'-5 1/2 "	2°51'51"	1'-6"	13'-1"	21'-1"	20'-0"	154'-6 1/2 "	59'-6 1/2 "	95'-0"	50	45
LATERAL TURNOUTS, SPRING FROG																					
10	1°48'32"	16'-6"	27'-0"	39'-0"		8'-2 1/2 "	4'-2 1/2 "	706.757'	8°07'31"	19'-7 1/8 "	109'-0 3/4 "	5°43'29"	-16'-3 1/2 "	25'-4 1/2 "	14'-6"	(3) 29'-0"/13'-0"	77'-4 3/4 "	29'-10 3/4 "	47'-6"	23	15
EQUILATERAL TURNOUTS, MOVEABLE POINT FROG (5)																					
15	0°22'24"	26'-0"	38'-0"	60'-0"		10'-7 1/2 "	6'-7 1/2 "	3706.808'	1°32'44"	0'-0"	159'-11 7/16 "	3°49'06"	0'-1 1/2 "	11'-8 1/2 "	24'-3 1/2 "	N/A (6)	111'-2 3/4 "	39'-11 3/4 "	71'-3"	53	45
20	0°12'45"	39'-0"	59'-6"	60'-0"		10'-7 1/2 "	6'-7 1/2 "	6578.664'	0°52'15"	0'-0"	226'-5 1/2 "	2°51'51"	0'-2"		29'-9"	N/A (6)	154'-6 1/2 "	59'-6 1/2 "	95'-0"	70	60
26.5		64'-4 3/4 "	74'-4 3/4 "	76'-6 1/2 "		7'-0 1/4 "	7'-0 1/4 "	10694.000'	0°32'09"	5'-7 7/8 "	308'-6 3/4 "	2°09'40"	8'-9 7/8 "		24'-8"	N/A (6)	221'-1 1/4 "	95'-2 3/4 "	125'-10 1/2 "	89	80
TANGENTIAL TURNOUTS, MOVEABLE POINT FROG																					
15			59'-3"	74'	78'	10'-7 1/2 "	6'-7 1/2 "	1622.174'	3°31'55"	-2'-8"	171'-4 13/16 "	3°49'06"	4'-10 1/8 "	11'-8 1/2 "	24'-3 1/2 "	N/A (6)	122'-7 13/16 "	51'-4 13/16 "	71'-3"	35	30
20			81'-4 1/2 "	96'	100'	10'-7 1/2 "	6'-7 1/2 "	3212.010'	1°47'02"	-4'-1 29/32 "	235'-0 5/8 "	2°51'51"	-0'-7"	14'-5"	29'-9"	N/A (6)	171'-1 5/8 "	76'-1 5/8 "	95'-0"	49	45
26.5		64'-4 3/4 "	74'-4 3/4 "	76'-6 1/2 "		7'-0 1/4 "	7'-0 1/4 "	5347.000'	1°04'18"	-5'-7 7/8 "	308'-6 3/4 "	2°09'40"			24'-8"	N/A (5)	221'-1 1/4 "	95'-2 3/4 "	125'-10 1/2 "	63	60
26.5		88'-2 11/32 "	113'-6"	124'	128'	10'-7 1/2 "	6'-7 1/2 "	8556.759'	0°40'11"	-7'-5 15/16 "	368'-5 1/2 "	2°09'40"		20'-11"	55'-1"	N/A (6)	276'-4 3/8 "	153'-10 3/4 "	122'-5 5/8 "	80	70
32.75			121'-4 1/2 "	132'	136'	10'-7 1/2 "	6'-7 1/2 "	10116.255'	0°33'59"	-8-10 3/4 "	406'-6 29/32 "	1°44'52"	-24'-4 9/32 "	24'-4 9/32 "	47'-7 23/32 "	N/A (6)	301'-1 3/16 "	145'-5"	155'-8 3/16 "	87	80

NOTES:

1. The frog number is the run over the rise of a frog casting.

   Example: A frog that changes in width from 6" to 12" (rise) over a distance of 60" (run) is a 60"/6" = Number 10 frog.

2. Negative values in column 7 indicate a distance back from the point of switch. For column 10 they indicate a distance forward from the toe of frog in a turnout when using a handed frog design.

3. Guard rail lengths for a No. 10 turnout with moveable point spring frog are for the straight and diverging sides respectively.

4. For moveable point frog designs using lateral No. 15 and No. 20 layouts, use frog arm lengths and distances to the point given for tangential moveable point frog designs.

5. For rigid frog designs using equilateral No. 15 and No. 20 layouts, use frog arm lengths and distances to the point given for lateral rigid frog designs.

6. No guard rails are used on moveable point frog turnouts except for No. 10 spring frog turnouts.

(b) In addition to the turnout specified above there are numerous turnouts in track that are non-welded and have conventional bolted heel blocks.

§213.8.4(ST) Slip Switch Characteristics

On the following page is a general listing of slip switch characteristics.

General Characteristics of Standard Slips[a][b][c]

Slip No.	End Frog to End Frog (1/2" points)	Radius	Outside Switch Point Length	Center Switch Point Length	Switch Angle	Frog Angle	End Frog No.	End Frog Length	Center Frog Length
8	76'-1-3/4"	678.83'	17'-0"	10'-3-7/8"	1°-14'-04" (undercut)	7"-09'-10"	8	13'-0"	N/A
10	95'-1-3/8"	1193.42'	19'-6"	11'-6"	1°-01'-56" (undercut)	5"-43'-29"	10	16'-6"	N/A

Notes: (a) Data may not be consistent with all existing slips.

(b) See AREMA Plan No. 813-55 Double Slip Switch With Moveable Center Points

(c) See AREMA Plan No. 814-55 Double Slip Switch With Moveable Center Points

Subparts B, C, D and E — Inspection Limits

§213.50(ST) Required Measurements

(a) Inspection limits are limits, once passed, that would require the immediate repair of track, slow orders, or removal from service. It is MNR's policy to have track that never reaches these limits.

(b) Each turnout inspection form has dedicated columns and rows that are provided as part of the inspection report for the inspector to make and record "required measurements."

(c) Measurements shall be recorded on the appropriate inspection report and compared with the prescribed minimum acceptable inspection limits contained in the applicable subparts of MW-4. For a list of forms see Part I, §213.243.

(d) The inspector may take as many additional measurements as required to adequately describe the condition of the turnout.

(e) The inspector shall have the necessary complement of tools required to perform the appropriate level of inspection (see Part I, §213.250 for a recommended list of tools).

(f) Wayside turnouts will be identified by name and location as designated in the timetable.

(g) Switches within interlocking limits shall be designated by number and name of interlocking.

(h) The inspector shall fill out all portions of the inspection form before signing.

§213.51(ST) Inspection Limits

(a) Measurements made during turnout inspection shall be compared with the values or limits specified in this subpart or with other appropriate subparts of Part I.

(b) The inspector will take the necessary remedial action, if required, in accordance with Part I, §213.5.

(c) Inspectors are reminded that the speed of the track through the two routes of a turnout will likely be different. Track class will be determined by the speed of the route inspected.

§213.53(ST) Gage

Gage measurements shall be taken in special trackwork as indicated on the appropriate inspection form and shall not exceed the prescribed limits given in Part I, §213.53.

§213.55(ST) Alinement

Alignment measurements shall fall within the prescribed limits given in Part I, §213.55.

§213.57(ST) Curves: Elevation and Speed Limitations

Elevation measurements and the maximum allowable speed in curves shall be as prescribed in Part I, §213.57.

§213.63(ST) Track Surface

Track surface measurements shall fall within the prescribed limits given in Part I, §213.63.

§213.64(ST) Turnouts Diverging to the High Side of Curve (Track Surface)

(a) Turnouts and crossovers in curves that have the diverging route (turnout side) to the outside of the curve shall:

(1) Meet the requirements of Part I, §213.63.

(2) Be inspected and maintained according to the maximum allowable speed for the diverging route and the straight route.

(b) When the diverging route of a turnout or crossover is located to the outside of a curve:

(1) The maximum speed through the diverging route will be determined by using the V_{max} formula (Part I, §213.57) or the geometry or layout of the turnout; whichever is more restrictive.

(2) The maximum diverging speed through a No. 32.75 turnout on MNR is 80 MPH (Class 4).

(3) For a turnout located in a uniformly elevated curve, the reverse crosslevel elevation (see Part I, §213.63) may not be more than:

Track Surface	**Class of Track (inches)**				
Turnouts diverging to the high side of a curve	**1**	**2**	**3**	**4**	**5**
The reverse crosslevel elevation on curves may not be more than	3	2	1-3/4	1-1/4	1

(4) The maximum allowable operating speed of the straight route through the turnout shall be determined in accordance with Part I, §213.57.

§213.109(ST) Switch Ties

(a) Switch ties shall be visually inspected to make an assessment of their condition and performance in the turnout.

(b) Switch ties shall meet the requirements of Part I, §213.109.

(c) Defective switch ties shall be noted by tie number (for concrete), type of tie, and tie length, on the inspection report.

(d) In addition to the inspection guidelines for concrete ties as given in Part I, §213.109, additional inspections shall be made and conditions noted for:

(1) The condition of flexible tie splices in the crossover.

(2) The condition of the cast-in-place shoulders in the vicinity of the tie splices to ensure that these shoulders are not skewed.

(e) In all classes of track, at least half of the movement ties (ties that support mechanisms that throw switch points or moveable point frogs) at any switch machine shall be effective.

(f) Each 39' segment of track in a turnout must be supported by a minimum number of effective ties as given in the following table:

Minimum Number of Effective Wood or Concrete Switch Ties				
Class of Track	**Maximum Allowable Speed (MPH) F-P**	**Minimum Number of Effective Ties in 39'**	**Maximum Distance Between Effective Ties (center to center)**	**Maximum Number of Successive Defective Ties (normal spacing)**
1	10-15	6	100"	3
2	25-30	9	80"	3
3	40-60	10	60"	2
4	60-80	14	60"	2
5	80-90	14	60"	2

§213.113(ST) Defective Rails

All rails within the turnout shall be inspected for defects in accordance with Part I, §213.113.

§213.115(ST) Rail End Mismatch

The maximum allowable rail end mismatch for all classes of track is given in Part I, §213.115.

§213.119(ST) Continuous Welded Rail (CWR); General

Continuous welded rail in and around special trackwork must meet the requirements of Part I, §213.119 and Appendix A, Continuous Welded Rail Procedures.

§213.121(ST) Rail Joints

Rail joints in special trackwork shall be inspected and meet the requirements of Part I, §213.121.

§213.123(ST) Tie Plates/Switch Plates

(a) In Track Classes 3-5, there must be tie plates on at least 9 of any 10 consecutive wood ties.

(1) In Track Classes 3-5, no metal object that causes a concentrated load by solely supporting a rail shall be allowed between the base of the rail and the bearing surface of the tie plate Examples include tie plate shoulders, spikes, etc.

(2) Canted tie plates shall be installed so as to ensure that the rail is canted inward.

(b) The welds on switch plates and tie plates with welded shoulders, stops, etc. shall be visually inspected for cracks and breaks.

(c) Switch plates shall be inspected to see that the stock rails are seated properly in the plates.

(d) Switch plates that accept elastic or spring type fasteners to limit the movement of the stock rail shall be inspected to see that the fasteners are functioning as intended.

(e) Turnouts with raised switch plates shall be inspected for wear, breakage, and damage. Plates with elastic clips that cannot effectively control the horizontal and vertical movement of the stock rail shall be considered defective and replaced.

§213.124(ST) Tie Pads

Missing, broken, and worn tie pads shall be replaced so that the integrity of the rail seat and fastening system for concrete ties is preserved.

§213.125(ST) Rail Anchoring (Conventional Anchors and Elastic Fasteners)

(a) Turnouts shall be inspected to determine if there is rail movement within the turnout. Rail movement shall be controlled with the placement of additional rail anchors and the replacement of worn or loose elastic fasteners as described in §125.1(M) Fasteners Required and §125.2(M) Anchor Placement.

(b) Elastic fasteners designed to restrict longitudinal rail movement are considered the same as rail anchors.

§213.127(ST) Fastening Systems

(a) Cut spikes, lock spikes, and lag screws for wood ties and resilient rail fasteners for wood or concrete ties shall meet the requirements of Part I, §213.127.

(b) All rail and appliance fastening systems within the turnout shall be inspected to determine if they are performing their intended function of limiting the horizontal and vertical movement of the rail or associated turnout component (i.e., frog, wing rail, stock rail, switch point, frog point stops, switch machine, etc.).

(c) The bolts that hold the switch motor mounts used with concrete turnouts and support the switch machine shall be inspected to ensure that the machine is being held securely and that there is no excessive motion between the machine and the operating or point detector rods.

(d) All frog point stops in the area of the moveable point frog shall be inspected to ensure that all stop bolts are tight. Any loose stop bolts shall be tightened.

(e) All switch plates shall be inspected to ensure that the plate is clean and has been properly lubricated.

(f) Rail fastening systems that are not performing their intended functions shall be replaced as soon as possible and shall be reported on the inspection form by location and tie number or shall be otherwise identified when the tie number is not available. A tie is considered defective if it contains missing or non-performing fasteners. See Part I, §213.109.

§213.133(ST) Turnouts and Track Crossings; General

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

(b) Classes 3-5 track must be fully box anchored through and on each side of track crossings and turnouts for a minimum of 200' to restrain rail movement affecting the position of switch points and frogs as described in §125.1(M)(h)(1 and 2).

(c) Each flangeway must be at least 1-1/2" wide.

(d) The flangeway depth, measured from a plane across the wheel-bearing area of the frog, may not be less than 1-3/8" in Track Class I or less than 1-1/2" in Track Classes 2-5.

§213.135(ST) Switches

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

(b) Each switch plate shall fit its stock rail properly, with the switch stand in either of its closed positions to allow wheels to pass the switch point. Lateral and vertical movement of a stock rail in the switch plates or of a switch plate on a tie shall not adversely affect the fit of the switch point to the stock rail.

(c) Broken or cracked switch point rails will be subject to the requirements of Part I, §213.113, except where remedial actions C, D, or E require the use of joint bars, and joint bars cannot be placed due to the physical configuration of the switch. When joint bars cannot be placed remedial action B will govern, taking into account any added safety provided by the presence of reinforcing bars on the switch points.

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

(e) When a worn stock rail allows wheel flanges to cause excessive or accelerated wear on switch points, the stock rail should be replaced. If possible when changing out a stock rail, a new switch point should be installed. Replacement switch points must not be installed against worn or mismatched stock rails.

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

(g) Unusually chipped or worn switch points that are found to have an unprotected flat surface 5/16" or more in width at a depth of 5/8" below the top of the stock rail and switch point must be removed from service. This type of point wear may contribute to wheel climb derailments.

(h) Metal overflow on the gage face of stock rails and on the back side of switch points should be noted on the inspection form. Flow must be removed by grinding to prevent deterioration and chipping of the rail steel and to maintain the proper fit of the switch point against the stock rail.

(i) Chipping or wear on any switch point should be investigated, its cause determined, and corrective action taken. The wear or chipping produces a sloping surface on the face of the switch point that may tend to raise or lift a wheel having an imperfect flange. The switch rail should be further examined to locate any point of hard contact by the wheel that might contribute to wheel climb.

(j) Switch points and matching non-undercut stock rails shall be replaced when worn or chipped so that the top of the switch point, at any place, is more than 5/8" below the plane across the top of stock rail.

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

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

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

(n) The motion of the switch point, connecting, operating and lock rods shall be observed when inspecting a turnout by reversing the switch points.

(o) Any loss of motion in the switch rods shall be noted on the switch inspection form so that the working components can be replaced or switch clips tightened.

(p) Each switch point shall be inspected to ensure that the point sits properly against the stock rail.

(q) Switch obstruction tests must be performed by Signal personnel at approximately 6" behind the point of switch and recorded on the proper switch inspection form. Adjustment of the connecting rod on powered switches shall be made by the Signal Department to ensure that the switch point seats properly and that the switch point gap is 3/16" or less when an obstruction test is performed by the Signal Department.

(r) Switch rods shall be inspected to see that the bearing connection on advanced technology turnouts and bolted connection to the switch point clip on conventional turnouts permits easy operation of the switch point.

(s) All switches must have all switch rods and connectors working as intended. There can be no defective or missing switch rods and connectors.

§213.136(ST) Frogs; Wing Rails (MNR)

(a) Wing rails will be inspected visually when performing the monthly switch inspection.

(b) Conditions found in any portion of the wing rail that is not contacted by the wheel tread shall be noted on the switch inspection report and be treated on an individual case basis that considers the locations and bolt support system.

§213.137(ST) Frogs; General (Railbound Manganese and Welded Heel Manganese)

(a) Each flangeway at turnouts and track crossings must be at least 1-1/2" wide.

(b) The flangeway depth, measured from a plane across the wheel-bearing area of the frog, may not be less than 1-3/8" in Track Class I or less than 1-1/2" in Track Classes 2-5.

(c) If a frog point is chipped, broken, or worn more than 5/8" down and 6" back, operating speed over that frog may not be more than 10 MPH.

(d) If a riser or insert of a frog is broken out or worn down more than 3/8" below the original contour, operating speed over that frog may not be more than 10 MPH.

(e) The wheel wear pattern on the frog shall be observed by the inspector. Unusual wear shall be noted on the inspection report so that maintenance forces can weld or grind the frog casting. The inspector shall identify the location and approximate depth and length of wear pattern.

(f) If the frog being inspected requires repair and has been previously welded, the inspector shall include the welders identification code for that repair on the inspection report.

(g) Missing or loose frog bolts shall be replaced or re-tightened.

§213.138(ST) Frogs; Moveable Point (MNR)

(a) Moveable point frogs shall be inspected to ensure that the point is free from debris and both faces of the “vee” point are seated properly in the normal and reverse positions.

(b) Switch obstruction tests must be performed by Signal personnel at the detector rod location and the results of the test recorded on the monthly switch inspection report.

(c) The motion of the moveable point frog and the connecting, operating, and lock rods shall be observed during the inspection of the turnout. This inspection is required to detect broken and missing parts and a point that has lost motion due to component wear.

(d) Adjustment of the operating rod shall be made by the Signal Department to ensure that the moveable point seats properly and that the frog point gap is 3/16" or less when performing an obstruction test.

(e) Chipped, worn, or cracked frog points in the moveable point frog shall be noted on the inspection report so that appropriate repairs can be made.

(f) Lugs on the “vee” point shall be visually inspected with the aid of a mirror to ensure that the lug is not cracked or damaged.

(g) If a moveable point frog lug is cracked or broken, the frog point must be immediately clamped to protect all train moves until the frog point is replaced. The repair of any moveable point lug by in track welding is not permitted. The frog lug repair will be made out of track at a MNR-approved welding shop.

(h) Moveable point frog points and matching wing rails shall be replaced when worn or chipped so that the top, at any place, is more than 7/8" below the plane across the tops of the wing rails.

(i) The width and length of any metal flow on the frog point or on the wing rails shall be noted on the inspection form so that maintenance forces can perform grinding maintenance.

(j) All braces and frog bolts that are loose shall be reported on the inspection form and retightened or replaced.

§213.139(ST) Spring Rail Frogs

(a) The clearance between the hold-down housing and the horn may not be more than 1/4".

(b) Typically, by design, there is a gap of up to 3/8" between the spring wing rail and frog point within the first 5" of the frog point. It is desirable to maintain contact between the spring wing rail and the remainder of the frog.

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

(d) The ties supporting the toe of each wing rail must be solidly tamped and the toe must be fully bolted.

(e) Any frog with a bolt hole defect or head-web separation must be replaced.

(f) Each spring must have sufficient compression force to hold the wing rail against the point rail.

(g) The inspector shall check the opening between the spring wing rail and frog point of spring frog to ensure that there is no debris that may impede the operation of the spring wing rail.

(h) Semi-annually, the inspector shall block the spring wing rail with a wooden wedge or other approved device for inspection (must be noted on the inspection report). The inspector shall visually inspect the spring frog and spring wing rail for breaks, cracks, chips, and unusual wear or debris. The inspector shall make use of a mirror as necessary to aid in making the visual inspection of the spring frog.

(i) While the spring wing rail is blocked in the open position the guard face gage (back to back) measurement must be taken.

(j) The inspector shall report all loose bolts found in a spring frog assembly. Bolts in the hold-down assembly and horns of a spring frog should be kept tight at all times.

(k) Any defect found in the portion of the wing rail contacted by the wheel tread or in the flex portion of the wing rail of a spring frog shall be noted on the switch inspection report.

§213.141(ST) Self-Guarded Frogs

(a) The raised guard face on a self-guarded frog may not be worn horizontally more than 3/8". Wear measurements may be taken with a contour gage (see Part I, §213.251, Inspection Tools).

(b) If repairs are made to a self-guarded frog without removing it from service, the guarding face must be restored before rebuilding the point. This practice will ensure that a wheel does not strike a rebuilt frog point.

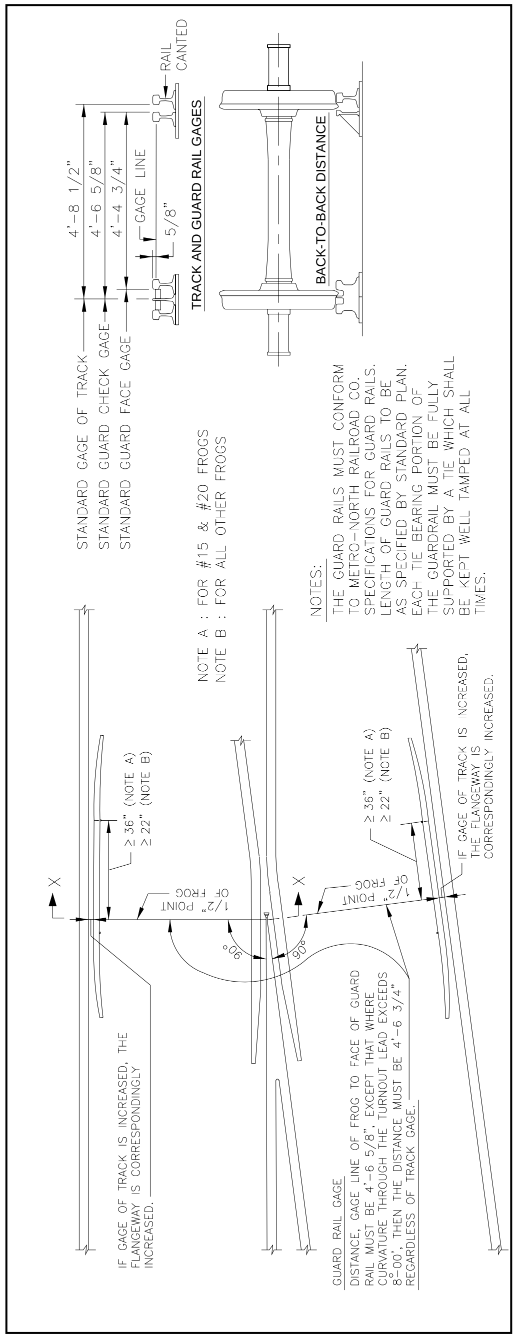
§213.143(ST) Frog Guard Rails and Guard Faces; Gage

(a) The guard check gage and guard face gage for frogs must be within the limits prescribed in the following table.

Class of Track	**<u>Guard Check Gage</u>** **The distance between the gage line of a frog to the guard line[(1)] of its guard rail or guarding face, measured across the track at right angles to the gage line[(2)], may not be less than (inches):**	**<u>Guard Face Gage</u>** **The back to back distance between guard lines[(1)], measured across the track at right angles to the gage line[(2)], may not be more than (inches):**
1	54-1/8	53-1/4
2	54-1/4	53-1/8
3 and 4	54-3/8	53-1/8
5	54-1/2	53

(1) A line along that side of the flangeway that is nearer to the center of the track and at the same elevation as the gage line.
(2) A line 5/8" below the top of the centerline of the head of the running rail or the corresponding location of the tread portion of the track structure.

(b) The relationship between the guard check gage and guard face gage is shown in the figure below:



Guard Check and Guard Face Gage

§213.205(ST) Derails

(a) For the purposes of this section, a derail is a device which will divert the movement of railroad rolling stock or other railroad on-track equipment away from the main track.

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

(c) There are generally three types of derails: the “split switch”, “sliding block” and the “hinged-block” types.

(d) Each derail must be made clearly visible with yellow paint.

(e) When in a locked position, a derail must be free of lost motion that would prevent it from performing its intended function or allow it to be operated without removing the lock.

(f) Each derail must be maintained to function as intended.

(g) Each derail must be properly installed and of the proper size for the rail to which it is applied.

(h) All main line derails shall be inspected when making a monthly turnout inspection.

§213.207(ST) Switch Heaters (MNR)

Switch heaters must be inspected to see that they do not interfere with the proper operation of the switch or otherwise jeopardize the safety of railroad equipment.

Subpart F — Inspection Responsibility and Schedule

§213.230(ST) Inspection

Special trackwork and appliances shall be inspected by qualified individuals as described in Part I, §213.7(b).

§213.235(ST) Inspection of Switches and Track Crossings

(a) Turnouts must be inspected as part of the prescribed track inspection at minimum intervals in accordance with Part I, §213.233.

(b) Except as provided in paragraph (c) of this section, for Classes 1-5 track, each switch, turnout, track crossing, expansion joint and moveable bridge lift rail assembly or other transition device must be inspected on foot monthly.

(c) Each switch in Track Classes 3-5 that is held in position only by the operating mechanism and one connecting rod shall be operated to all of its positions (normal and reverse) monthly.

(d) In the case of track that is used less than once a month in Track Classes 1-5, each switch, turnout, track crossing, expansion joint and moveable bridge lift rail assembly or other transition device must be inspected on foot before it is used.

(e) All main line switches must be inspected annually by a Track Supervisor and a report submitted to the Engineer of Track Maintenance.

(f) In the event of fire, flood, severe storm, temperature extremes or other occurrence that might have damaged the track structure, a special inspection must be made of the track involved as soon as possible after the occurrence in accordance with Part I, §213.233.

(g) If the person making the inspection finds a deviation from the requirements of this Part, the inspector shall immediately take remedial action.

(h) Each frog and switch inspection report shall be reviewed by Track Supervisor or Assistant Supervisor and forwarded to the Assistant Director - Track Coordination for review and inclusion into the Track & Structures (T&S) file.

§213.250(ST) Tool Requirements

See Part I, §§213.250 and 213.251 for a list of typical inspection tools.

SUBPARTS A–F

RECOMMENDED PRACTICE FOR THE INSPECTION AND RESTORATION OF MITER RAILS

(INCLUDES EXPANSION JOINTS)

RECOMMENDED PRACTICE FOR THE INSPECTION AND RESTORATION OF MITER RAILS (INCLUDES EXPANSION JOINTS)

SUBPARTS A-F
Track Classes 1 - 2

Subparts A—F
Track Classes 1-2

Subpart A — General

§213.1(MR) Scope

(a) Inspection limits are limits, once passed, that would require the immediate repair of track, slow orders, or removal from service. It is MNR's policy to have track that never reaches these limits.

(b) This subpart prescribes the minimum requirements and inspection limits for the inspection of miter rail systems and expansion joints on moveable bridges.

(c) The limits and specifications for miter rails and expansion joints are found in this subpart or in applicable sections of Part I.

(d) This subpart is issued by the Assistant Vice President - Maintenance of Way. Its paragraphs (and referenced paragraphs in other portions of the MW-4) shall remain in effect until notification is made of a revision to, or amendment to the paragraph, subpart or part.

(e) The results of these inspections shall be reported on the appropriate inspection forms. These inspections shall be made to ensure the integrity and safety of all components and systems that make up the entire miter rail and expansion joint system.

§213.3(MR) Application

This subpart applies to all miter rails and expansion joints on moveable bridges that MNR owns and maintains.

§213.5(MR) Responsibility for Compliance

(a) Primary responsibility for inspection of miter rails is delegated to the Track Department. In addition, the Signal, Power and Structures (B&B) Departments play key roles in these inspections.

(b) The inspection of miter rail and expansion joints shall be done monthly. (c) When it is known by the track inspector, or person in charge that a track does not comply with the requirements of this subpart, the following action must be taken:

   (1) Bring the track into compliance;

   (2) Halt operations over that track; or

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

(c) If the moveable bridge is restricted for marine operations, the U.S Coast Guard shall be notified.

§213.7(MR) Designation of Qualified Individuals

Track Department personnel designated by MNR to inspect and supervise the maintenance, restoration and renewal of miter rails and expansion joints shall be as designated in accordance with Part I, §213.7.

§213.9(MR) Classes of Track: Operating Speed Limits

Unless restricted to a lower class operation, trains passing over a track with a miter rail and/or expansion joint shall not exceed the speeds as given in the Operations Manual.

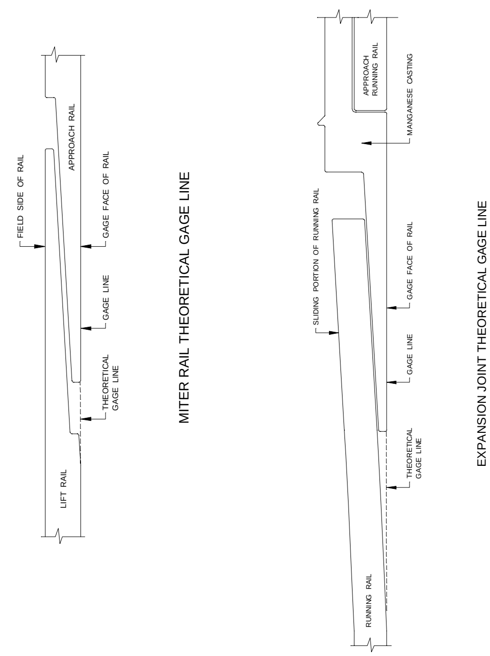
§213.13(MR) Measuring Track Not Under Load

When track, not under load, is measured to determine compliance with the requirements of this part and rail movement under load is apparent, that amount of rail movement must be added to the measurements taken.

§213.53(MR) Gage

(a) As a minimum, gage measurements shall be taken at intervals of 1', 5', 10' and 15' on both sides of the point of the miter rail or expansion joint.

(1) The point of both miter rails and expansions joints may be recessed from the gage line. Use a 36"-long straightedge to determine the locations ahead of and behind the point of the miter rails where the gage corner of the miter rail is in line with the theoretical gage line through the entire miter rail assembly. Gage shall be measured at the following points.



(b) If the point of the miter rail projects beyond the theoretical gage line, take immediate action to correct the deficiency.

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

Subpart C — Structure

§213.105(MR) Scope

This subpart describes the minimum requirements for ties, fasteners and the physical conditions at miter rails and expansion joints.

§213.113(MR) Bolt Hole Cracks in Rail, Castings and Forgings

If bolt hole cracks are found, remedial action will be taken in accordance with Part I, §213.113 "Defective Rails".

§213.115(MR) Rail End Mismatch

(a) All rail ends shall be inspected for mismatch. This includes the joints between the moveable and fixed ends of a miter rail assembly and the connecting joints to the miter rail and expansion joints.

(b) Rail end mismatch shall be measured with a 3' straight edge and a taper gauge to the nearest 1/16".

(1) Most miter rail and expansion joint designs recess the miter rail point inside of the gage line and below the nominal rail tread. The variations from the normal surfaces on either side of the miter rail point are not "mismatches" and should not be reported as such.

§213.117(MR) Rail End Batter (MNR)

Rail end batter at miter rails shall comply with Part I, §213.117.

§213.121(MR) Rail Joints In or Adjacent to Miter Rails and Expansion Joints

(a) All rail joints shall be of a structurally sound design and the proper dimension.

(b) If a joint bar is cracked, broken or because of wear allows excessive vertical movement of either rail when all bolts are tight, the track must be protected by a maximum speed restriction of 10 MPH (FRT) and 15 MPH (PAS) until the bar is replaced.

(c) If both joint bars are found to be broken entirely through between the middle two bolt holes, trains may be operated only under the visual supervision of a person designated under Part I, §213.7 at walking speed (not exceeding 5 MPH).

(d) Each rail end at a miter or expansion joint must be bolted with bolts filling all joint bar holes

(e) Repair of any miter rail or expansion joint bar by welding is prohibited.

§213.123(MR) Assembly Support Plates

(a) Castings and plates that support miter rails and expansion joints shall be in good condition. Examine for cracks, excessive corrosion or other evidence that plates and the fastenings that anchor the plates to the bridge ties are not providing adequate vertical and lateral support to the miter rail or expansion joint.

(b) Fasteners that attach the supporting plates and castings to the bridge ties shall be inspected. Threaded elements shall be of the proper size and tight. If fasteners are missing or defective, a person designated under Part I, §213.7 shall replace the defective fasteners or take the appropriate remedial action.

§213.127(MR) Fastening Systems

(a) All rail fastening systems along the miter rail or expansion joint shall be inspected to determine if they are performing their intended function of limiting the horizontal and vertical movement of the rail and associated components.

(b) Rail fastening systems that are not performing their intended function, shall be noted on the inspection report.

(c) When defective rail fastening systems are found at miter rails or expansion joints, a person qualified under Part I, §213.7 shall determine the cause and take appropriate remedial action.

§213.137(MR) Flangeways and Points

(a) Flangeway depth, measured from the top of rail plane across the track, shall not be less than 1-1/2" in all classes of track. Flangeway width must be at least 1-1/2" wide.

(b) If the point of a two piece type miter rail is chipped, broken or worn down more than 3/8" and 6" back, operating speed over the assembly shall not exceed 10 MPH.

(c) If the tread portion of a hollow manganese steel casting miter rail or expansion joint is worn down more than 3/8", operating speed over the miter rail shall not exceed 10 MPH.

§213.143(MR) Guard Face and Guard Check; Gage

(a) Whenever a miter rail includes a guarding face opposite the mitered joint, use the limits given in Part I, §213.143 “Frog Guard Rail and Guard Faces; Gage”.

(b) In-track welding of miter rail guard faces shall be accomplished by use of hard facing of the guard face.

Subpart D — General Inspection Requirements

§213.230(MR) Scope (MNR)

This subpart describes the frequency and manner of inspection of miter rails and expansion joints to detect deviations from the limits and requirements prescribed in this part.

§213.231(MR) Inspection

During the search for internal defects as required in Part I, §213.237, locations where the rail test vehicle cannot test through miter rails and expansion joints, must be hand tested once a year.

§213.232(MR) Inspection Procedures (General Requirements) (MNR)

(a) At monthly joint inspections, inspectors shall observe each miter rail in both the closed and the open positions. Swing bridges and bascule bridges need not be fully opened during each inspection.

(b) When a crack of any length is found in any miter rail component, it shall be recorded and the appropriate remedial action taken.

(c) Inspectors shall be alert for any changes in gage, alignment, profile or crosslevel that may occur between track inspections as these may indicate a structural problem with the bridge itself. Such changes should be noted on the inspection report as a non-class-specific defect.

(d) In the closed position, all components must be properly seated.

(e) When making any inspection, gaps between the fixed point and the moveable point of the miter rail assembly shall be measured, recorded and compared against previously recorded values. When making gap measurements, record rail temperatures.

(f) During the opening and closing movements of a bridge, observe any jerky or unusual movement or noise of the miter rail assembly. During closing, observe whether mating surfaces line up without being forced or requiring obvious realignment of the moveable bridge span. All miter rails must be properly seated.

(g) During the monthly inspection and special inspections as may be appropriate, while the miter rail assembly is open, remove grease and oil as may be required to conduct a thorough inspection.

    Examine contact surfaces for signs of unusual wear. Examine all surfaces for evidence of cracking or other failure. Examine bolts and other fastenings for tightness and any evidence of failures.

Subpart E — Inspection Procedures by Rail/Appliance Type

§213.233(MR) Specific Inspection Procedures

The following paragraphs give specific procedures for the inspection of the various types of miter rails and expansion joints found on the MNR. These procedures are in addition to the basic inspection requirements found in Part I, §213.232(MR).

§213.235(MR) Miter Rails and Expansion Joints

§213.235.1(MR) Mitered Point Rails and Joints

(a) Point rails must be seated properly when bridge is closed.

(b) Remove any obstructions and clean the area of any debris that may interfere with proper rail seating.

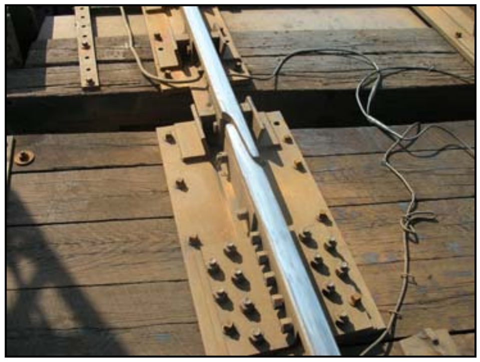
(c) Tighten any loose bolts that may interfere with the movement of lift rail assemblies. During tightening, observe the head of all countersunk bolts to ensure that they are seated properly. No part of a bolt head, thread, or nut may extend beyond the vertical face of the side bar or joint bar at heel of the mitered point rail. Replace any stripped bolts.

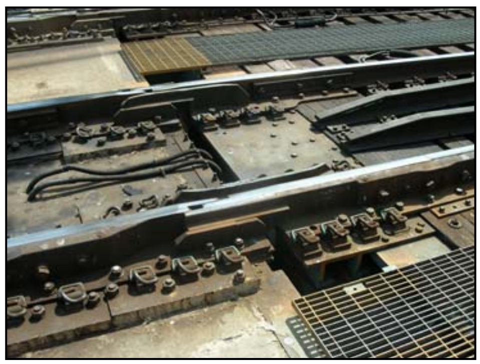
(d) If rail ends are mismatched at the miter or heel this could indicate other problems. Inspect hinge joint bolts, check for proper torque and thoroughly inspect area until the cause is found and necessary remedial action taken to eliminate rail end mismatch.

(e) Inspect the rails for metal flow, and if found, reprofile rails by grinding as necessary to assure proper operation of miter rail.

§213.235.2(MR) Bedplates

(a) Inspect for loose fasteners – tighten or replace as required.





(b) Remove any obstructions that may interfere with the rail sitting squarely and uniformly on the bedplates.

(c) Visually inspect surfaces for cracks and/or excessive wear.

(d) All cracks or breaks shall be reported to the local Track Supervisor and repairs made as necessary.

§213.235.4(MR) Inspection of Two-Piece Manganese Steel Type Miter Joint

(a) Two-piece manganese steel type miter rails shall be inspected in accordance with Part I, §213.232(MR) and the following.

(b) This miter rail design is used on bascule lift bridges. Each miter rail consists of two solid manganese steel castings. The two-piece manganese steel design has no mechanical parts since the moving bridge superstructure provides all of the movement required. A typical two-piece manganese steel miter rail is illustrated in the photographs below.

Two-Piece
Manganese Steel Miter Rail

(c) Thoroughly examine manganese steel castings for cracks or other structurally significant defects. Clean castings as required to properly view all surfaces, including removal of all grease and debris from flangeway area.

(d) All cracks or breaks that are identified by inspection shall be reported to the local Track Supervisor and repairs made as necessary.

(e) The gap between fixed and moveable rails shall be no less than 1" and no more than 7" measured parallel to the gage line.

(f) Rail end gaps outside these limits will require adjustment.

(g) Gap between rail ends shall be free from metal flow. If metal flow is present, remove by grinding.

(h) If rail ends are mismatched, this could indicate other problems. Inspect joint bolts, check for proper torque and thoroughly inspect area until the cause is found and necessary remedial action taken.

(i) With miter joints in the closed position, inspect for vertical and gage line mismatch at the miter. Confirm compliance with Part I, §213.115.

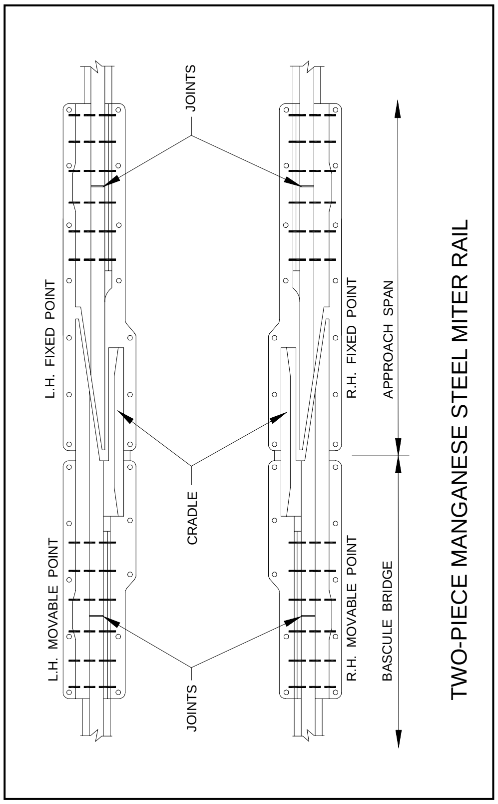
(j) Inspect rail surface defects, cracks or breaks in compliance with Part I, §213.113 (Defective Rails).

(k) If the manganese point is worn or broken out more than 5/8" down and 6" back, maximum speed is 10 MPH until repairs are made.

(l) All crack repairs must be made by a qualified welder using an approved welding process.

(m) Examine base of cradle on fixed rail end for cracks. All cracks must be repaired as soon as possible.

(n) See below drawing for locations of components described above.



§213.235.5(MR) Inspection of Rail Expansion Joints

(a) Rail expansion joints shall be inspected in accordance with Part I, §213.232(MR) and the following.

(b) It is very important that miter rail assemblies remain fixed relative to the bridge structures that they sit upon. In addition to being well-anchored to the bridge deck, the miter rails should not be subjected to high thermally induced forces from the adjacent rail. This is particularly true when the adjoining rails are continuously welded.

(c) In order to prevent rail thermal stress from moving miter rail assemblies, Peck Bridge incorporates expansion joints in the fixed rail approaches to the miter joints. Typically a single length of rail is placed between the expansion joint and the miter joint rail. The expansion joint relieves any thermally induced stress in the welded rail approaching the miter joint. Most expansion joints allow for rail movement in one direction only. The small amount of rail thermal stress that occurs between the miter rail and the sliding rail expansion joint can be handled by proper anchorage of the rails and the miter rail assembly to the bridge deck.

(d) Rail expansion joints are sometimes called "sliding rail joints" since they function by allowing the rail on the land side of the expansion joint to slide back and forth as rail temperatures change.

(e) The expansion and contraction of rail through the expansion joint minimizes rail induced stresses on the miter rail and bridge approaches.

(f) The photograph below illustrates a typical expansion joint.

Sliding Rail Expansion Joint

(g) Measure the gap at the top of the rail heads between the full side of the sliding rail and the casting. The gap should be less than 1/16". Gaps greater than 1/16" indicate the start of loose bolts, braces and blocks and will require adjustment.

(h) The gap between side of the sliding rail and the casting shall be free from any metal flow. Remove metal flow by grinding.

(i) Inspect the sliding rail of the expansion joint for surface defects, cracks or breaks in accordance with Part I, §213.113.

(j) Inspect the point area of the casting for cracks/breaks.

(k) If a point is worn or broken out more than 5/8" down or 6" back, the component shall be replaced. Until replacement is made, maximum speed is 10 MPH.

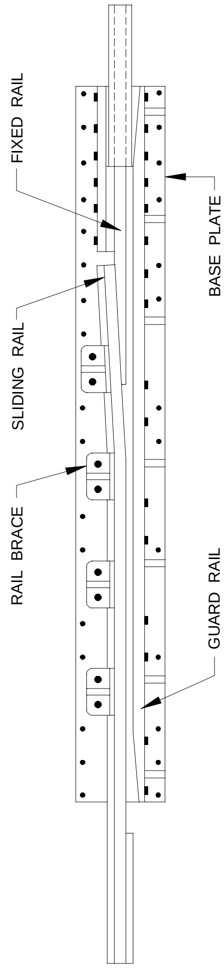
(l) All crack repairs must be made by an approved welding process.

(m) If any brace or fastening bolts are loose, tighten. If any bolts are missing, replace with a bolt of the proper diameter and length.

(n) Rail expansion joints must be installed and maintained in pairs and opposite each other with no stagger so that the guard rail of each can protect the point of the other.

(o) If a rail expansion joint must be removed from track, it must be replaced immediately. At no time shall a single rail expansion joint exist in track under traffic conditions without its mate.

(p) See drawing below for locations of components described above.



EXPANSION JOINT

Subpart F — Inspection Records and Tools

§213.241(MR) Inspection Records

(a) **Inspection records shall comply with the requirements of Part I, §213.241. The results of inspections of miter rails are to be made on the appropriate form.**

(b) Inspection forms must be completed by the designated inspector at the time of day that the inspection was made. Forms shall be filled out in the field during the actual inspection.

§213.242(MR) Inspection Responsibilities (MNR)

Track Supervisors shall review, sign and date all miter rail inspection reports for their territory.

Metro-North Railroad

TRACK DEPARTMENT MW-4

PART II

RECOMMENDED PRACTICE FOR THE MAINTENANCE OF TRACK, SPECIAL TRACKWORK AND MITER RAILS

SUBPARTS A-E

RECOMMENDED PRACTICE
FOR THE
MAINTENANCE OF TRACK

RECOMMENDED PRACTICE FOR THE MAINTENANCE OF TRACK SUBPARTS A-E

Subpart A - General

§1.0(M) Scope

(a) Maintenance is replacing a component of the track structure such as laying new or fit rail or installing ties. Maintenance limits are to be used as a triggering mechanism that prompt maintenance or reconstruction. It is MNR's policy to have a track structure that stays between construction and maintenance limits. As the track structure wears, maintenance should be programmed before the track reaches the maintenance limits. Maintenance must be executed whenever the maintenance limits are exceeded and completed prior to reaching the inspection limits. Whenever possible, track should be repaired or reconstructed to construction limits.

(b) This subpart provides practices that will be used for the maintenance of track. It is for the guidance of Engineering Department forces that maintain and repair track.

(c) This subpart contains "maintenance limits" that are to be used when maintaining track and are not to be confused with the "inspection limits" or "construction limits".

§7.0(M) Quality Control

(a) The person in charge of performing the maintenance activity or repair shall be responsible for the overall quality of the work performed.

(b) All maintenance work shall be performed in accordance with this Part.

(c) The Track Foreman, Assistance Track Supervisor, Track Supervisor and Assistant Director of Track shall review the work performed for quality, consistency and compliance to this Part.

(d) Trackwork repairs that are deficient:

(1) May be cause for remedial action;

(2) Shall be brought to the attention of the Track Supervisor.

(e) The Track Supervisor shall see that any additional work necessary is performed to bring the repair into compliance with this Part.

(f) The Track Supervisor shall be responsible to re-inspect substandard or deficient work to ensure that the corrective work is in compliance with this Part.

(g) Track Foremen are encouraged to make recommendations to the Track Supervisor or Assistant Director of Track as to required modifications to methods, procedures and practices to improve the overall quality of the work.

§9.0(M) Safety of Work in Electrified Territory

(a) When working in electrified territory each employee is governed by “Electrical Instructions for Operating Employees” (MN-290 OP) as well as the following paragraphs.
(b) Verify that third rail and/or catenary is de-energized.
(c) When working on track with live third rail use rubber mats or plywood boards.
(d) Ensure that all tools are adequately insulated.
(e) When working between running rail and third rail care must be taken to avoid bridging the gap between the third rail and running rail.
(f) Crane and boom truck operators should be aware of proximity of catenary and third rail.
(g) Never stand on the running rail or third rail protection board.
(h) Prior to energizing third rail or catenary, be sure that all personnel are notified that the third rail will be energized. All personnel and equipment must be clear of the third rail.

§10.0(M) Sidings

MNR Maintenance of Way forces maintain up to and including the derail on sidings adjacent to main tracks.

Subpart B - Roadbed and Right-of-Way

§31.0(M) Seasonal Preparation and Maintenance

(a) Winter

(1) Dig out switch (gas, electric, pots) rods
(2) Fill pots
(3) Check heaters (gas-plumbers, electric-signal and electric traction (ET))
(4) Place snow fence
(5) Clear crossing ends and flanges – keep clear of excessive snow, ice and debris
(6) Fill salt boxes
(7) Ensure adequate supplies of materials/tools and snow equipment
(8) Order frost spikes/shims
(9) Order rope (prep usage) from approved supplier

(b) Spring/Summer (Special Inspections after Acts of Nature)

(1) Verify proper neutral temperature of rail installed at less than the desired neutral temperature range and adjust as required (see Appendix A)
(2) Change out the summer/winter rails on moveable bridges
(3) Plan vegetation control
(4) Remove shims/frost spikes
(5) Remove pots
(6) Bring winter equipment back to central headquarters
(7) Lubricate yard switches
(8) Perform heat patrol (kinks) as required
(9) Perform rain storm patrols – inspection and cleaning of culverts as required

§33.0(M) Drainage

(a) Drainage is of prime importance for the maintenance of track. Water mixing with materials in the roadbed tends to make the entire track structure unstable depending upon the kind of material under the track and the amount and flow of water.

(b) Water seeping or flowing toward the track should be carried across and off the roadbed or otherwise diverted before it reaches the roadbed.

(c) Water falling upon the roadbed should be quickly drained off to side ditches or drainage structures.

(d) Every effort should be made to see that water from adjacent property does not drain on MNR right-of-way. In areas where this condition is observed the Supervisor of Track shall be notified.

(e) Cross drains should be installed and maintained, particularly where bridges, road crossings and sags interfere with longitudinal drainage.

(f) Maintenance of drainage systems must satisfy the requirements of Part I, §213.33.

(g) Distribution of track or construction materials, and the disposal of fouled ballast and ditch materials should be handled in such a manner that they do not run back into the ditch.

§33.1(M) Culverts

Culverts require regular inspection and maintenance as do other railroad structures. Culverts are maintained by the Structures Department of MNR. When making inspections of Track and Roadway MNR Engineering Personnel should:

(1) Be aware of the location of culverts within the right-of-way.
(2) Be aware that culverts must not only support the live load of trains but the dead load of the track structure including the soil.
(3) Report the backup of water near culverts or any abnormal condition around the ends of culverts to the Structures Department.
(4) Report any abnormal condition found in the track structure at a culvert to the Supervisor of Track.
(5) If unusual conditions are found at culvert locations take the appropriate remedial action as required.
(6) For additional information on culverts, see AREMA, Chapter I, Part 4, "Culverts."

§35.0(M) Cross Section (Roadway)

Roadbeds, embankments and excavations should be maintained in accordance with Metro-North Standard Track Plan No. 70003. Deviation from approved cross sections should not be made without authorization by the Assistant Vice President – Maintenance of Way.

§37.0(M) Vegetation

(a) Growth of vegetation should be encouraged on slopes of embankments, cuts and deep ditches to prevent erosion and to maintain stability.

(b) Vegetation growth must be controlled in accordance with the requirements of Part I, §213.37.

§39.0(M) Signs

(a) Track signs and posts must be placed and maintained in accordance with Metro-North Standard Track Plans and MNR special instructions. They should not be installed so as to interfere with signals or safety appliances.

(b) The following is a list of the common signs found on the Metro-North Railroad which are maintained by the Maintenance of Way Department.

    (1) Whistle posts (see Paragraph (c) for placement)
    (2) Temporary speed signs (see Appendix E)
    (3) Mile posts (see Track Charts)
    (4) Station car markers (see Time Table Special Instructions)
    (5) End of Block
    (6) Clearance marker (fouling point) painted on rail, or ties (Assistant Director of Track)
    (7) Switch targets (Track Supervisor)
    (8) Cross bucks (passive) (Track Supervisor).

(c) Whistle post placement.

(1) F.R.A. requires that a whistle post be placed 1,320' in advance of all public grade crossings.

§41.0(M) Highway Grade Crossings

Typical grade crossing surfaces found on Metro-North Railroad are as follows:

1. Asphalt with cut flangeways
2. Timber and asphalt
3. Full depth rubber
4. Full depth concrete on wood or concrete ties
5. Rubber flangeway and asphalt
6. Non-skid products for pedestrian crossings associated with grade crossings

§41.1(M) Placement of Devices

(a) Whistle signs shall be installed in accordance with F.R.A. Regulations (see Part II, §39.0(M)(c)).

(b) The design and placement of grade crossing signage, roadway signage and appliances are governed by the Manual on Uniform Traffic Control Devices (MUTCD).

§41.2(M) Highway Grade Crossing Maintenance

(a) All roadway signs, traffic signal systems and pavement markings are maintained by the road owner.

(b) Passive or active warning devices at the crossings are maintained by MNR.

(c) Crossings should be kept clean and attention given to the following:

(1) Drainage, sloping the surface if necessary, and constructing underground drains, as required.

(2) Surface water flowing along the highway toward the railroad should be diverted before it reaches the tracks.

(3) The ends of the crossing shall extend at least 2' beyond the width of the highway. Crossing surface installed in a gated pedestrian walkway area should be restricted to the width of the sidewalk gate.

(4) It is recommended that the ends of the crossing surfaces be protected at either end by deflector plates, ballast or asphalt to prevent against dragging equipment.

(5) Flangeways shall be 2-1/2" wide and not less than 2" deep. They must be kept clean at all times and free of debris, ice and snow.

(6) Crossing surface materials and components should be inspected, aligned and properly secured to the track structure so that the materials cannot damage rolling stock and/or motor vehicles. Crossing surface material that cannot be properly secured and/or repaired shall be removed and temporarily replaced with cold patch or asphalt.

(7) The four quadrant site distances for vehicles approaching the highway grade crossing shall be kept as clear as practicable.

(8) When installing or making general repairs to crossings, track alignment should be established by transit, string or mechanical lining devices.

(9) The condition of crossing approaches are vital to the performance of a grade crossing. Special attention should be paid to the surface and alignment on the crossing approaches so that the ties are tamped and there is a smooth transition out of and into the crossing area.

(10) Special attention should be paid to the maintenance of joints at crossing ends. This includes insulated as well as conventional track joints. When performing maintenance, track joints should be eliminated as soon as possible.

(11) When working at a crossing, rail should be observed under load to determine if there is excessive rail movement. As track deflects under load, cut spikes and lock spikes tend to loosen. Loose and worn fastening systems should be repaired and/or replaced as necessary to minimize the movement between the ties and rail and the crossing surface.

(12) In an emergency (broken weld or rail), when welding joints within the limits of the crossing panel, field welds may be made.

(13) When changing a broken rail in a crossing ensure that all anchors and/or clips, spikes, plates and excessively worn components are replaced and secured. Ties should be tamped. Rails temporarily joined with joint bars should be field welded as soon as practicable. If the broken rail is replaced in CWR territory refer to Appendix A for proper rail adjustment procedures.

(14) Use of gage rods in crossings is prohibited.

(15) The proper fastening and clipping devices shall be used provided they do not interfere with the installation of the crossing surface materials.

(16) Galvanized e-clips should be used in crossings with the Pandrol fastening system.

(17) Joints must be avoided within the area of the crossing panel.

(d) MNR has a number of different types of highway grade crossings. A list of the typical types with photographs are shown below:

(1) Asphalt With Cut Flangeway (not recommended for mainline track except overnight during crossing renewals.)

(2) Timber and Asphalt

(3) Full Depth Rubber

(4) Full Depth Concrete on Wood or Concrete Ties

(5) Rubber Flangeway and Asphalt

Subpart C - Track Geometry

§53.0(M) Gage

§53.1(M) Standard for Gage

(a) The standard gage for track, measured between the running rails at right angles to the alignment of the track, 5/8" below the top of rail, is 56-1/2".

(b) Gage on curves over 8° and for turnouts less than No. 8 will be specified by The Assistant Vice President - Maintenance of Way

(c) When gaging is required, care should be taken to not adversely affect the alignment of the track. Changes in prescribed gage should be made in uniform increments as given in Part II, §53.2(M).

(d) Gage shall be changed by adjustment of the rail opposite the line rail. (Preferred Method)

(e) When conditions require, gage may be adjusted on the line rail (e.g., joint elbowed out on the line rail).

§53.2(M) Maintenance of Gage

(a) Gage shall be measured with a standard track gauge or other authorized devices. These devices must be checked daily prior to use for accuracy.

(b) Maintenance shall be performed when gage reaches the following limits:

Gage Maintenance Limits			
Class of Track	**Minimum (inches)**	**Maximum (inches)**	**Maximum Rate of Change in Gage per 31 Feet (inches)**
1	56-1/4	57-1/4	1
2	56-1/4	57-1/4	3/4
3	56-1/4	57-1/4	3/4
4	56-1/4	57-1/4	1/2
5	56-1/4	57-0	1/2

(c) Gage rods shall be applied only in emergency situations for temporary repair. Permanent repairs should be completed and gage rods removed as soon as possible. On main line tracks these appliances shall be installed only with the permission of Assistant Director of Track and removed within 24 hours unless approved by the Assistant Director of Track. When using gage rods in signal territory, rods are to be insulated.

§55.0(M) Alignment

Alignment is the horizontal location of a railroad as described by curves, spirals and tangents.

§55.1(M) Maintenance of Alignment

(a) Outer rails of curves and field-side rails on tangents should be selected as the line rails. On single tangent track, either rail may be used as the line rail. The same line rail shall be used for the full length of that tangential segment of track.

(b) In general, alignment information may be obtained using the following:

(1) The stringline method.

(2) Surveying equipment or a rail-mounted laser.

(3) The automatic geometry guidance system (AGGS) which is a long base automatic reference system.

(c) Maintenance shall be performed when alignment values reach the limits given in the table below.

(1) Alignment deviation in curves, as defined in this table, is the difference in midordinate value between adjacent stations and not the average of multiple stations (uniformity) as defined in Part I, §213.55.

(2) The definition of alignment deviation used in this paragraph, allows MNR to achieve alignment tolerances that are more restrictive than those defined in Part I, §213.55.

Alignment Maintenance Limits

	Tangent Track	**Curved Track**	
Class of Track	**The deviation of the mid-ordinate from a 62' chord[(1)] may not be more than (inches):**	**The deviation of the mid-ordinate from a 31' chord[(2)] may not be more than (inches):**	**The deviation of the mid-ordinate from a 62' chord[(2)] may not be more than (inches):**
1	3-3/4	N/A[(3)]	3-3/4
2	2-1/4	N/A[(3)]	2-1/4
3	1-3/8	7/8	1-3/8
4	1-1/8	3/4	1-1/8
5	1/2	3/8	1/2

(1) The ends of the line shall be at points on the gage side of the line rail, five-eighths of an inch below the top of the railhead. Either rail may be used as the line rail, however, the same rail shall be used for the full length of that tangential segment of track.

(2) The ends of the line or chord must be at points on the gage side of the line rail, 5/8" below the top of the rail head. Use line rail in accordance with Part II, §55.1(M).

(3) N/A – Not Applicable.

(d) Curve realignment changes must be made in accordance with Appendix A, Continuous Welded Rail (CWR) Procedures.

(e) Alignments must be maintained within the prescribed limits given above and must fall within the minimum roadway clearances prescribed in Metro-North Standard Track Plan 70051.

§55.2(M) Stringlining Curves

(a) Stringlining of curves is based on the following principles:

   (1) The mid-ordinates of a curve are indicative of its degree of curvature.

   (2) The mid-ordinates of a uniform circular curve are equal for chords of uniform length.

   (3) The mid-ordinate varies directly with the degree of curvature.

   (4) Where track is thrown in or out at any single station on the curve, the mid-ordinate of the curve at the station is affected by the amount of the throw and the mid-ordinates at the adjacent stations are automatically affected by half that amount, but in the opposite direction.

(b) Stringlining of curves is a method for determining the most advantageous alignment that can be obtained with reasonable amounts of throw.

(c) Any of the established numerical or mathematical methods, such as the Automated Geometry Guidance System (AGGS), "Bartlett Method" or "Bracket Method" may be used to calculate the throws of curves. All calculations should be checked to ascertain that the calculated throws will actually produce the required changes in mid-ordinates. An example of stringline calculations is shown in the following paragraph:

(d) Example:

   (1) Stringlining principals:

      (i) Stringlining is based on the principal that in a circular curve, the mid-ordinates are equal throughout the body of the curve. This method determines the best alignment that can be obtained with the minimum amount of throws.

      (ii) Any of the established mathematical methods such as the "Bartlett Method" or "Bracket Method" may be used to calculate the throws of curves.

      (iii) Where track is thrown in or out at any single station, the mid ordinates of the two adjacent stations are affected by one half the amount of throw in the opposite direction.

      (iv) In calculating throws, a throw to the high side of a curve is considered "+", and a throw to the low side of a curve is considered "-".

   (2) Stringline procedures:

      (i) Ensure area to be measured has the proper Road Worker Protection (RWP) Procedures in effect.

      (ii) A minimum of three people is required when using conventional stringline equipment.

(3) Items/tools required are as follows:
   (i) Writing instrument
   (ii) Keel or crayon marker
   (iii) Proper data sheet with clip board
   (iv) 50' tape
   (v) Stringline paddles with nylon surveyor's plumb bob string
   (vi) Ordinate ruler
   (vii) Level board
   (viii) 6' ruler

(4) Information to be taken at each station when stringlining curves is to consist of the following:
   (i) Mid-ordinate is taken with the ordinate ruler at 5/8" below top of rail head to read to 1/16" accuracy
   (ii) Crosslevel as measured by a level board
   (iii) Gage is measured with a 6' ruler or another approved measuring device.
   (iv) Track Centers if in multiple track territory, at 31' intervals
   (v) Physical features in the field, such as crossings, turnouts, joints, curve tags, open-deck bridge abutments, etc.

(5) Use the gage side of the high rail for stringlining

(6) Station markings are to be made on the field side of the web of the rail.

(7) Extend a minimum of 5 stations onto tangent track when stringlining a curve

(8) The practical relationship between station and chord length, mid-ordinate and degree of curvature for various station lengths is shown below:

Degree of Curve	Mid-Ordinate (inches)	Station Length (feet and inches)	Chord Length (feet)
1°	1/4	15-6	31
1°	1	31	62

(9) In higher degree curves, shorter station lengths and chords are to be used. It may be desirable to use longer station lengths and chords for curves less than 30 minutes.

(10) Whenever correcting alignment deviations by stringlining, the preferred chord length is 62' with 31' stations.

(11) When additional information is required shorter station lengths will be used. Refer to following table in (12) which shows the relationship between station length and chord applications.

(12) Stationing may be done in any increment based on even multiples of the chord length chosen. The shorter the station length the more accurately the curve is defined. Examples are shown below.

Chord Length (feet)	Smallest Station Lengths (feet and inches)	Optional Station Lengths (feet and inches)
31	15-6	15-6
62	15-6	15-6, 31

(13) Figure 1 shows a typical curve with stationing laid out and the chords applied. Ordinate readings are taken at every station. A chord length of 62' is the largest chord for this stationing.

(e) Track shall be stationed for stringlining on the gage side of the outer (high side) rail of the curve, with stationing marked on the web of the rail.

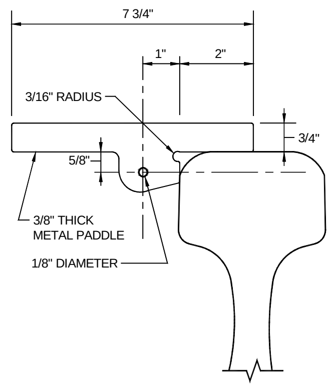
(1) Stationing shall begin at a point on the tangent far enough ahead to permit the measurement of any, reverse curvature or “dog-leg”, and continue throughout the curve to a point on the tangent 5 stations beyond the tangent point to permit measurement of any reverse curvature on the leaving end.

(2) 31' station (62' chords) should be used for most curves found in main tracks, in which case a mid-ordinate of 1" will indicate 1° of curvature. It may be desirable to use shorter chord lengths for higher degree curves.

(f) Mid-ordinates should be measured to the gage side of the rail in 1/16" increments.

(1) Stringline paddles should be used to position the string a distance of 1" away from the gage line of the rail, so as to permit measurement of any local deviations in the curve. A typical stringline paddle is shown on Page II-16.

(2) Mid-ordinate measurements should be taken with the stringline pulled taut, not affected by the wind, and with the stringline paddles and the scale held horizontal and perpendicular to the gage. The measurements should be taken to the gage side of the rail in increments of 1/16".



STRINGLINE PADDLE
SCALE: 3"=1'-0"

Note: In curved track, measurements are taken on the gage side of the high rail.

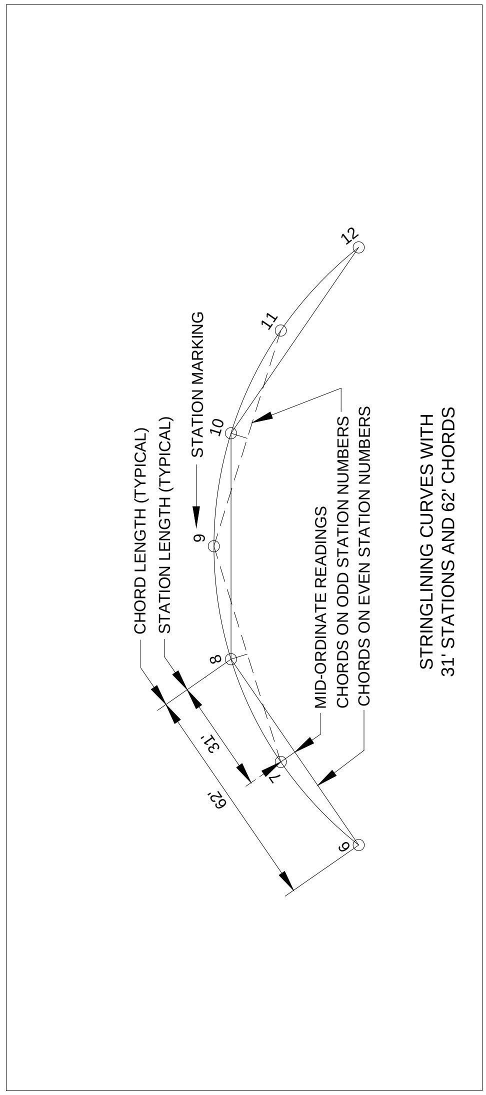


Figure 1 – Stringlining of Curves

(3) To avoid field errors, if a conventional ruler is used to measure the mid-ordinate, the actual scale reading should be recorded and a correction made to compensate for any offset of the stringline from the rail. Conventional stringline paddles require that 1" be subtracted from the readings taken.

(4) The Stringline Data Form should be used to record field measurements and for making mathematical calculations. See below. The latest calculation or records of field measurements should be retained by the Assistant Director of Track.

(g) Track center lines should be measured and recorded at every station in a two or more track territory. The distance from centerline of track to any obstruction that might interfere with the lining of the curve should be measured and recorded so that limiting throws for these tight spots may be determined.

(h) The location of the curve points Tangent to Spiral (TS), Spiral to Curve (SC), Curve to Spiral (CS) and Spiral to Tangent (ST) should be noted so that the relationship between alignment and superelevation can be determined. Refer to Part II, §63.0(M) for the surfacing of track.

(i) Stringline Example

(1) Enclosed is a data chart filled out with actual data taken from MNR.

Metro-North Commuter Railroad
Track Department

STRINGLINE DATA

Line NEW HAVEN Date 12-26-96 Sheet 1 of 1
Curve Number 55B Curves to RT. Chief of Party M. SEDORE
Track Number 1 Degree 4-27 Crew R. KIRNER
Milepost 55.8 To 56.2 R. CIAMPAGLIONE
Spiral Length: New York End 124'
Far end 217'
1-2

REMARKS	STATION	EXISTING ORDINATE	PROPOSED ORDINATE	THROW	EXISTING TRACK CENTERS	PROPOSED TRACK CENTERS	EXISTING SUPER ELEVATION	PROPOSED SUPER ELEVATION
	0	11			11-11 1/8		1"	
	1	12			11-11		1 1/8	
7/8 COMP. TAG	2	15			11-11 1/4		1 1/4	
1 1/8 TAG	3	16			11-11 5/8		1 3/4	
1 3/8 TAG	4	16			11-11 3/4		1 3/4	
1 5/8 COMP. TAG AND EAST	5	21 RAIL			11-11 7/8		1 5/8	
END BRIDGE 56.20	6	27 1			BRIDGE		1 5/8	
	7	23 WORN			11-10 3/4		1 5/8	
	8	19			11-10 7/8		2"	
	9	18			11-11		1 7/8	
	10	14			11-10 7/8		1 7/8	
	1	15			11-10 7/8		2"	
	2	17			11-10 7/8		2"	
1 5/8 COMP. TAG	3	15			11-10 5/8		2 1/8	
	4	14			11-10 5/8		2 1/4	
	5	15			11-10 1/2		2 1/2	
	6	15			11-10 1/4		2 3/4	
	7	15			11-10 1/4		2 3/4	
	8	14			11-10 3/8		3 1/8	
3 1/8 TAG	9	14			11-10 5/8		3 3/8	
3 3/8 TAG	20	17			11-10 1/8		3 1/2	
3 5/8 TAG	1	16			11-11 3/4		4"	
3 7/8 TAG	2	25			12-1 3/4		4"	
	3							
	4							
	5							

Metro-North Commuter Railroad
Track Department

STRINGLINE DATA

Line ____________ Date ____________ Sheet ____ of ____
Curve Number ____________ Curves to ____________ Chief of Party ____________
Track Number ____________ Degree ____________ Crew ____________
Milepost ____________ To ____________
Spiral Length: New York End ____________
Far end ____________

REMARKS	STATION	EXISTING ORDINATE	PROPOSED ORDINATE	THROW	EXISTING TRACK CENTERS	PROPOSED TRACK CENTERS	EXISTING SUPER ELEVATION	PROPOSED SUPER ELEVATION
	0							
	1							
	2							
	3							
	4							

§57.0(M) Curves: Elevation and Speed Limitations

§57.1(M) General

(a) Elevation, or superelevation, is the vertical distance of the outer rail of a curve above the inner rail. It is provided to overcome or partially overcome the effects of curvature and speed.

(b) Passenger railroads primarily elevate curves to provide adequate ride quality.

(c) Maximum authorized speed is that specified in the current Employee's Timetable.

§57.2(M) Superelevation

(a) The Assistant Vice President - Maintenance of Way shall establish the amount of superelevation and underbalance to be placed and maintained on each curve.

(b) The maximum maintenance superelevation shall not exceed 5" unless authorized by the Assistant Vice President - Maintenance of Way. Where authorized, elevation shall not exceed 6".

(c) See Appendix C, Underbalance Table - Maximum Allowable Operating Speed On Curves.

§57.3(M) Superelevation Tags

(a) Curves should be tagged in the field. Points to be marked or tagged on the curves are: TS, SC, CS and ST.

(b) Information on curve tags shall include the maximum design superelevation.

(c) Superelevation tags are placed as follows:

   (1) The TS and the ST tags are placed 1" off the tie plate and/or elastic fastener perpendicular to the high rail.

   (2) The SC and CS tags are placed 1" off the tie plate and/or elastic fastener parallel to the high rail.

§61.0(M) Clearances and Track Centers

§61.1(M) Track Centers

(a) In maintaining alignment, the existing track centers, including equivalent centers on curves, must not be reduced below 12'-0" without the authority of the Assistant Vice President - Maintenance of Way

(b) If the measured track center in tangent track is less than 11'-9" notify the appropriate Track Supervisor for guidance. For curved track the minimum track centers are given in the following table.

(c) On curves the track center must be increased as follows:

   (1) Where the amount of superelevation is the same on adjacent tracks or the superelevation of the inner track is greater than the superelevation of the outer track, increase the track center distance by 1" for each 0°-30' of curvature and 1" for each 1" of superelevation added.

(2) Where the superelevation of the outer track is greater than the superelevation of the inner track, the track center distance should be increased 1" for each 0°-30' of curvature and 3-1/2" for each 1" of elevation difference between the two tracks considered.

(3) When aligning and superelevating curves the required increase in track centers should be as given in paragraphs (1) and (2).

(4) Under no circumstances should the final track centers be less than that shown in the following table. Track centers that do not meet the requirements of the following table should be reported to the Assistant Director of Track.

Track Center Requirements
(Where Superelevation is The Same on Adjacent Tracks)

Distance From Center to Center of Tracks on Curves to Provide at Least 6" Clearance Between Any Combination of Diesel Locomotives, Electric Locomotives, AAR Plate "C" Cars and Passenger Equipment at 3" Underbalanced Speeds

Degree of Curvature	Superelevation of Tracks (E_A)				
	1"	2"	3"	4"	5"
1°	11' 10-1/8"	11' 10-1/8"	11' 10-1/8"	11' 10-1/8"	11' 10-1/2"
2°	11' 11-3/8"	11' 11-3/8"	11' 11-3/8"	11' 11-3/8"	12' 0"
3°	12' 0-1/2"	12' 0-1/2"	12' 0-1/2"	12' 0-1/2"	12' 1-5/8"
4°	12' 2-3/8"	12' 2-3/8"	12' 2-3/8"	12' 2-3/8"	12' 3"
5°	12' 3-5/8"	12' 3-5/8"	12' 3-5/8"	12' 3-5/8"	12' 4-5/8"
6°	12' 5-1/8"	12' 5-1/8"	12' 5-1/8"	12' 5-1/4"	12' 6-3/8"
7°	12' 6-1/2"	12' 6-1/2"	12' 6-1/2"	12' 7-1/8"	12' 8-1/8"
8°	12' 8"	12' 8"	12' 8"	12' 8-7/8"	12' 10"
9°	12' 9-3/8"	12' 9-3/8"	12' 9-7/8"	12' 10-3/4"	13' 0"
10°	12' 10-7/8"	12' 10-7/8"	12' 11-5/8"	13' 0-5/8"	13' 1-5/8"

Notes:

(a) Plate C cars may be constructed to an extreme width of 10'-8" when truck centers do not exceed 46'-3". The swingout at the ends of a car does not exceed the swingout in the center of a car on a 13° curve. A car to these dimensions is defined as the base car.

(b) For Plate C cars when truck centers exceed 46'-3" car width shall be reduced to compensate for the increased swingout at center and/or ends of car on a 13° curve so that the extreme width of car shall not project beyond the center of track more than the base car.

(c) For additional detail on Plate C cars see AREMA, Chapter 28 "Clearances", Part 2 "Equipment Diagrams."

§61.2(M) Clearance Limiting Objects

(a) For clearance limiting objects see Metro-North Standard Plan 70051.

(b) The clearance from the center line of track to objects within the right-of-way such as: signal appliances, signal bridge foundations, bridge abutments and platforms shall not be reduced without ascertaining that the final clearance to the object is no less than given on Metro-North Standard Plan 70051.

METRO-NORTH STANDARD PLAN 70051

GENERAL INSTRUCTIONS

Clearance requirements shown on this plan apply to new construction or reconstruction. Existing structures and tracks may be maintained and extended at present clearances, unless otherwise required by Local or State authorities.

Structures must not be located nearer to the track than the minimum clearance limits shown on this plan and these distances should be exceeded where possible. Consideration should be given to the probability of increased distance between track center lines, widening roadbed shoulders and widening and deepening ditches, and the structures located accordingly.

For standard distances between track center lines and the spacing of tracks where intertrack clearance limiting objects are located, see MW-4, Paragraphs 61.0(C) and 61.2(C), inclusive.

Where physical conditions impose insurmountable restrictions, necessitating clearances closer than those specified, the matter must be submitted to The Assistance Vice President – Maintenance of Way for any modifications.

Minimum clearances shown on this plan are from level tangent track. For curved track the following provisions apply:

Vertical - Same as for tangent track measured vertically above top of high rail, except above top of near rail for passenger and freight platforms.

Lateral - Outside and inside clearances shall be measured radially and horizontally and increased by 1" per degree of curvature over that shown for tangent track. In addition, the inside clearance for superelevated track shall be further increased by 1" per inch of superelevation for each 5' of height above the top of low rail.

METRO-NORTH STANDARD PLAN 70051

REFERENCES

(1) On main running tracks, where practicable, a lateral clearance of 18'-0" instead of 16'-0" is desired.

(2) On private side tracks the standard clearance to platforms of 8'-0" to be obtained if possible. Where the industry demands a less than standard clearance for platforms, a minimum of 6'-6" from center line of track may be used, subject to State approval where required, on one side of such track only, provided a full 8'-6" clearance is maintained on the opposite side of track, or track centers to adjacent tracks are not less than 14'-0".

(3) Unless authorized by The Assistant Vice President – Maintenance of Way high passenger platforms must not be constructed on track having curvature in excess of 1º-40' or where speed requires elevation of outer rail in excess of 1".

High-Level platforms will not be constructed adjacent to any freight only tracks or freight/passenger joint tracks without approval from the Senior Vice President – Operations.

(4) For side clearance to handrails or bridges, trestles and turntables see appropriate Standard Plan.

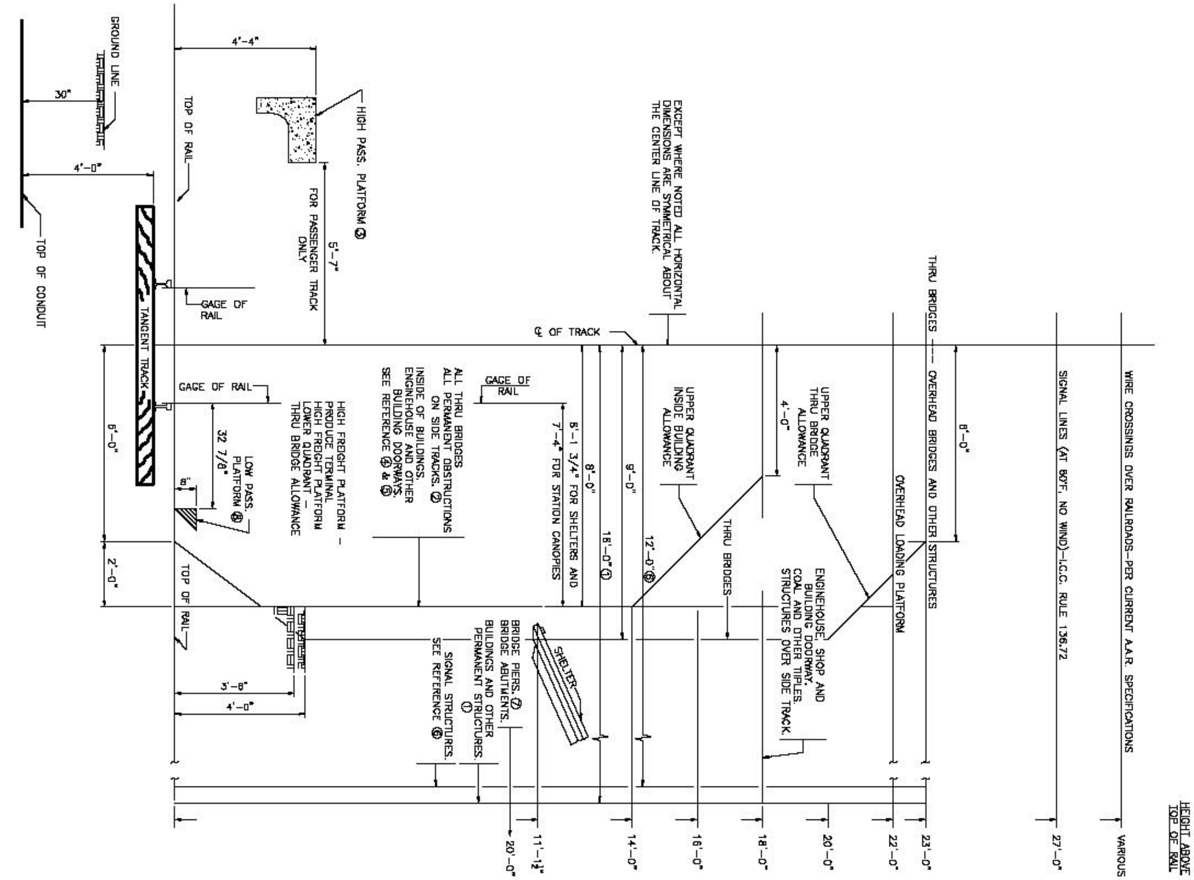
(5) State Clearance Requirements at Variance With Dimensions Shown on This Plan.

Location	**General Clearances**		**Inside Buildings and Doorways**	
	Horizontal	**Vertical**	**Horizontal**	**Vertical**
Connecticut	8'-6"	22'-6"	8'-0"	22'-6"
New York	8'-6"	22'-0"	8'-0"	18'-0"

(6) Signal masts will be 12'-0" from centerline of track.

(7) Bridge piers and abutments to be minimum of 20'-0" from centerline of track on tangents and inside of curves, and 21'-0" on outside of curves where 10' roadway is provided.

(8) Minimum clearance needed to clear third rail shoes on passing equipment.



Metro-North Railroad

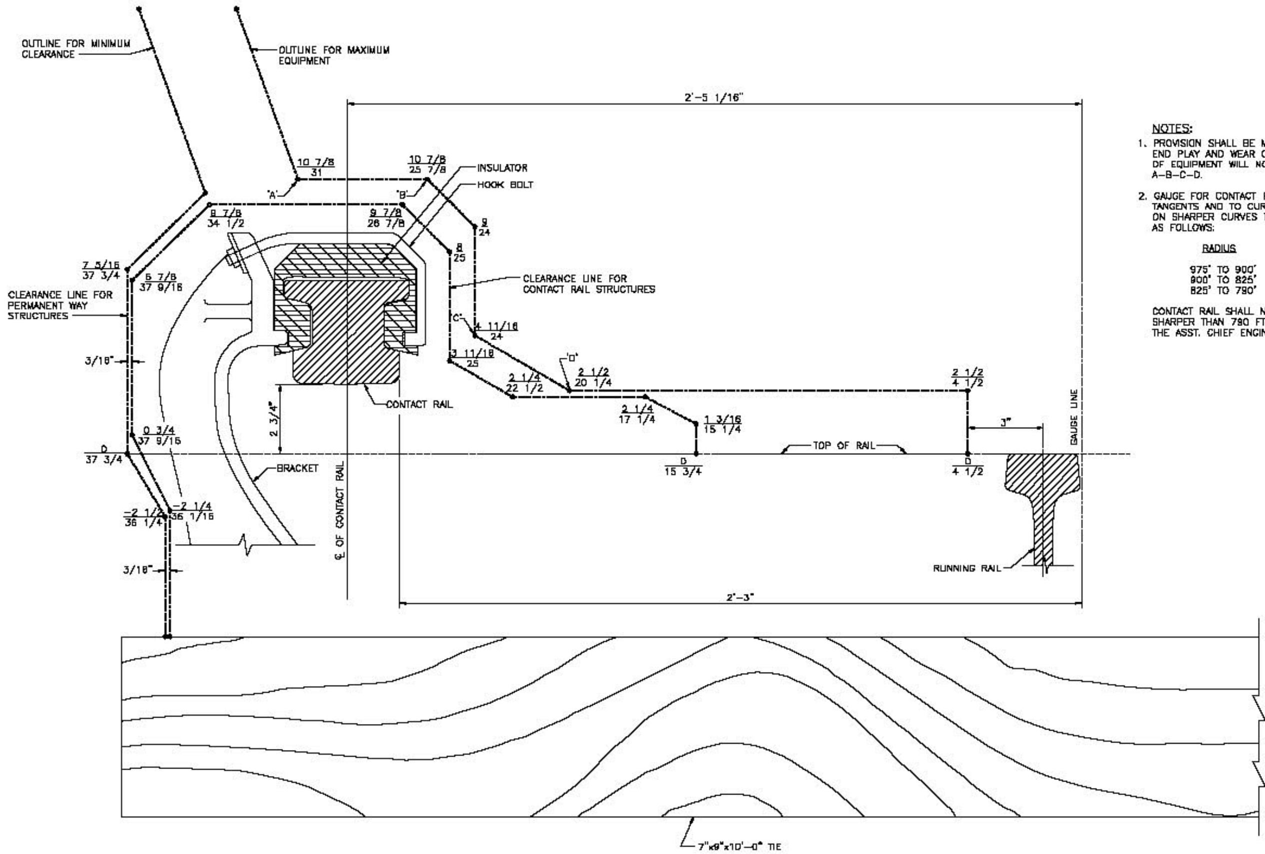
MINIMUM ROADWAY CLEARANCES

70051

REV. 06-07-06

ASS'T VICE PRESIDENT MAINTENANCE OF WAY

DIRECTOR TRACK & STRUCTURES



NOTES:

1. PROVISION SHALL BE MADE FOR STRUCTURAL VARIATION, END PLAY AND WEAR OF EQUIPMENT, SO THAT PARTS OF EQUIPMENT WILL NOT PROJECT BEYOND THE LIMITS A-B-C-D.

2. GAUGE FOR CONTACT RAIL CONSTRUCTION APPLIES TO TANGENTS AND TO CURVES OF MORE THAN 975 FT. RADIUS. ON SHARPER CURVES THE GAUGE SHALL BE INCREASED AS FOLLOWS:

RADIUS	GAUGE
975' TO 900'	2'-3 1/2"
900' TO 825'	2'-4"
825' TO 790'	2'-4 1/4"

CONTACT RAIL SHALL NOT BE INSTALLED ON CURVES SHARPER THAN 790 FT. RADIUS EXCEPT AS DIREDTED BY THE ASST. CHIEF ENGINEER-POWER.

EQUIPMENT CLEARANCE DIAGRAM

SCALE: N.T.S.

Metro-North Railroad

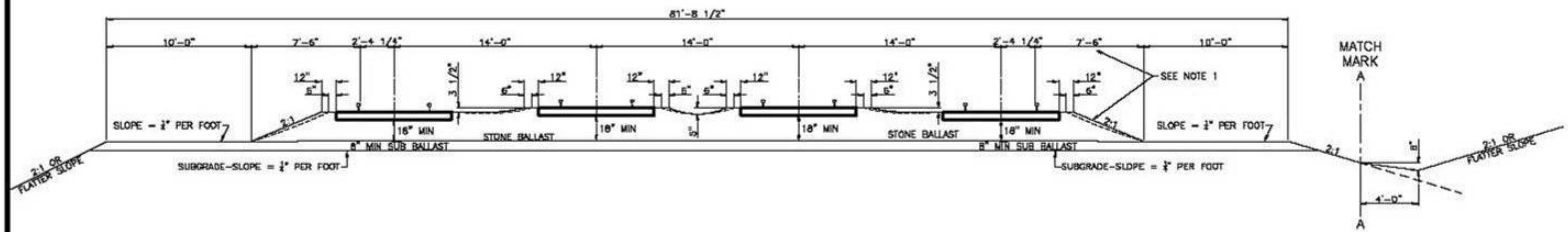
MINIMUM ROADWAY CLEARANCES

70051

REV. 06-07-06

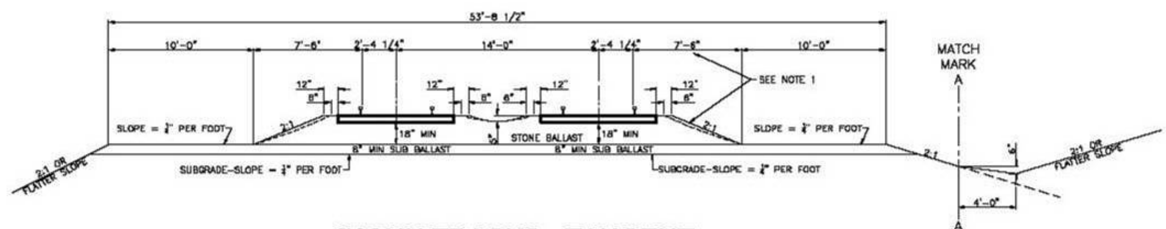
ASS'T VICE PRESIDENT MAINTENANCE OF WAY

DIRECTOR TRACK & STRUCTURES



4 MAIN TRACKS - TANGENT

SCALE: N.T.S.



2 MAIN TRACKS - TANGENT

SCALE: N.T.S.

NOTES:

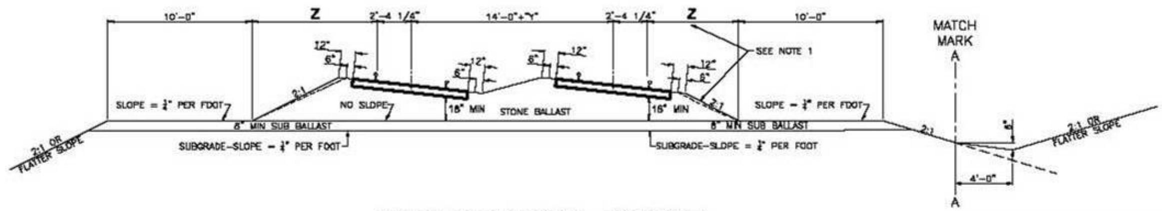
1. BALLAST SECTION SHOWN IN SOLID LINES IS FOR TRACK IN CONTINUOUS WELDED RAIL TERRITORY. IN BOLTED RAIL TERRITORY BALLAST SECTION WITH SHOULDERS INDICATED BY SHORT DASHED LINES MAY BE USED, AND DIMENSIONS DESIGNATED "Z" SHALL BE REDUCED BY 6".
2. "Y" = ON ADJACENT TRACKS—WHERE SUPER—ELEVATION IS THE SAME OR THE OUTER TRACK HAS THE LESSER, THIS DIMENSION SHALL BE INCREASED 1" FOR EVERY 1/2 DEGREE OF CURVATURE.
3. WHERE SUPER—ELEVATION ON OUTER TRACK IS GREATER, THIS DIMENSION SHALL BE INCREASED AS ABOVE, PLUS 3 1/2 TIMES THE AMOUNT OF DIFFERENCE IN SUPER—ELEVATION.

Metro-North Railroad

TRACK CROSS SECTIONS ON TANGENT RUN

ASS'T VICE PRESIDENT MAINTENANCE OF WAY

DIRECTOR TRACK & STRUCTURES



2 MAIN TRACKS - CURVE

SCALE: N.T.S.

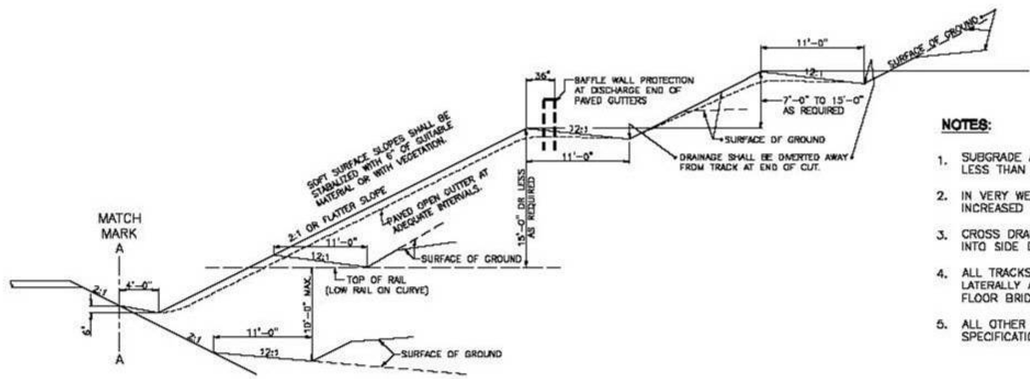
NOTES:

1. BALLAST SECTION SHOWN IN SOLID LINES IS FOR TRACK IN CONTINUOUS WELDED RAIL TERRITORY. IN BOLTED RAIL TERRITORY BALLAST SECTION WITH SHOULDERS INDICATED BY SHORT DASHED LINES MAY BE USED, AND DIMENSIONS DESIGNATED "Z" SHALL BE REDUCED BY 6".
2. "Y" = ON ADJACENT TRACKS-WHERE SUPER-ELEVATION IS THE SAME OR THE OUTER TRACK HAS THE LESSER, THIS DIMENSION SHALL BE INCREASED 1" FOR EVERY 1/2 DEGREE OF CURVATURE.
3. WHERE SUPER-ELEVATION ON OUTER TRACK IS GREATER, THIS DIMENSION SHALL BE INCREASED AS ABOVE, PLUS 3 1/2 TIMES THE AMOUNT OF DIFFERENCE IN SUPER-ELEVATION.

TABLE OF DIMENSIONS "Z"

OUTSIDE EDGE OF BALLAST FROM GAGE OF NEAR RAIL FOR CURVED TRACK

SUPER-ELEVATION	INSIDE OF CURVE	OUTSIDE OF CURVE
1"	7'-0"	7'-5"
2"	6'-10"	7'-7"
3"	6'-9"	7'-10"
4"	6'-8"	8'-1"
5"	6'-7"	8'-4"
6"	6'-6"	8'-7"



NOTES:

1. SUBGRADE AND SUB BALLAST SHALL EACH BE ROLLED WITH NOT LESS THAN A 10 TON ROLLER.
2. IN VERY WET CUTS THE DEPTH OF SUB BALLAST SHALL BE INCREASED IF NECESSARY.
3. CROSS DRAINS OF CAST IRON OR OTHER MATERIAL, SHALL DRAIN INTO SIDE DITCH AND BE LOCATED MIDWAY BETWEEN RAIL JOINTS.
4. ALL TRACKS SHALL BE BROUGHT TO THE SAME ELEVATION LATERALLY AT HIGHWAY CROSSINGS AND OVER OPEN OR SOLID FLOOR BRIDGES.
5. ALL OTHER REQUIREMENTS SHALL CONFORM TO THE MTA LIRR SPECIFICATIONS FOR CONSTRUCTION AND MAINTENANCE OF TRACK,

TYPICAL SLOPE SECTION

SCALE: N.T.S.

MTA Metro-North Railroad

TRACK CROSS SECTIONS ON CURVED RUN

ASS'T VICE PRESIDENT MAINTENANCE OF WAY

DIRECTOR TRACK & STRUCTURES

§62.0(M) **Grades**
(See Construction Part III)

§63.0(M) **Track Surface**

§63.1(M) ***General***

(a) Track surface is the relationship of opposite rails to each other in profile and crosslevel. Track profile is the running surface along the top of the grade rail. Crosslevel is the difference in elevation across opposite rail heads measured at right angles to the track alignment. The ideal surface is a uniform profile consisting of constant grades connected by vertical curves, with zero crosslevel on tangents and predetermined crosslevel on curves.

(b) The profile of track being surfaced should not be raised above established grades, except under instructions from the Assistant Vice President - Maintenance of Way, who will give consideration to the required elevations and clearances in tunnels, under catenary systems and overhead structures, at interlocking plants, undergrade bridges, platforms and highway grade crossings.

(c) Any encroachment upon the published minimum overhead or side clearances from a track will not be permitted. See Metro-North Standard Plan 70051.

§63.2(M) ***Maintenance of Track Surface***

(a) The following criteria will serve as a practical guide for maintaining smooth riding conditions on existing tracks.

(b) For Track Classes 1-5, surface may not deviate more than the amount prescribed in the following table:

Surface Maintenance Limits					
Track Surface	**Class of Track**				
	1	**2**	**3**	**4**	**5**
The **runoff** in any 31' of rail at the end of a raise may not be more than (inches):	2-5/8	2-1/4	1-1/2	1-1/8	3/4
The deviation from uniform **profile** on either rail at the mid-ordinate of a 62' chord may not be more than (inches):	2-1/4	2	1-5/8	1-1/2	1
The deviation from zero **crosslevel** at any point on a tangent or reverse elevation on curves may not be more than (inches): (1)	2-1/4	1-1/2	1-1/4	1	3/4
The difference in crosslevel **(twist)** between any two points less than 62' apart may not be more than (inches):	2-1/4	1-5/8	1-1/2	1-1/4	1-1/8
The difference in crosslevel **(twist)** between any two points less than 31' apart may not be more than (inches):(2)	2	1-3/4	1-1/4	1	3/4

(1) The maximum allowable speeds for curve as shown in this table is based on a single point deviation. For curves with uniform reverse elevation the maximum speed shall be calculated as per Part I, §213.57.

(2) Use 31' definition of twist only in spirals.

(c) For Grand Central Terminal the difference in crosslevel between any two points less than 17' apart, on anything other than tangent track, is designated as **short twist** and may not be more than:

Track Surface	Grand Central Terminal
Short Twist	1"

(d) The basic tools for determining correct track surface are the standard track level and stringline. The track level should be checked by the employee inspecting the track prior to use. If found to be incorrect, it must be accurately adjusted or replaced. Other approved devices may be used for determining crosslevel, but their accuracy should be determined by comparison with a standard track level in correct adjustment (see Part I, §213.251(k)).

(e) When surfacing or raising track, one rail, which shall be the low rail on curves and usually the line rail on tangents, shall be selected as the grade rail. The other rail must be brought to surface by adjusting the crosslevel as required.

§63.3(M) Surfacing Areas that Require Special Attention

(a) Special attention must be given to the surface and line of track at the ends and approaches of bridges, crossings and platforms.

(b) When surfacing, installing or tamping ties, particularly in interlocking plants, care must be taken to avoid breaking or damaging bond wires, pipes, cables or wire connections to the tracks. The Signal Department should be notified prior to any work. Notify the Signal Department immediately if damage occurs. Care shall be exercised to avoid the dropping or laying of metal tools or objects across the rails and causing a shunt of the signal circuits.

(c) In overhead electrified territory, prior to surfacing, notification must be made to power department personnel. Care must be exercised to avoid reducing clearance between the top of rail and contact wire at established low points, or to establish new low points.

(d) In hot weather when surfacing track the requirements of Part I, §213.119 and Appendix A, Continuous Welded Rail (CWR) Procedures must be followed.

(e) During freezing and thawing weather, attention must be given to the surface of track likely to be affected by heaving due to frost action. Surface irregularities due to frost action that cannot be corrected by usual procedures may be temporarily corrected by use of track shims. Shimming must be performed in compliance with Part I, §213.129 and Part II, §129.0(M).

(f) Undercutting, out-of-face track surfacing and out-of-face tie renewal shall be performed in accordance with Appendix A, Continuous Welded Rail (CWR) Procedures.

§63.4(M) Surfacing Track

(a) When track is given a general raise, both rails should be raised at the same time. When track jacks are used, they should be placed opposite each other and must not be placed between the rails except when absolutely necessary.

(b) When track is given a general raise, it is important to consider the relationship between the amount of lift and durability of results. In general, average lifts between 1" to 2" are desirable. Stabilizing after each lift is recommended practice. Higher raises may be performed under the authority of an Assistant Director of Track.

(c) Adequate ballast for dressing to the required ballast cross section should be distributed in advance of surfacing and aligning track.

(d) CWR track that has been surfaced and aligned and is being returned to service will be inspected by a person qualified under §213.7(a)(b) before releasing and in accordance with Appendix A, Continuous Welded Rail Procedures.

(e) Track should not be raised in interlockings or automatic signal territory until advance notice has been given to the Signal Maintainer so that switches, or other appliances, can be protected and then reinspected when the work is completed.

(f) In overhead electrified territory, prior to surfacing, notification must be made to power department personnel. Care must be exercised to avoid reducing clearance between the top of rail and contact wire at established low points, or to establish new low points.

Subpart D - Track Structure and Materials

§100.0(M) Material

Included in "track structure" are: sub-ballast, ballast, ties, rails, rail fastenings and other track materials (OTM).

§100.1(M) Handling and Care of Materials

(a) Moving materials from place to place and caring for materials on hand is costly. For these reasons, the amount of material on hand and the number of handlings should be kept to a minimum. This requires careful planning of work.

(b) Threaded and/or insulated materials and parts should be protected from the weather. If exposure to the weather is unavoidable, threaded materials should be coated with a protective oil.

(c) Materials should be distributed in such a manner so as not to become a tripping hazard and from being lost prior to installation in track.

(d) Whenever possible, CWR distributed for installation should be distributed clear of the track. When necessary to be placed in the center line of the track the rail ends should be protected by proper nosing. The rail should be secured and insulated in such a manner as to prevent shunting of the signal system. The top of the CWR when distributed in the center line of track should not exceed the height of the running rails.

§100.2(M) Classification of Materials

Materials are classified as follows:

(a) New - Unused, as manufactured.

(b) Rehabilitated - Materials removed from track which may be used again and upon which work has been performed since removal such as rebuilt frogs.

(c) Fit - Usable (second-hand), material removed from track with no work performed upon it such as: relay ties, rail, frogs, joints, fasteners, turnouts and special track work.

(d) Scrap - Materials removed from track that are not fit for reuse.

§103.0(M) Ballast; General

§103.1(M) Characteristics

(a) Unless supported by a structure, all track must be supported on a material that will:

    (1) Transmit and distribute the load of the track and railroad rolling equipment to the sub-grade.

    (2) Provide restraint for the track in lateral, longitudinal and vertical directions.

    (3) Provide drainage for the track structure.

    (4) Facilitate maintenance of track crosslevel, surface and alignment.

(b) Ballast shall conform to the MNR and AREMA standards and may be obtained only from approved quarries.

§103.2(M) Ballast Unloading

(a) To the extent practicable, ballast should be unloaded in position for use with a minimum of redistribution and dressing, using special ballast cars when available.

(b) Ballast must be distributed or immediately dressed so that ample clearance below top of rail is provided for rolling stock. Switches are not to be fouled and guard rails are not to be obstructed. Ballast should not be distributed in a manner that impedes the operation of the third rail and contact shoes on rolling stock

(c) When unloading ballast cars caution should be used to ensure that both sides of the car are unloaded equally.

(d) The quantity of ballast distributed should be appropriate for the work being performed.

§103.3(M) Ballast Section

(a) Ballast and sub-ballast cross sections should conform to the Metro-North Standard Track Plan shown in Plan No. 70003.

Jointed Rail 6" shoulder	2:1 slope
CWR Rail 12" shoulder	2:1 slope

(b) On track with CWR corrective action must be taken where there is insufficient ballast (see Appendix A, Continuous Welded Rail Procedures).

§103.4(M) Ballast Cleaning

(a) When ballast in track becomes fouled, it should be mechanically cleaned or removed and replaced to restore proper drainage. The type of cleaning procedure employed should depend on the nature and extent of the fouling.

   (1) Shoulder ballast cleaning will promote lateral drainage of the track structure. A proper cycle of shoulder cleaning can aid in extending the cycle between undercutting operations.

   (2) Undercutting is a means of cleaning the ballast under the ties as well as the crib ballast.

   (3) See Appendix A, Continuous Welded Rail Procedures, for shoulder cleaning and undercutting of track with CWR.

§103.5(M) Ballast Gradation

The nominal size of crushed stone ballast used for maintenance and new construction shall be as follows, unless otherwise authorized by the Assistant Vice President - Maintenance of Way for:

All Tracks Except Yard:
Ballast Size No. 3 1" to 2"

Yard Tracks:
Ballast Size No. 4: 3/4" to 1-1/2

§109.0(M) Crossties

§109.1(M) Dimensions

(a) MNR wood crossties are 7" in depth, 7" to 9" in width and 8'-6" in length. Ties 9'-9" long are used at third rail bracket locations.

(b) MNR concrete crossties are 8" – 8-1/2" in depth, 9-1/8" – 10" in width and 8'-6" in length. Concrete ties for existing and proposed third rail territory are equipped with threaded inserts on both ends, which are designed to support the third rail.

(c) The specifications for wood and concrete crossties shall be in accordance with MNR Engineering specifications.

(d) Wooden transition ties are used at locations of bridge and viaduct approaches. This approach section consists of twelve (12), 10' timbers.

§109.2(M) Use

(a) The Assistant Vice President - Maintenance of Way shall determine the types and sizes of crossties to be used in any specific situation.

(b) The type and spacing of ties for each line and class of track shall be designated by the Assistant Vice President - Maintenance of Way, in accordance with the service requirements.

(c) MNR tie spacing for concrete and wood ties is given below:

   (1) Concrete Ties 24"

   (2) Wood Ties 19-1/2"

§109.3(M) Placement

(a) Wood Crossties

   (1) Ties should be placed in track square to the line of the rail.

   (2) The ends of standard 8'-6" ties should be brought to a uniform line 18-1/2" from the field-side edge of the base of the rail and on the line side as follows:

      (i) In areas with two or more main tracks, align the field ends of ties.

      (ii) Exceptions may be made where, in the use of tie installation machinery, it is advisable to line the opposite ends or where it is desired to retain an existing line side.

      (iii) When necessary to use non-standard length ties, they shall be centered in the track.

(b) Concrete Crossties

   (1) Concrete ties shall be replaced in kind and not intermixed with wood crossties, except in an emergency. The intermixed wood ties shall be removed and replaced with concrete ties as soon as possible.

(c) All Crossties

(1) Ties shall be kept sufficiently spaced and square to the line of rail to permit proper tamping and distribution of load. When necessary, ties should be re-set to standard spacing.

(2) Ties shall be square to the line of rail so that fastening systems are not subjected to a torsional load because of tie skewing.

(3) Crossties shall be properly tamped 12" on both sides of the base of rail.

(4) In third rail territory, third rail bracket ties should be installed in accordance with the Power Department requirements.

§109.4(M) Preventing Tie Damage

(a) All Crossties:

(1) When handling and/or spacing ties, care shall be taken not to damage them with maintenance of way equipment, picks and spiking hammers. Tie tongs, lining bars and other suitable tools or tie spacing equipment shall be used.

(2) For additional information on fastener application, see Part II, §127.0(M).

(b) Wood Crossties:

(1) Adze ties to obtain a sound and true bearing to support the tie plate.

(2) If a tie will be reused, treated tie plugs must be used to fill holes where spikes, pins and lag screws have been removed. Square tie plugs (5/8") are used with spikes and pins, round tie plugs (3/4" diameter) are used with lag screws.

(c) Concrete Crossties:

(1) Concrete ties are easily damaged by mishandling. They must only be handled with equipment or tools intended for the purpose. Care must be taken to insure that they are not dropped. Sledges or spike mauls must not be used to align concrete ties. Lining bars may be used to align them provided the concrete ties are not struck with the bars.

(2) Care must be taken to avoid striking concrete ties when applying or removing elastic fasteners.

(3) Holes may not be drilled in or attachments made to concrete ties unless approved by the Assistant Vice President - Maintenance of Way.

§109.5(M) Bridge Timber

(a) Oak ties, or other approved equals, shall be used on all open deck bridges.

(b) Bridge ties shall be adzed, framed and sized according to framing plans prior to treatment.

(c) Every third tie is fastened to the structure with a hook bolt. Suitable holes must be bored for lag screws that fasten tie spacing bars on timbers.

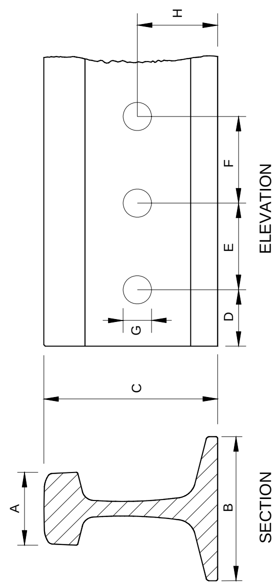
(d) All open deck bridges with CWR shall have spacer blocks between all timber.

§113.0(M) Rail

§113.1(M) Rail End Drilling and Bolt Hole Sizes

(a) As used in these instructions, jointed rails are conventional rails bolted together. CWR is rails fabricated into strings longer than 400' by electric flash butt or other welding methods.

(b) Rail size dimensions and bolt hole drilling for typical Metro-North Railroad rail sections are given in the following table.



NEW RAIL DATA

NEW RAIL DATA (inches)										
Rail Section Dimensions In Inches	**105# D.Y.**	**112# R.E.**	**115# R.E.**	**119# R.E.**	**127# D.Y.**	**127# D.Y.M.**	**131# R.E.**	**132# R.E.**	**136# R.E.**	**140# R.E.**
A – Head Width	3	2-23/32	2-23/32	2-21/32	3	3	3	3	2-15/16	3
B – Base	5-1/2	5-1/2	5-1/2	5-1/2	6-1/4	6-1/4	6	6	6	6
C – Height	6	6-5/8	6-5/8	6-13/16	7	7	7-1/8	7-1/8	7-5/16	7-5/16
D – Drilling	2.75	2-1/2	3-1/2	3-1/2	2-3/4	3-1/2	2-1/2	3-1/2	3-1/2	3-1/2
E – Drilling	5.6	6-1/2	6	6	5-5/8	6	6-1/2	6	6	6
F – Drilling	5.6	6-1/2	6	6	5-5/8	6	6-1/2	6	6	6
G – Diam. of Bolt Hole	1-1/16	1-1/8	1-1/8	1-1/8	1-1/8	1/18	1-/18	1-5/16	1-1/4	1-1/4
H – Base to Ctr. of Hole	2-5/8	2-7/8	2-7/8	2-7/8	3-1/8	3-1/8	3-3/32	3-3/32	3-3/32	3
I – Diam. of Bolt	15/16	1	1	1	15/16	1	1	1-1/8	1-1/8	1-1/8

§113.2(M) Recommended Maintenance Wear Limits for Rail

§113.2.1(M) Head and Gage Face Wear

(a) With traffic, the rail head wears vertically and horizontally. As this wear increases, the cross section of the rail decreases. This decrease in rail section may overstress the rail causing rail failure.

(b) The following table contains the maintenance wear limits for vertical wear and gage face wear (both gage and field) for rail sections commonly found on MNR.

(c) Rail replacement should be programmed prior to reaching the given maintenance rail wear limits.

RECOMMENDED MAINTENANCE RAIL WEAR LIMITS

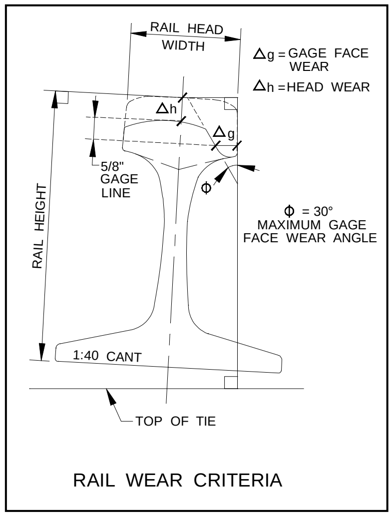
		Allowable Head Wear (inches)			Allowable Gage Face Wear (inches)		
Rail Section	**New Rail Height (inches)**	**Mainlines**	**Other Tracks**	**New Rail Head Width[1] (inches)**	**Mainlines**	**Other Tracks**	**Total Head Width Wear[2]**
105 DY	5-11/16	1/2	5/8	2-43/64	3/8	5/8	1/2
112 RE	6-5/8	1/2	5/8	2-23/32	3/8	5/8	1/2
115 RE	6-5/8	1/2	5/8	2-23/32	3/8	5/8	1/2
119 RE	6-13/16	1/2	5/8	2-21/32	3/8	5/8	1/2
132 RE	6-5/8	1/2	1/2	3	3/8	3/4	3/4
136 RE	7-5/16	5/8	3/4	2-15/16	1/2	3/4	3/4
140 RE	7-5/16	5/8	3/4	3	1/2	3/4	3/4

(1) Measure gage face wear at 5/8" below top of crown of railhead.
(2) Combine field and gage side wear 5/8" below top of crown of railhead. This wear column only applies to rail that has been transposed.

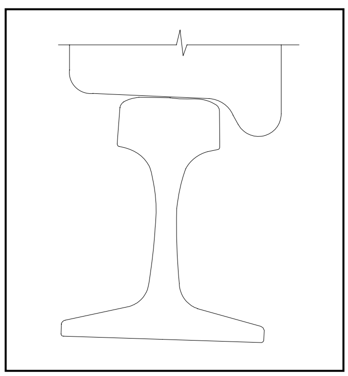
§113.2.2(M) Gage Face Angle (Worn Rail)

(a) When a rail is placed in track, under traffic, the gage face wears at an angle (ϕ). As this angle increases, the possibility for a wheel to climb the gage face of a rail and derail increases.

(b) As shown on the following diagram, rail replacement shall be accomplished when the gage face angle (ϕ) exceeds 30°. As the rail wear readings approach 30°, the Division should make necessary plans to change out the rail.



(c) For an example of new wheel and new rail interface, see the following diagram.



§113.3(M) Rail Classifications

§113.3.1(M) Defective Rails

(a) Rails removed from track on account of any defects listed in Part I, §213.113(a), except end defects described in paragraph (c) below, must be marked “NG” (no good) and a torch mark made in the head of the rail.

(b) Defective rails should be immediately removed from the right-of-way.

(c) Rails removed from track with rail end defects, such as a bolt hole cracks or head-web separations where a portion of the rail end is not physically broken out, must have the top of the rail head noticeably damaged at the location of the defect, using a cutting torch or power saw to insure that a rail of this type is not returned to service without cropping off the defective end.

§113.3.2(M) New Rails

Class of Rail*	**Use**
Medium-Hard Rail	In all tracks.
Head-Hardened Rail or Fully Heat-Treated Rail	For curves, turnouts, grade crossings, special trackwork, tunnels, and other locations where head-hardened or fully heat-treated rail currently exists.

* Medium-Hard Rail - prime rail that conforms to latest AREMA Specifications.

* Head-Hardened Rail - prime rail that is fully quenched and tempered in the head area only to increase hardness and strength.

* Fully Heat-Treated Rail - prime rail that is fully quenched and tempered to increase hardness and strength.

113.3.3(M) Cropped or Fit Rails

(a) Rails removed from track having only end defects, such as bolt hole cracks or head-web separations within joint bar areas, may be used without restrictions after defects have been eliminated by cropping.

(b) Fit rail for relay should be checked against the rail wear table given in Part II, §113.2.1(M) prior to installation.

§113.4(M) Disposition and Shipment of Rails

(a) Rails released from renewals and retirements must be disposed of as authorized by responsible Track Supervisor.

(b) Other track materials (OTM) must be removed from the individual rails before loading rail onto railcars or trucks.

(c) For shipment, relay rails may be loaded head up in the same car with wood stripping between layers.

§113.5(M) Transposing Rail on Curves

(a) To increase the service life of rails on curves, the high and low sides may be transposed before horizontal wear, vertical wear or flow of metal in the head makes this impractical because of undesirable rail head stresses.

(b) Rail may need to be transposed in concrete tie track to re-establish maintenance gage limits. See Part II, §53.2(M).

(c) On curves, the high and low sides should be transposed when the horizontal wear on either rail reaches the maintenance rail wear limits given in the table in Part II, §113.2(M).

§113.6(M) Distributing Rail

(a) Rails should be unloaded in a position as close as possible for laying to minimize further handling (see §100.1(M)(d)).

(b) Rails should be placed parallel with the track and base down, to avoid excessive bending or damage. Care should be taken to avoid placing rails on manhole covers, on signal cables and conduits, impedance bond boxes or close to air lines.

(c) Rail is not to be stored between the running rail and third rail.

(d) The ends of CWR ends must be offset and blocked to allow for thermal expansion.

(e) In yards and at locations where employees must walk close to the track, rail should be placed as near to the ends of ties as possible to avoid obstructing walkways.

§113.7(M) Laying Rail (General)

(a) Track should be placed in good line and surface prior to rail renewals. Track to be laid with CWR must have standard ballast section for welded rail.

(b) Rails should be visually inspected for external defects and damage prior to laying in track.

(c) When laying rail take care not to damage the rail or rail fastening systems. Loose ties should be tamped to bear fully under the rail immediately behind rail laying operations.

§113.8(M) Laying Jointed Rails

(a) Jointed rails should be laid, one at a time, with space allowance for expansion being provided between rail ends in accordance with the following table:

Jointed Rail Expansion Tables

39' Rails

Rail temperature (°F)	Rail End Space (inches)
Below 6	5/16
6 to 25	1/4
26 to 45	3/16
46 to 65	1/8
66 to 95	1/16
Over 95	None

(b) To insure the required space allowance, rail ends should be brought squarely together against approved expansion shims of proper thickness and the rail joints applied before spiking.

(c) Space between rail ends in insulating joints (paper type) should only be sufficient to permit insertion of standard end posts.

(d) An approved rail thermometer shall be used in accordance with Part II, §119.4(M). The supervisor in charge shall see that rail temperature is checked frequently and that proper rail expansion shims are used.

§113.9(M) Joint Stagger When Laying Rail

(a) The preferred joint location to prevent the possibility of a twist follows. Whenever possible, rails should be laid so that the joints of one line of rails are opposite the third (1/3) point of rails in the other line with permissible variations as follows:

(1) Wherever possible, the staggering of the joints on one side should not vary more than 18" in either direction from the third point of the opposite rail.

(2) When possible, joints on curves should be staggered in accordance with paragraph (1) above.

(3) Wherever possible joints should be staggered so that there are no parallel joints. Parallel joints should be staggered a minimum of 4', welded or replaced with welded rail with staggered plant welds as soon as possible.

(4) Where approved by the Assistant Director of Track, joints on tangents in newly constructed track laid by the panel method, may be left equal and opposite until welded. Welding and staggering of joints or change out to CWR should be accomplished as soon as possible.

(b) It is the goal of the Engineering Department to have no jointed rails in track less than 39' in length. Rails less than 18' are prohibited in main tracks.

(c) In some situations it may not be possible to install an 18' rail. Under the following conditions rails with a minimum length of 14' may be used for:

(1) Connections within turnouts and crossovers.

(2) Temporary closures.

(d) If possible, when installing rail, avoid placing permanent bolted joints in or closer than 50' to the edges of road crossings, or closer than 39' within the limits of switch points, guard rails, ends of open floor bridges, concrete deck direct fixation track, trestles or viaducts.

(e) Rails of the same section should be used on open floor structures, through road crossings and paved track areas of station platforms and in turnouts and crossovers.

(f) Rails of different sections must be brought to an even surface at joints. If the difference in height of rails must be run off by the use of shims, wood or metal shims of proper thickness, with holes provided for spikes that are of ample size to permit secure fastening to the ties, must be placed between the tie plates and ties.

§113.10(M) Rail End Bolt Holes

Holes must be drilled in accordance with standard plans and the following practice:

(a) When holes are necessary, they must be drilled. Bolt holes should be drilled with the joint bars removed by marking the location of the center of the hole with a proper size template block and center punch (if applicable) or by drilling through an approved template.

(b) When bolt holes are drilled, a uniform feeding pressure should be maintained and then reduced as the cutting tool cuts through the opposite side of the web. Forcing the cutting tool may produce a ragged hole, which may possibly produce bolt hole cracks. If required, an environmentally sensitive lubricant should be used throughout the drilling process.

(c) Bolt hole sizes and drillings are found in the rail end drilling table given in Part II, §113.1(M).

(d) Rail ends should be drilled in such a manner as to provide for closure by field welding (no holes closer than 9-1/2" to the joint). In those instances where the joint will not be welded, all holes will be drilled in the joint bars and fully bolted.

§113.11(M) Cutting Rail

(a) The tools which may be used for cutting rails are listed below:

  (1) Power saws with approved guide attachments.

  (2) Gas cutting torches, in emergency only in accordance with Part I, §213.122.

(b) Gas or electric arc welding is prohibited on any portion of the rail, except as listed below:

  (1) Welding of engine burns in accordance with Engineering Practices. Engine burns deeper than 3/8" should not be welded. If there are more than 4 engine burns in a length of rail, the rail should be changed out.

  (2) Top of rail within limits of joint bars.

(c) Any rail damaged by torches must be promptly removed from track.

(d) Any rail damaged by electrical burns should be removed from track unless it is so slight that it can be ground out.

§113.12(M) Bonding Rails For Track Circuits

(a) Where rails are bonded for track circuits, no rail bonds shall be broken or rails removed, except in an emergency, unless a signal maintainer is present.

(b) In case of emergency, a broken rail, or switch point or frog may be renewed without waiting for the signal maintainer or power department. In such cases, the joints shall be tightened to make as good contact as possible with the rails and the signal maintainer notified that the rail bonds have been broken.

(c) However, if a broken rail is replaced within the starting circuit of automatic highway crossing protection, the track shall not be restored to service until all trains approaching the crossing have been instructed to be prepared to stop prior to passing over the crossing involved or until crossing protection is provided or the signal maintainer has applied rail bonds.

§113.13(M) Changing Rail In Electrified Territory

(a) When making rail renewals contact the Power Supervisor to request that the third rail be de-energized.

(b) In electrified territory when required to work with a live third rail, one running rail should always be connected to insure that at least one return path for electric traction current is maintained before disconnecting the leads of impedance bonds or removing rails, frogs, etc. The use of an approved third rail protection device such as rubber mats, plywood, or other approved barrier is required when working with live third rail.

(c) Care should be taken to avoid shunting of track circuits or striking a live third rail with tools, jacks, lining bars, claw bars, tapes or other material carried or laid across the rails.

§113.14(M) Maintenance of Rail By Grinding

(a) Rail grinding can be accomplished with profile grinders or production grinding units. Hand grinding should be limited to small areas where the use of profile grinders is not practical. Out-of-face grinding must be performed with production grinding units.

(b) In special trackwork a combination of production grinding and hand grinding may be required.

(c) Production grinding of rail should be performed at regular intervals based on the condition of the rail, the number and type of trains and the accumulated tonnage at a particular location.

(d) Production grinding is required to remove surface anomalies such as flakes, checks, shells and corrugations on the rail head and to re-profile the rail head.

(e) Production rail grinding is required to remove flow and to restore the head radius of the rail.

(f) Rail grinding on open deck bridges is permitted provided that proper precaution is taken against fire.

(1) Grinding shall only be performed when there is no highway or river traffic directly under the area to be ground.

(2) The rail grinding crew has a supply of water or other fire suppressants to protect against fire.

(3) After grinding, the entire structure is inspected for possible “hot spots” or fire.

§115.0(M) Rail End Mismatch

Rail shall be maintained so that the mismatch of rails at joints may not be more than that prescribed in the following table:

Rail End Mismatch Maintenance Limits		
Class of Track	**Any mismatch of rails at joints may not be more than the following:**	
	On the head of the rail ends (inch)	**On the gage side of the rail ends (inch)**
1-3	1/8	1/8
4 and 5	1/16	1/16

§117.0(M) Rail End Batter/Beveling of Rail Ends

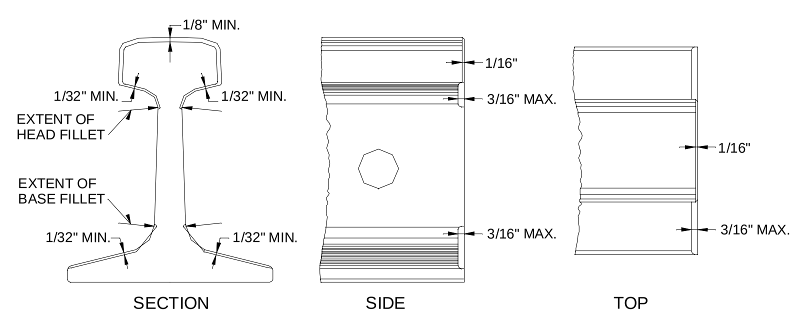
(a) Rail end batter is the depth of depression in the rail head near the end of the rail. It is measured by placing an 18" straightedge on the head of the rail at the rail end, without bridging the joint and measuring the maximum distance between the bottom of the straightedge and the top of the rail head. A taper gauge is usually used to measure rail end batter.

(b) When rail end batter is detected, it should be monitored and corrected before reaching the class-specific defect limits given in Part I, §213.117.

Rail End Batter Maintenance Limits	
Class of Track	**Rail End Batter May Not Be More Than (inch):**
1 – 2	1/4
3 – 5	1/8

(c) To avoid chipping or spalling under service due to overflow of steel, the rail end faces should be cross cut by grinding with a 1/8" beveled slotting wheel to a depth of not less than 3/16" below the surface of the head. The maximum cut should not be wider than 1/8". If the rails are not in contact, the overflowed metal should be removed from both end faces by grinding 1/16" from the ends of both rails. See following figure as developed by AREMA.

THE HEEL ENDS OF SWITCH RAILS, THE ENDS OF THE ARMS OF TURNOUT AND CROSSING FROGS, THE ENDS OF CLOSURE RAILS WITHIN CROSSINGS OR OTHER SPECIAL TRACKWORK LAYOUTS, AND THE ANALOGOUS PORTION OF THE ENDS OF SOLID MANGANESE FROGS AND CROSSINGS SHALL BE BEVELED AS SHOWN ON THIS PLAN.



BEVELING OF RAIL ENDS FOR TRACKWORK

§118.0(M) Rail Lubrication

(a) The gage face of the running rail or at special trackwork installations must be lubricated as follows:

  (1) Running rail in curve locations greater than 3° or as specified by Assistant Director of Track.

  (2) All switch points and stock rails and frogs in heavily used routes in interlockings regardless of turnout size or type.

  (3) After grinding or welding repairs to switch points and/or frogs.

  (4) In all new installations of stock rails, switch points.

(b) When lubricating rail, care should be taken to avoid lubricating the running surface of the rail.

(c) When lubricating rail, care should be taken to control the amount of lubricant being used to avoid migration to the running surface of the rail.

§119.0(M) Continuous Welded Rail (CWR); General

§119.1(M) Use on MNR

(a) CWR fabricated by an approved process may be laid anywhere on MNR

(b) CWR may be laid across open deck bridges where bridge ties are spaced with timber blocks between ties, provided that the following conditions are satisfied:

  (1) All bridge ties are blocked and are tightly jacked and fastened together with spacing bars secured by lag screws in at least every third tie.

  (2) Bridge ties are securely fastened to steel structure by means of hook bolts, tie anchors or other approved holding devices.

  (3) The bridge structure is properly anchored to abutments and piers to prevent any movement other than normal expansion.

  (4) CWR is anchored to the bridge ties in both directions in accordance with Part II, §125.1(M); or

  (5) Approved elastic fastening systems are used under the running rails when all bridge timber is renewed and properly secured.

(c) After application, timber holding devices must be checked and retightened, until ties have fully seated on the top flanges of bridge members.

§119.2(M) Welding or Bolting CWR

(a) CWR strings may be field welded by the electric flash butt or thermite methods. See Part II, §120.0(M), Field Welding.

(b) When field welding is not possible, CWR strings are to be fastened to each other or to other rails with fully bolted rail joints.

(c) If it becomes necessary to apply joint bars temporarily, the end bolt hole in each rail must not be drilled to permit subsequent field welding. Rail anchors must be applied at this joint location in accordance with Part II, §125.1(M).

§119.3(M) Anchoring CWR

Each CWR string is to be anchored in accordance with Part II, §125.1(M).

§119.4(M) CWR Temperature

(a) An approved rail thermometer or other approved device shall be used to measure the rail temperature of all CWR. The thermometer should measure temperatures on the web, shielded from direct rays of the sun after being left there long enough to determine the temperature accurately. All thermometers must be checked for accuracy.

(b) CWR must be adjusted by heating or mechanical straining (stretching) and anchored to a neutral rail temperature between 95°(F) to 125°(F). The desired neutral temperature on MNR is 95°(F) (see Appendix A, Continuous Welded Rail Procedures).

(c) The supervisor installing CWR shall be responsible for recording the rail temperature at which each CWR string is anchored for all CWR laid or adjusted. Rail temperature installation is recorded on Report C in Appendix A, Continuous Welded Rail Procedures.

§119.5(M) Calculate Required Adjustment of CWR

(a) To adjust existing CWR when anchoring temperature is below 95°(F), the amount of rail expansion must be calculated in accordance with paragraph (c). The rail then must be properly adjusted by expanding or straining.

(b) If the anchoring temperature is above 125°(F), it may require adjustment at the direction of the Assistant Director of Track.

(c) The number of inches by which a segment of CWR should be adjusted to achieve a temperature between 95°(F) to 125°(F) may be calculated by taking the difference between the actual rail temperature at time of adjustment and desired rail temperature, multiplying that difference in degrees Fahrenheit by the length of the CWR in feet and multiplying the product by the coefficient 0.000078.

(d) For example, to adjust a 1,450' length of CWR, anchored at a rail temperature of 45°(F) to the corresponding length of rail at 95°(F), subtract 45 from 95 to obtain a difference of 50 and then multiply as follows:

$A = (T_d - T_a) \text{ x } L \text{ x } \alpha_s$

A = (95-45) x 1450 x 0.000078 = +5.65" ~ 5-5/8"

where:

T_d = desired rail temperature (95°F)

T_a = actual rail temperature (°F)

L = length of rail (feet)

α_s = 0.000078 coefficient of expansion for rail steel (inches/foot)

A = Adjustment (inches)

§119.6(M) Adjust CWR by Heating or Mechanical Strain

(a) Rail must be adjusted before it is anchored. All rail fastening systems must be removed from strings of CWR requiring adjustment to permit the desired expansion or contraction.

(b) The number of inches each CWR string should be adjusted during the rail laying or adjusting operation may be determined by calculation according to Part II, §119.5(M) or referring to the CWR adjustment table in Appendix A.

(c) Prior to removing rail fasteners ensure that there is a sufficient gap in the CWR to provide the amount of expansion required.

(d) Tie plates should be tapped with a sledgehammer or approved mechanical device used to free the rail. Be aware of the location of field welds so that they do not interfere with the movement of CWR.

(e) On concrete crosstie track, lightly tap the head of the field side of the rail with a sledgehammer or use an approved mechanical device to free the rail.

(f) A uniform expansion of CWR is to be controlled by marking each quarter of the string and introducing expansion as follows:

1/4 point - 1/4 of total required expansion

1/2 point - 1/2 of total required expansion

3/4 point - 3/4 of total required expansion

(g) Quarter points should be marked with a continuous line from the base of rail to the tie plate or shoulder of concrete tie so the amount of expansion can be accurately determined. The reference point must be one that will not move as the rail expands.

(h) CWR that is below 95°(F) should be heated so that expansion is introduced uniformly from one end of the string to the other end. Heat should be steadily applied while moving forward until the required expansion has been obtained at the end of the string. In the event any quarter point does not achieve the required expansion, move the heater back over that portion (without applying heat) and then reheat the rail until the necessary expansion is obtained.

(i) CWR that is below 95°(F) may be expanded by mechanical means with a hydraulic rail stretcher. The expansion induced by strain is introduced uniformly from one end of the string to the other end. In the event any quarter point does not achieve the required expansion, vibrate the rail to ensure it can move freely.

(j) As adjusting is progressed, a minimum of four ties should be boxed or have rail fasteners applied per 39' of rail to prevent the rail from losing adjustment.

§119.7(M) Maintaining the Desired Neutral Temperature of CWR

(a) It is important to maintain the desired neutral temperature of CWR so that the track remains stable.

(b) When performing maintenance or out-of-face work it is important to recognize activities that may or may not significantly change the neutral temperature of CWR (see Appendix A, Continuous Welded Rail Procedures).

§119.8(M) Replacement of Defective Rails or Welds

Defective rails or welds shall be removed and classified in accordance with Part II, §113.3.1(M) and Appendix A, Continuous Welded Rail Procedures.

§121.0(M) Rail Joints

§121.1(M) Field Welding of Rail Joints

(a) The goal of the Engineering Department is to reduce the quantity of joints in track by laying CWR and field welding joints wherever possible.

(b) Thermite and flash butt are acceptable methods for in-track field welding.

(c) Thermite welding shall be performed in accordance with the manufacturer's recommended procedure.

(d) When it is necessary to install plug rails, the plug rails should be at least 18' in length.

(e) Bonded insulated joint rail assemblies shall be field welded.

(f) Whenever possible it is desirable to field weld all new turnouts and special trackwork.

(g) For a concrete tie turnout or crossover, it is required to field weld all joints.

(h) If it becomes necessary to apply temporary joint bars, the end bolt hole in each rail must not be drilled as this would prevent subsequent field welding. Additional rail anchors must be applied to this joint in accordance with Part II, §125.1(M).

(i) Field welding on open deck bridges is permitted provided that proper precaution against fire is taken.

(j) Wherever possible, field welds shall be located:

  (1) At least 14' away from a field weld in the same rail.

  (2) At least 4' from a plant weld in the same rail.

  (3) At least 7'-9" (the short leg on a 19'-6" staggered bonded insulated joint) from a bonded insulated joint unless field conditions mandate a shorter distance.

(k) The rail should be installed to ensure placement of the weld in the center of the crib. If a weld cannot be made at the center of a crib, the weld may be located at a minimum of 4" from the nearest tie plate or rail seat. If the above conditions cannot be met, ties shall be respaced.

(l) Field welds will not be made within 6" of a bolt hole.

§121.2(M) Bolted Rail Joints

(a) Rail ends shall be fastened together by bolted standard, compromise, insulated or glued joints.

(b) The use of shims or spring washers between the web of the rail and the joint bar to align the gage sides of rail heads is prohibited.

(c) The use of acetylene torches or grinding to manufacture or change the dimensions of compromise joint bars is prohibited.

(d) Compromise joint bars of an approved design shall be used to join rails of the respective sections.

(e) Where a straight bar is used to join 115RE to 119RE sections, care must be used to avoid rail end mismatch. Refer to limits given in the table in Part II, §115(M).

(f) Compromise joints are specified as left or right hand as shown in the following diagram. To determine where a left hand ("LH") or right hand ("RH") lays, stand in the center of the track and face the joint to be compromised.

(g) If rail end mismatch exists after applying approved joint bars, the rail head and gage face surfaces may be adjusted by electric arc welding the smaller rail and grinding to finish the weld.

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

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

(j) In main line track construction with conventional jointed rail, each rail must be bolted with at least two bolts in each rail, or with all joint bar bolt holes filled.

(k) If a permanent joint connection is made between CWR and bolted rail, all joint bar holes must be filled.

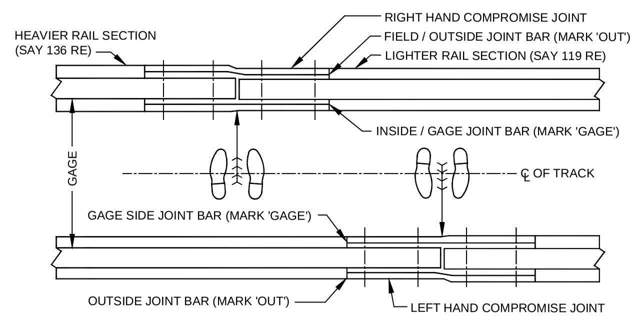
(l) Each joint bar must be held in position by track bolts tightened sufficiently to provide firm support for abutting rail ends and to allow longitudinal movement of rails in the joint to accommodate expansion and contraction due to temperature variations.

(m) No rail or joint bar having a torch cut or burned bolt hole may be used in track.

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

(o) When a bolt is changed in a joint in track Classes 1-5 or a frog bolt is changed, then all bolts in the connections shall be checked and retightened as required.

(p) Whenever possible, new bolts, nuts and spring washers should be used when new or fit joint bars are applied.



COMPROMISE JOINT EXAMPLE

STAND IN CENTER OF TRACK FACING THE COMPROMISE JOINT GIVING IN EACH CASE THE INFORMATION STATED BELOW

INFORMATION REQUIRED TO ORDER COMPROMISE JOINTS:

1 - RAIL SECTIONS (INCLUDE WEAR IF ANY)

2 - DRILLING IN RAIL ENDS (EACH RAIL)
- (A) HORIZONTAL SPACING
- (B) ELEVATION OF HOLES FROM BOTTOM OF RAIL
- (C) SIZE OF BOLTS, SIZE OF BOLT HOLES (ROUND OR OVAL) AND DESIGNATE WHICH HOLES IN JOINT BAR ARE TO BE ROUND, OTHERWISE ALL HOLES SHALL BE OVAL

3 - LOCATION OF SPIKE NOTCHES WITH SIZE OF NOTCHES IF ANY REQUIRED

4 - A JOINT SHALL CONSIST OF TWO BARS

(q) Tighten all bolts, working from center of joint bars outward. During this final tightening, drive the toes of the bars inward by tapping with a sledgehammer.

(r) In locations of elastic fasteners, the appropriate clip will be used (i.e., “j” clip, modified “e” clip, “c” clip) to properly fasten the ties through the joint area.

§121.3(M) Insulated Rail Joints

(a) Position

For new work or rail renewals in track circuit territory, insulated joints shall be located as follows:

(1) Insulated joints shall not be staggered if possible.

(2) To provide for effective electric locking, insulated joints, as prescribed in paragraph (1) above, shall be located with respect to signals as follows:

(i) No insulated joint shall be placed less than 0" nor more than 60" in advance of a signal, except that where there are opposing signals at the same location, the insulated joints shall be placed as near an equal distance (between) opposing signals as practicable.

(3) Insulated rail joints in turnouts and crossovers and at highway grade crossings shall be located in accordance with the applicable Signal Standard Plans.

(4) Insulated rail joints located in accordance with former railroad specifications need not be relocated until rail is renewed.

(b) Application of Armored Insulated Joints (Paper Joint)

(1) An insulated joint should not be applied to rails with battered or rough cut edges as they will damage insulating fibers. Such edges that come in contact with the insulated parts of the joint, i.e., under the rail head, web and top and bottom of the rail base should be rounded to approximately 1/8" radius by grinding or filing.

(2) Rails should be spaced so that the ends will bear firmly against the insulated end post to avoid damage to bolts and insulated bushings. If the opening between rail ends is too small, the rail ends should be forced apart with an approved rail expander. The end posts should not project above or beyond rail heads. Use of a wedge is not permitted.

(3) Ties under 24" or 36" armored type insulating joint should be spaced and tamped to provide uniform support.

(4) Abrasion plates must be used under insulating joints.

(5) Before insulated joints are applied, the parts of the rails to be covered by the insulated joint should be thoroughly cleaned to remove all rust, scale and

dirt. All metal parts of the joint should be thoroughly cleaned.

(c) Application of Bonded Insulated Joints (Glued Insulated Joints)

(1) All bonded insulated joints are to be installed as suspended joints.

(2) Conventional rail joints adjacent to bonded insulated joint rails should be field welded.

(3) Double shoulder tie plates or elastic fastener tie plates should be used on the two wood crossties supporting suspended bonded insulating joints.

(4) Rail holding spike heads must be in reverse position and must be carefully driven to ensure that spike head is not in contact with the bar, which could result in the joint's being short circuited. All bonded insulating joints will have plate holding spikes installed. An approved type fastener shall be used where insulated joints are installed in concrete crosstie track.

(5) Joints installed with elastic fasteners shall have the correct clips (modified "e" clips) applied to prevent possible damage to the joint.

(6) No attempt should be made to tighten bolts in bonded insulated joints. In the event the bolts in the joint become loose, the joint should be replaced.

(7) Any rail head overflow at a bonded insulated joint is to be removed by grinding. Extreme care must be exercised to ensure that the end post is not damaged. The overflow should be ground only to the rail end, so that the joint gap will not be greater than the original gap.

(8) The bonded insulated joints will be considered as welded rail for purposes of compliance with the anchoring requirements of Part II, §125.1(M).

(d) Application of Polyurethane Coated Steel Insulated Joints (Poly Joints)

(1) Polyurethane-coated steel insulated joints may be used permanently in track where the use of a bonded insulated jointed rail is not practical.

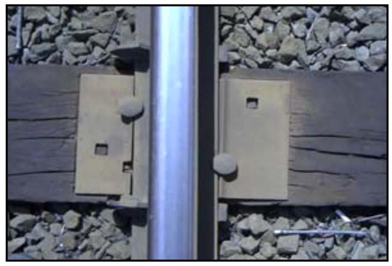
(2) Whenever possible, polyurethane-coated steel insulated joints are to be installed as suspended joints.

(4) The top of the polyurethane-coated steel must be set first into the fillet area of the rail. Bolts should be applied and tightened from the center out to the end of the bar.

(5) Rail holding spikes shall be reversed and not driven up against the polyurethane coated steel.

§123.0(M) Tie Plates

(a) Tie plates shall be installed under running rails on all wood crossties, switch timber and bridge timber.



(b) Tie plates with different cants and flat plates shall not be mixed.

(c) Canted tie plates shall be installed so that the rail cants towards the centerline of track.

(d) Tie plates must be placed square to the base of the rail and no portion or part of the shoulder can be under the base of the rail.

(e) No metal object that causes a concentrated load by solely supporting a rail shall be allowed between the base of the rail and the bearing surface of the tie plate. Examples include tie plate shoulders, spikes, etc.

§124.0(M) Tie Pads (Wood and Concrete Ties)

(a) The use of tie pads, under the tie plates on open deck bridges, may be used only with the approval of the Director of Track & Structures.

(b) Elastomeric tie pads shall be used on concrete ties. There are several designs such as those used with the "e" clip and "5-1/2" and 6" fast" clip assemblies.

§125.0(M) Rail Anchors/Fasteners

§125.1(M) Fasteners Required

(a) Insufficient anchors may result in improper distribution of expansion allowance, stresses in CWR, and movement of rail resulting in distortion of line and surface, which could create a hazardous condition.

(b) A sufficient number of anchors must be applied to effectively control longitudinal rail movement.

(c) Additional anchors must be applied when there is evidence that rails are moving longitudinally under traffic.

(d) See next pictures for typical fastening and anchoring systems on MNR.

(e) It should be recognized that when track is raised out-of-face, the resistance to creepage is reduced and additional anchors may be required to avoid undue rail movement.

Conventional Tie/Creeper (Box Anchor)

Fast Clip (Anchor)

Pandrol Clip (Anchor)

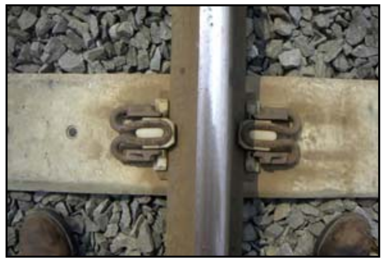
Rail Anchoring of Turnouts

(f) Every other tie shall be box anchored in all CWR tracks.

(g) All jointed rail tracks require a minimum of twelve (12) anchors per 39' rail and be boxed on six (6) ties.

(h) A fully clipped wood tie, bridge timber or fully clipped and insulated concrete tie is considered equivalent to a box anchored wood tie.

Deficient Rail Fastening System
(Caused by Foul Ballast)



Fast Clip

(i) On main tracks the number of anchors to be applied when CWR is laid and maintained is as follows:

(1) When using conventional fasteners, box anchor every wood tie 200' in each direction from:

(i) Ends of CWR strings.

(ii) Joints.

(iii) Turnouts, crossovers and other special trackwork.

(iv) Rail track crossings.

(v) Public and private highway grade crossings.

(vi) Additional anchors may be added if longitudinal movement of the rail is detected.

(vii) Transitions to locations with elastic fasteners.

(viii) Open decks on bridges, where the timber are hooked and blocked in accordance with Part II, §119.1(M).

(2) To the extent practical, fully box anchor all CWR within switch, turnout and crossover areas.

(j) Rail anchoring systems shall be used on open deck bridges, trestles and viaducts, except when the deck does not meet the requirements of Part II, §119.1(M), or their use is prohibited by the Director of Track & Structures

§125.2(M) Anchor Placement

Rail anchors shall be applied as follows:

(a) Anchors shall be applied at both ends and on the same side of the tie. Where special applications may be necessary, other spacing may be used with permission of the Assistant Director of Track. Wherever practicable, rail anchors shall be applied from the gage side of the rail.

(b) When adjusting or laying rail, the necessary anchors shall be applied immediately after the rail is adjusted.

(c) Anchors should be tightly applied against sound ties.

(d) When ties at a joint cannot be anchored because of interference with a joint bar, there shall be no anchors applied to the affected joint.

(e) In conventional turnouts, drive on type anchors shall be applied to switch stock rails from the field side of the track. Care must be taken in application of anchors so as not to foul switch rods or damage rails.

§125.3(M) Maintenance

(a) Rail anchors must have full bearing against the tie or tie plate when applied.

(b) In order to avoid damage, only proper tools or machines should be used in applying and removing rail anchors. Anchors should not be driven along the base of the rail.

(c) When the bearing of rail anchors against the tie is disturbed by renewing or re-spacing ties or moving rail, the anchors must be taken off and then reapplied in proper position. All anchors removed must be reapplied replacing any broken or defective anchors and adding additional anchors, as necessary.

(d) Proper opening between rail ends is maintained by the use of adequate rail anchors.

§125.4(M) Use

New or fit rail anchors may be used at any location on MNR as long as they perform as intended.

§127.0(M) Rail Fastening Systems

§127.1(M) Number Required

(a) The requirements of Part I, §213.127 must be satisfied as to minimum number and location of effective track fasteners.

(b) Additional fasteners may be used where they are needed to hold gage and/or restrain the movement (both longitudinal and lateral) of rail.

§127.2(M) Installation of Fasteners

(a) All elastic fasteners shall be inserted or removed from the cast-in-place shoulder (concrete tie) or tie plate (wood tie) with an approved device such as a sledgehammer. The use of a spike maul is prohibited.

(b) Elastic fasteners should not be overdriven as overdriving will cause premature relaxation of the fastener.

(c) Fasteners that have been overdriven or are not performing their intended function of limiting the vertical and longitudinal movement of the rail shall be replaced.

(d) In the case of an “e” clip, a distance of 3/8" (approximate width of a wooden pencil) between the shoulder and the face of the clip is required to prevent overdriving.

(e) In the case of the “fast” clip, the clip shall be driven or inserted until the clip is engaged in the shoulder notch.

(f) When applying clips with a sledgehammer, the clip must be gently tapped to ensure proper insertion before the clip is fully seated. When removing clips with a sledgehammer, secure clip with foot and gently tap clip to remove the toe load to ensure safe removal of the clip.

(g) When installing clips the tie must be flush with the base of the rail before driving the clip so as not to damage the clip. The clip is not to be used to pull the tie up to the base of the rail.

(h) Striking a concrete tie to make adjustments in the alignment of the tie with any type device is prohibited.

(i) 15/16" diameter lag screws shall be used to secure elastic fastener plates (1" diameter holes) with elastic fasteners to wood ties and timber. Lag screws must be screwed into a 11/16" diameter, pre-drilled hole, 6" deep. Driving of lag screws with a sledgehammer or spike maul is prohibited.

(j) All spikes (cut spikes) shall be driven with the head pointed toward the rail, except that spikes driven against the sides of insulated joints, shall be driven with the head pointing away from the rail and not in solid contact with the joint bars.

(k) Spikes should not be driven at ends of insulated joints in any manner that would cause the insulated joint bar to become electrically connected to the rail.

(l) Spikes must be started vertically and squarely and driven straight. The shank of rail holding spikes must have full bearing against the base of rail. Do not overdrive spikes

(m) The use of lock spikes (hair pins) are prohibited.

Wood Tie Elastic Fastening System

Wood Tie Elastic Fastening System

(n) Care must be taken not to strike the rail, its fastenings or signal and electric traction appliances when driving spikes.

(o) Spikes in main tracks, that have a cut throat or are deteriorated due to rust, should be replaced.

(p) All old spikes, when pulled, shall be picked up and scrapped.

(q) Track spikes shall not be driven into round plate holes.

(r) On all open deck bridge structures, when the head of the track spike is broken off, the replacement spike should be inserted in a new location, leaving the spike stub in the tie. The stub shall be driven below the bottom of the plate.

(s) All spike holes shall be plugged with wood plugs.

§127.3(M) Rail Fasteners Required

(a) Track shall be fastened by a system of components that effectively maintains gage within the limits prescribed in Part I, §213.53.

(b) When spikes and elastic fasteners are used, unless otherwise ordered by the Director of Track & Structures, each rail shall be fastened to every tie in the following manner:

Conventional Tie Plates	Rail Holding Spikes	Plate Holding Spikes
Tangent	2[(1)]	1
Curves 2° and over and curved leads on all turnouts and crossovers	2 (1 field side; 1 gage side)[(1)]	2 (1 field side; 1 gage side)[(1)]

Elastic Fastener Tie Plates (e.g. Pandrol, Norfast)[(3)]	Elastic Fasteners (Clips)	Lag Screws
Tangent	2 Clips	2 (1 field side; 1 gage side)[(2)]
All Curves	2 Clips	4 (2 field side; 2 gage side)

(1) Spikes should be applied diagonally on opposite sides of the rail.
(2) Apply diagonally on opposite side of clip.
(3) Lock spikes (hairpins) are not to be used.

(c) Each concrete crosstie must have four elastic fasteners, four insulators and two tie pads.

(d) Each wood or concrete tie must have four elastic fasteners and meet the requirements of Part I, §213.127.

§129.0(M) Track Shims

(a) If track does not meet the geometric limits (e.g. temporary rail section mismatch, crosslevel or profile) track shims may be installed to temporarily correct the track surface.

(b) Shimmed track must be watched carefully to see that shims are securely in place and tight, and that proper gage and crosslevel are being maintained.

(c) If shims are used, they must be removed as soon as the weather or other conditions permit the track to be surfaced.

(d) Permanent use of steel shims may be required but must be authorized by Director of Track & Structures.

(e) Tie plates must not be removed from the ties as a means of adjusting the surface or crosslevel of track.

(f) Track shims must be at least the size of the tie plate and be spiked directly to the tie with spikes which penetrate the tie at least 4-1/2".

§145.0(M) Bridge Guard Rails

§145.1(M) Use

(a) A continuous line of rails, connected by bolted joints or welds, fastened to the crossties or bridge ties adjacent to the gage side of one running rail. One such rail is designated in these instructions as a “Single” Bridge Guardrail. Two such continuous lines of rail, one adjacent to the gage side of each running rail are designated as “Full” Bridge Guardrail.

(b) Bridge Guardrails are applied between the running rails of main tracks at undergrade bridges which meet the below listed criteria. Guardrail shall only be used on secondary track when approved by the Assistant Vice President - Maintenance of Way.

(c) Full Bridge Guardrails shall be installed at the following locations:

  (1) All open deck bridges in curves.

  (2) All truss bridges.

  (3) All moveable bridges, except in Class 1 track.

  (4) All open deck viaducts.

  (5) All direct fixation track on an elevated structure.

  (6) Any other locations as directed by the Assistant Vice President – Maintenance of Way.

(d) Existing Bridge Guardrails applied in accordance to previous standards or practices need not be changed unless instructed by the Assistant Vice President - Maintenance of Way. When it is necessary to remove bridge guardrail to perform maintenance work, bridge guardrail will be reinstalled only where required by the above instruction.

§145.2(M) Materials

(a) Suitable scrap or fit running rails may be used. The installed rail section will be approximately one-half inch, but not more than two inches below the top of the adjacent running rails, and in no case higher than the running rail.

(b) Joints shall be either four or six hole bars with a minimum of four bolts. Joint bars shall not be used within the 21' curved end section of the guardrail.

(c) An L-6" x 6" x 3/8" angle iron may be used as a guardrail with the approval of the Assistant Vice President - Maintenance of Way.

§145.3(M) Application

(a) Bridge Guardrails shall extend a minimum distance of 50' beyond each end of the bridge abutment, unless increased distances have been prescribed for specific territories or locations. Bridge guardrails should be curved and brought to the center of the track for a distance of 21' from each end.

(b) Guardrails shall have the rail ends beveled, bent down, or fitted with bridge guardrail nose, or suitable fitting. Each end shall be fastened to the center of the track so as to divert a derailed wheel and not catch dragging equipment.

(c) Guarding Face of bridge guardrails on open deck bridges shall be parallel to and 11" from the gage of the running rail. If Pandrol plates are used on open deck bridges, see Paragraph (d)(3) below.

(d) The distance of the guarding face will be changed in the following locations:

    (1) On ballasted truss bridges the guarding face shall be at 18".

    (2) On ballasted approach to bridges the guarding face shall be at 18".

    (3) Where it is determined to use Pandrol plates to install the bridge guardrail, the guarding face of the bridge guardrail shall be parallel to and 14" from the gage of running rail to allow for adequate space between plates. When lag plates are used, plates and clips will be installed on every other tie.

(e) On direct fixation track or concrete ties an L-6" x 6" x 3/8" angle may be used as an inner bridge guardrail with the approval of the Chief Engineer. The distance from the gage face of the running rail to the gage face of the angle is 11".

(f) Guardrail Ends shall rest on a sound tie and be securely fastened.

§145.4(M) Inspection and Maintenance

Guard rails shall be inspected periodically to make certain that bolts and joints are tight, spikes are firmly against base of the rail and castings fastened securely to rail ends, or ends properly beveled or bent down.

Subpart E -- Tools

§150.0(M)   Tool Requirements

See Part I, §213.250 for typical tools used in inspection and maintenance.

RECOMMENDED PRACTICE FOR THE MAINTENANCE OF SPECIAL TRACKWORK

RECOMMENDED PRACTICE FOR
THE MAINTENANCE OF SPECIAL TRACKWORK

Subpart A -- General

§1.0(STM) Scope

(a) This subpart is intended to provide guidance as to the types of maintenance and maintenance limits required for special trackwork**.**

(b) This subpart shall be used by the Engineering Department forces to maintain a safe, reliable track structure in the most economical and efficient manner possible.

(c) Forces engaged in the repair of special trackwork and appliances shall be aware that their maintenance goal is to provide a safe and reliable track structure with a superior ride quality.

(d) Ensuring adequate spare material inventory for all trackwork is the responsibility of the Assistant Director of Track.

§2.0(STM) Maintenance Responsibilities

(a) Engineering personnel in charge of making repairs and performing maintenance of turnouts and other trackwork shall attend and successfully complete courses prescribed by the Engineering Department of MNR.

(b) For Track Classes 1-5, individuals designated to supervise the maintenance, restoration and renewal of trackwork shall be designated in accordance with MW-4, Part I, §213.7.

§3.0(STM) Scheduled Maintenance

(a) Turnouts and other special trackwork must be maintained on a regular basis to provide a safe and reliable track structure, to provide acceptable ride quality and to maximize the life of the turnout in track.

(b) The maintenance schedule for special trackwork is driven by:

(1) The location of the special trackwork.

(2) The frequency and accumulated tonnage over the special trackwork.

(3) The type and maintenance history of the special trackwork.

(4) The requirements for maintenance as indicated on inspection reports (e.g., Monthly Switch Inspection, Track Patrol, Annual Switch Inspection).

(c) A summary of scheduled maintenance activities for special trackwork is given in the following table. This table is not intended to be all-inclusive and only identifies the major activities that are usually associated with special trackwork maintenance.

Scheduled Maintenance Activities for Special Trackwork
Lubrication of switch and frog plates
Maintenance grinding of frog and switch point areas
Maintenance grinding of welds, forged areas and slotting of mechanical joints
Maintenance welding of worn frogs and guard rails
Maintenance welding of wheel burns
Production grinding of trackwork and approaches
Inspection of gage, with attention to the spread of the rail due to defective fasteners and/or timber
Inspection of head block (head stick) area to include switch point adjustment
Clean, adjust, repair or replace switch targets
Maintenance and replacement of gage plate and rod insulation
Spot tamping of trackwork
Out-of-face surfacing and alignment of trackwork
Spot replacement of major trackwork components (stock rails, switch points, frogs, etc.)
Spot rail replacement to include the replacement of insulated joints and curve worn rail
Bolt maintenance: tighten or replace loose and defective bolts and torque to specifications.; inspect and install cotter pins as required
Replacement, addition or adjustment of defective fasteners
Insulator and pad maintenance
Maintenance of drainage and waterways
Vegetation management
Spot ballast maintenance
Out-of-face ballast replacement (undercutting)

Notes: The above items represent major maintenance activities for special trackwork and do not detail every maintenance activity that may be required.

The Signal Department must be notified of any work done from point to heel in the switch area and also at moveable point frog locations

§4.0(STM) Unscheduled Maintenance Activities

(a) Unscheduled maintenance activities are maintenance activities that cannot be planned or programmed.

(b) Unscheduled maintenance of special trackwork and components can be due to:

(1) Natural events, such as fire, flood, severe storms and extreme temperatures or extreme variations in temperature.

(2) A sudden change in the type of traffic, speed of traffic or frequency of traffic over special trackwork.

(3) A “run-through” or derailment within the area of special trackwork or a component of special trackwork.

(4) Failure of a component or components.

Subpart B – Maintenance Program

§5.0(STM) Maintenance

(a) The responsible personnel in charge of performing the maintenance work (MW Foreman) shall be qualified to maintain, restore, or renew trackwork in accordance with Part I, §213.7.

(b) The person responsible for the work shall coordinate and report all work performed to their Track Supervisor.

(c) A record of all maintenance performed on special trackwork shall be maintained by the Assistant Director of Track Coordination for a minimum of one (1) year.

§6.0(STM) Planning and Coordination

(a) Refer to Part II, §3.0(STM) for the list of maintenance activities that shall be planned at the maintenance subdivision level and performed by division forces.

(b) The Subdivision shall plan and coordinate all maintenance so that a comprehensive maintenance program can be developed. Programmed maintenance at the division level shall provide for the safety of train operations and shall be carried out in a cost-effective manner to provide maximum life to the trackwork and maximum benefit to MNR.

(c) The information contained in inspection reports shall be used to plan trackwork maintenance.

§7.0(STM) Quality Control

(a) The person in charge of performing the maintenance activity or repair shall be responsible for the overall quality of the work performed.

(b) All maintenance work shall be performed in accordance with the MW-4 and MNR issued directives.

(c) The Track Supervisor and Assistant Director of Track shall periodically review the work performed for quality, consistency and adherence to §(b).

(d) Trackwork repairs that are deficient:

  (1) May be cause for remedial action

  (2) Shall be brought to the attention of the Track Supervisor.

(e) The Track Supervisor shall see that any additional work necessary is performed to bring the repair into compliance with MNR recommended practices and procedures and shall re-inspect for substandard or deficient work.

(f) MNR Engineering personnel are encouraged to make recommendations to the Track Supervisor or Assistant Director of Track as to required modifications to methods, procedures and practices to improve the overall quality of work.

Subpart C – Scheduled Site Maintenance Activities

§33.0(STM) Drainage and Waterways

Drainage in and around special trackwork shall be maintained in accordance with Part II, §33.0(M).

§37.0(STM) Vegetation Management

Vegetation in and around special trackwork shall be maintained in accordance with Part II, §37.0(M).

Subpart D – Maintenance Limits

§50.0(STM) Scope

(a) Maintenance is the repair or replacement of a component of special trackwork which may include switch points, frogs and fastenings. Maintenance limits are to be used as a triggering mechanism that prompt maintenance or reconstruction.

(1) It is MNR goal to have special trackwork that stays between construction and maintenance limits.

(2) As special trackwork components wear, maintenance should be programmed before the track reaches the maintenance limits.

(3) Maintenance must be executed whenever the maintenance limits are exceeded and completed prior to reaching the safety limits.

(4) Whenever possible, special trackwork should be repaired or reconstructed to construction limits.

(b) The maintenance limits and recommended practice for special trackwork and other trackwork are found in this subpart or the applicable maintenance sections of Part II.

§53.0(STM) Gage

Trackwork gage shall be maintained in accordance with the following table:

Special Trackwork Gage Maintenance Limits			
Class of Track	**Minimum (inches)**	**Maximum (inches)**	**Maximum Rate of Change in Gage per 31' (inches)**
1 – 2	56-1/8	57-1/4	3/4
3	56-1/4	57-1/8	5/8
4 – 5	56-1/4	57	1/2

§55.0(STM) Alignment

(a) The straight stock rail (open point) in a turnout is the line rail. If stations fall within the housed or undercut portions of the stock rail, alignment measurements may be taken on the field side of the stock rail.

(b) Maintenance shall be performed when alignment values reach the limits given in the table below.

(1) Alignment deviation in curves, as defined in this table, is the difference in midordinate value between adjacent stations and not the average of multiple stations (uniformity) as defined in Part I, §213.55.

(2) The definition of alignment deviation used in this paragraph, allows the MNR to achieve alignment

tolerances that are more restrictive than those defined in Part I, §213.55.

Special Trackwork Alignment Maintenance Limits			
	Tangent Track	**Curved Track**	
Class of Track	**The deviation of the mid-ordinate from a 62' chord(1,2) may not be more than (inches):**	**The deviation of the mid-ordinate from a 31' chord(2) may not be more than (inches):**	**The deviation of the mid-ordinate from a 62' chord(2) may not be more than (inches):**
1	2-1/2	N/A(3)	2-1/2
2	1-1/2	N/A(3)	1-1/2
3	7/8	5/8	7/8
4	3/4	1/2	3/4
5	1/2	3/8	1/2

(1) The ends of the 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, however, the same rail shall be used for the full length of that tangential segment of track.

(2) The ends of the line or chord must be at points on the gage side of the line rail, 5/8" below the top of the rail head. Use line rail in accordance with Part II, §55.1(M).

(3) N/A – Not Applicable.

§63.0(STM) Track Surface

(a) The following criteria will serve as a practical guide for the maintenance of smooth riding conditions through existing special trackwork and will minimize the wear on special trackwork, special trackwork components and rail vehicles.

(b) For Track Classes 1-5 surface may not deviate more than the amount prescribed in the following table:

Special Trackwork Surface Maintenance Limits					
	Class of Track				
Track Surface	**1**	**2**	**3**	**4**	**5**
The **runoff** in any 31' of rail at the end of a raise may not be more than (inches):	1-3/4	1-1/2	1	3/4	1/2
The deviation from uniform **profile** on either rail at the mid-ordinate of a 62' chord may not be more than (inches):	1-1/2	1-3/8	1-1/8	1	7/8
The deviation from zero **crosslevel** at any point on a tangent may not be more than (inches):(1)	1-1/2	1	7/8	5/8	1/2
For turnouts on curves that have reverse elevation to the diverging route side, the **reverse elevation** may not be more than (inches): (1)	3	2	1-3/4	1-1/4	1
The difference in crosslevel **(twist)** between any two points less than 62' apart may not be more than (inches):	1-1/2	1-1/8	1	7/8	3/4
*The difference in crosslevel **(twist)** between any two points less than 31' apart may not be more than (inches):	2	1-3/4	1-1/4	1	3/4
(1) The maximum allowable speeds for curves as shown in this table is based on a single point deviation in elevation using an underbalance of 3".					

Subpart E – General Maintenance Requirements

§135.0(STM) Switches

(a) Each switch, frog and guard rail must be kept free of obstruction that may interfere with the passage of wheels.

(b) Switch points and moveable points should be kept in line and surface with all bolts tight and cotter pins in place.

(c) Switch points must fit the stock rails closely and accurately, with a full bearing against the head of the stock rail. If a wear pattern indicates bearing only along the top edge of point, the cause of wear shall be investigated and corrected.

(d) Switch points and stock rails should have the metal overflow removed by grinding. Attention must be given to the overflow of the gage face of stock rails and the back side of the switch point to maintain proper fit against the stock rail.

(e) Stock rails and switch points must bear uniformly on each switch plate.

(f) Cutting back of switch points in main tracks is prohibited. In yards, a housed switch point (non-Samson) may be cut back no more than 6".

(g) All bolts, braces and fastenings must be intact and maintained to keep switch and rail components securely in place. Care must be taken so as not to cant the rail by overtightening the braces.

(h) Adequately fasten switch points and stock rails to prevent longitudinal rail movement.

(i) Bolts used with horizontal switch rods must be placed with nut ends up and nuts secured with cotter pins.

(j) Fixed and floating heel blocks shall be installed and maintained as per the Metro-North Standard Track Plans.

(k) Switch plates and moveable parts should be kept clean and lubricated with an approved graphite dry lubricant on main lines. Approved lubricants may be used at other locations.

(l) Switch points shall be replaced when worn or chipped so that the top of the switch point, at any place, is more than 5/8" below the plane across the top of the stock rails. Whenever a switch point is changed, stock rails shall be changed as well (i.e., new switch point and stock rail or fit, matched switch point and stock rail).

(m) Switch points shall be replaced when the raised portion of the switch point (rise) is worn down to the level of the top of the stock rail. The purpose of the rise is to prevent the outer edge of the wheel tread from striking the stock rail and rolling the stock rail out of the switch plates.

(n) Chipping or wear on any switch point should be investigated, its cause determined and corrective action taken. Wear or chipping produces a sloping surface on the face of the switch point which may tend to lift a wheel having an imperfect flange. The switch rail should be further examined to locate any point of hard contact by the wheel, which might contribute to wheel climb.

(o) Switch points that have unusual wear or excessive chipping within the first 20" behind the point must be replaced.

(p) Welding of switch points may only be performed with the permission of the Assistant Director of Track. If a switch point is welded in the field, the first train will operate at restricted speed. The point will be reinspected before the track will be returned to maximum authorized speed.

(q) Spot grinding of points is allowed to remove chips, small imperfections, small cracks, etc., with care being taken to insure that proper profile is restored to the switch point to prevent wheel climb, not to exceed 5/8" below top of stock rail.

(r) Ground points must be greased at the completion of work.

(s) Clearance must be maintained between switch and moveable point frog rods and adjacent ties to prevent binding of switch rods.

(t) In yards when using No. 10 turnouts or smaller, and the maximum authorized speed does not exceed 15 MPH, a switch point guard may be applied to the outside of the stock rail.

(u) The switch point guard rail shall be installed so that the distance of the guarding face of the guard rail to the gage face of the switch point is set at 3-15/16". The gage face of the switch point guard shall be restored to original profile by welding once the wear exceeds 1/4" (4-3/16").

(v) Interior guard rails (house tops) may be used at locations of turnouts with housed points to minimize the wear on the reverse point. Guard rails should be built-up or replaced in order to maintain a gap between the guard rail and the running rail of 1-3/4". These guard rails are located on the straight point side of the turnout (i.e., Grand Central Terminal Loop Track).

(w) Switch points, components and connections must be examined frequently. It is important that the stock rails have no lateral movement in the switch plates and that switch plates have no movement on the ties.

§137.0(STM) Frogs

(a) All metal flow from frogs must be ground promptly and the gage and guard edges of castings rounded. The radius shall be ground to match the original radius of 1/8".

(b) New frogs should be ground 30 days following installation. Subsequent grinding may be required monthly for the first several months depending on frog type and service.

(c) When a frog point becomes chipped, broken or worn more than 1/2" down and 3" back, the frog should be repaired.

(d) Frog points, frog castings and wheel relief areas (false flange) should be built up by welding to maintain as-new cross section. See Standard Track Plans. Spring rail frogs and moveable point frogs have false flange relief areas by design.

(e) If possible, worn frogs should be repaired in track by an approved method of welding or grinding. This does not apply to moveable point frogs.

(f) Each flangeway in special trackwork must be at least 1-1/2" wide.

(g) The flangeway depth, measured from a plane across the wheel-bearing area of the frog, may not be less than 1-3/8" in Track Class l or less than 1-1/2" in Track Classes 2-5.

(h) If a frog point is chipped, broken or worn more than 5/8" down and 6" back, operating speed over that frog may not be more than 10 MPH. This does not apply to moveable point frogs.

(i) If a riser or insert of a frog is broken out or worn down more than 3/8" below the original contour, operating speed over that frog may not be more than 10 MPH.

(j) Welding repairs on manganese steel frogs shall be performed by subdivision forces in accordance with MNR recommended practice.

(k) Missing or loose frog bolts shall be replaced or re-tightened in kind and all the bolts tightened.

(l) All frogs requiring repairs that cannot be made in track, or at the site, shall be shipped to the designated point for repair or reclamation.

(m) Frogs shall be fully tamped and supported on effective timber to minimize wear and damage from train traffic.

§137.1(STM) Frogs: Moveable Point

(a) Welding of a moveable point frog may only be performed with the permission of the Assistant Director of Track. If a moveable point frog is welded in the field, the first train will operate at restricted speed. The moveable point frog will be reinspected before the track will be returned to maximum authorized speed.

    (1) The welding of a moveable frog point must be done in accordance with the manufacturer's recommended practices.

    (2) The recommended methods, procedures and location for repairing the frog may be driven by the location and size of defect.

(b) Unusually chipped or worn moveable points that are found to have an unprotected flat vertical surface 5/16" or more in width at a depth of 5/8" below the top of the wing rail must be removed from service and replaced immediately.

(c) Moveable point frog points and matching wing rails shall be replaced when worn or chipped so that the top of the moveable point is more than 3/8" below the plane across the top of the wing rails, or as specified with the manufacturer's specifications.

(d) The proper fit of the point rail against the wing rail is extremely important. Engineering personnel must use judgment to determine if the point fits the wing rail properly to allow wheels to pass the frog point.

(e) Movements of the wing rail must not adversely affect the fit of the frog point to the wing rail.

(f) The Signal Department must be notified of any work done on a moveable point frog.

§139.0(STM) Spring Rail Frogs

(a) The clearance between the hold-down housing and the horn may not be more than 1/8" at the top and 1/8" at the bottom.

(b) Typically, by design, there is a gap of up to 3/8" between the spring wing rail and frog point within the first 5" of the frog point. It is desirable to maintain contact between the spring wing rail and the remainder of the frog.

(c) Particular attention should be paid to the guard face gage in the point area on the straight side of the turnout. A 29' guard rail protects the straight move through the length of the moveable wing.

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

(e) The toe of each wing rail must be solidly tamped and fully bolted; or preferably field welded.

(f) Spring frogs should be ground 30 days following installation. Subsequent grinding may be required monthly for the first several months depending on frog type and service.

(g) Welding of a spring rail frog may only be performed with the permission of the Assistant Director of Track. If a spring rail frog is welded in the field, the first train will operate at restricted speed. The spring rail frog will be reinspected before the track will be returned to maximum authorized speed.

(h) Each spring must have sufficient compression force to hold the spring wing rail against the point rail.

(i) The opening between the spring wing rail and frog point of spring frog shall be kept free of any debris that may impede the operation of the spring wing rail.

§141.0(STM) Self-Guarded Frogs

(a) The raised guard face on a self-guarded frog may not be worn horizontally more than 3/8". Repairs require the use of a contour gauge (see Part I, §213.251, Inspection Tools).

(b) If repairs need to be made to the guarding face of a self-guarded frog, the track should be taken out of service, a guard rail added or the frog changed out.

(c) When repairing the guard face of a self-guarded frog, the build-up of weld material must be made from the top down to prevent wheel climb.

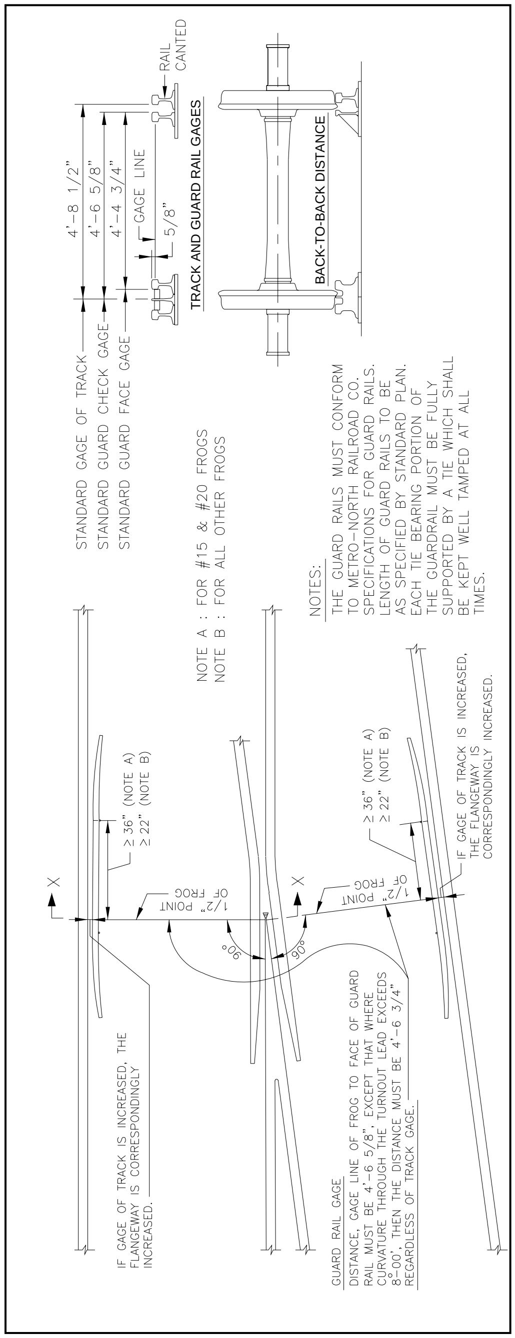
§143.0(STM) Frog Guard Rails and Guard Faces; Gage

(a) If possible, when performing trackwork maintenance, repairs shall be made to restore the installation dimensions of guard rails:

Track gage	56-1/2"
Guard check gage (may not be less than)	54-5/8"
Guard face gage (back to back) (may not be more than)	52-3/4"

(b) Maintenance limits contained in Paragraph (a) are more restrictive than those found in Part I, §213.143.

(c) See following diagram showing guard check gage and guard face.



Guard Check and Guard Face Gage

§145.0(STM) Inner Bridge Guard Rails

§145.1(STM) General

(a) Where inner bridge guard rails are required, they must be properly installed and maintained to prevent serious structural damage, with possible failure of bridge, in the event of a derailment. Installation of inner guard rails on structures should be held to a minimum to eliminate the extra maintenance needed, and to permit proper surfacing, lining and economical renewal of ties on bridge approaches. Where existing guard rails do not meet the above requirements, installations or removals should be made the next time the track is worked through the area.

(b) A "single" guard rail is a continuous line of rails fastened to ties adjacent to the gage side of the running rail. A "full" guard rail consists of such lines of rail, one adjacent to the gage side of each running rail.

§145.2(STM) Use

The use of inner bridge guard rails shall be as follows:

(a) Thru truss bridges and structures supported on piers or on bents that may be struck by derailed equipment with possible failure of the structure, i.e., where piers or bents have considerable batter or extend beyond the bridge trusses due to angular crossing of road, stream, etc.

  (1) Single track – Full guard rail.

  (2) Double track – Single guard rail in each track to deflect derailed wheels away from adjacent truss.

  (3) Three or more tracks – Single guard rail in each outside track to deflect derailed wheels away from adjacent truss. No guard rail is to be placed on other tracks.

(b) Moveable bridges:

Full guard rail in each track.

(c) Special and large structures:

Installation of guard rails must have the approval of the Director of Track and Structures.

§145.3(STM) Material

(a) Preferably, scrap rail will be used, of such a section that the top of guard rail is approximately 1 to 2 inches below the top of running rail.

(b) Joints may be either 4 or 6 hole bars with minimum of 4 bolts, without washers, per joint.

(c) No tie plates or braces will be used with inner bridge guard rails.

§145.4(STM) Application

(a) Inner guard rails shall extend a sufficient distance (approximately 30') beyond the bridge backwalls on either side to have the guard rails parallel to and 11" from the gage of running rails throughout the entire length of the structure to be protected.

(b) Full guard rails shall end on a tie in the middle of the track, with the ends beveled, bent down or fitted with a proper end casting, so as to divert a derailed wheel without catching dragging equipment.

(c) Single guard rails shall end on a tie, approximately 12" from the gage of the outside running rail, and beveled or bent down so as to avoid catching dragging equipment.

(d) To facilitate diverting derailed wheels, the guard rail shall be lined to a smooth uniform curve and/or tangent from bridge backwall to the guard rail end.

(e) Inner guard rails must be installed to protect the structure from traffic on both directions on that track.

(f) Inner bridge guard rails will be spiked on each cross tie or bridge timber with one spike on each side of the rail or casting, spikes being offset from each other to avoid splitting timber, spike holes should be prebored.

§145.5(STM) Inspection

Inner guard rails shall be inspected periodically to make certain that bolts and joints are tight, spikes firmly against base of rail, and castings fastened securely to rail ends, or ends properly beveled or bent down.

Subpart F – Scheduled Maintenance Activities

§150.0(STM) Description of Scheduled Maintenance Activities to be Performed

Refer to the table in Part II, §3.0(STM) for the list of major trackwork activities to be performed by subdivision forces.

§151.0(STM) Record of Trackwork Disturbance in CWR Territory

(a) Maintenance activities performed in trackwork installed in CWR track can cause a change in the neutral temperature of the CWR and cause track instability in and around the special trackwork.

(b) Maintenance of way employees in charge of or responsible for maintenance work performed in and around special trackwork in CWR track shall be thoroughly familiar with and understand the “Continuous Welded Rail Procedures” contained in Appendix A.

§152.0(STM) Lubrication of Switches and Frogs

(a) Switch, moveable point frog (MPF) and spring frog plates shall be cleaned and lubricated as necessary.

(b) The Signal Department has the overall responsibility to lubricate switches and moveable point frogs in main track.

§152.1(STM) Lubrication of New Switch Points

New switch points in conventional turnouts (non-tangential geometry) shall be greased after installation.

§154.0(STM) Repair of Welds, Forged Transition Areas and Rail Head Depressions by Welding or Grinding

(a) Field and shop welds shall be inspected for batter. Maintenance welding and grinding shall be performed as required.

(b) The depth of low spots and depressions around welds, forgings and other anomalies shall be measured with a 36" straightedge and taper gauge.

(c) The transition areas (forged area) of switch points in asymmetrical turnouts shall be inspected for any “low” spots or depressions that develop in the rail head.

(d) The preferred method of removing low spots, low areas and engine burns (but NOT engine burn fractures) in the rail head profile is by building up the rail head by welding.

(e) Any engine burn should be repaired as soon as practicable before rail and tie damage occur. Engine burns 3/8" or greater require removal and replacement of the rail.

(f) The repair of engine burns is especially important in concrete tie track or turnouts where impact forces may be detrimental to tie performance.

§154.1(STM) Cross Cutting (Slotting) of Bolted Joints

(a) Permanent bolted joints shall be inspected and rail ends slotted as required to remove metal flow and prevent end chipping.

(b) When rails are replaced at the location of a permanently bolted joint, the rail ends should be slotted.

(c) The frequency of grinding or slotting rail ends at permanently bolted joint locations may increase as traffic and other local conditions warrant.

§155.0(STM) Production Grinding (Out-of-Face)

(a) Production grinding of rail in special trackwork shall be performed at regular intervals based on the condition of the rail, the number and type of trains and the accumulated tonnage at a particular location.

(b) Production grinding is required to remove surface anomalies on the rail head and to remove surface conditions that cannot be readily removed with the profile grinder used for maintenance grinding.

(c) Production rail grinding is required to remove flow and to restore the gage corner and head radius of the rail in and around special trackwork.

(d) When grinding in the vicinity of a moveable point frog or a spring rail frog do not remove the groove for false flange relief.

(e) Production grinding shall be used to remove such surface conditions as flakes, checks, shells and corrugations.

(f) Out-of-face grinding of special trackwork should include grinding of the approaches for a minimum distance of 200' to provide a transition to the existing rail section.

(g) Representatives of the Signal and Power Departments shall be present as required when production grinding is completed to ensure that the frog and switch points seat properly and to replace any broken or damaged bonds.

§156.0(STM) Surfacing (Spot Tamping)

(a) Spot tamping is required to restore the surface and line when deviations approach the alignment and surface maintenance limits given in Part II, §§55.0(M) and 63.0(M).

(b) Spot tamping is particularly important in concrete tie turnouts to minimize the differential movement between ties and the vertical deflection of ties.

(c) Spot tamping is required to eliminate the excessive deflection and pumping of ties which:

   (1) Overstresses clips causing premature failure or backing out of clips.

   (2) Increases tie pad and tie seat abrasion.

   (3) Increases the wear on insulators.

   (4) Increases ballast abrasion and wear.

(5) Changes the load distribution over the length of the tie which, in some cases, may overstress the tie.

(d Tamping should be performed in such a manner as to prevent the centerbinding of timber and ties. This is particularly important for concrete tie turnouts.

(e) Tamping of switch machine motor mounts in concrete tie switches is not necessary as it may damage or break concrete frog and switch movement ties.

(f) In wood tie turnouts, head block (head sticks) and movement ties may require tamping by hand.

§157.0(STM) Out-of-Face Surfacing and Alignment

(a) Out-of-face surfacing shall be accomplished by multiple tool switch tampers, ballast stabilizers and ballast regulators.

(b) Out-of-face surfacing is required when spot surfacing no longer provides the desired surface, line, or ride qualities, or is no longer cost-effective.

(c) Out-of-face surfacing is required to restore the overall surface and line when deviations approach the alignpment and surface maintenance limits given in Part II, §§55.0(M) and 63.0(M).

(d) The Assistant Director of Production shall plan an annual out-of-face surfacing program for trackwork.

§158.0(STM) Spot Replacement of Major Components

(a) During the useful life of special trackwork, it may be required to replace major components and systems as part of a programmed maintenance activity. The major components include, but are not limited to:

    (1) Switch points and stock rails.
    (2) Switch plates or plates and clips, pads and insulators.
    (3) Guard rails.
    (4) Frogs.
    (5) Switch timber.
    (6) Switch/Frog machines.
    (7) Easer rails (behind knuckle rail in a slip).
    (8) Knuckle rails.

(b) The replacement of major components is based on:

    (1) The physical condition of the component.

    (2) The amount of measured wear on the component compared to an established maximum "wear limit" as given in this Part.

    (3) The ability of the component to sustain maximum authorized speed and meet the operational requirements of the Subdivision.

(c) When changing major components, all work performed shall be reported to the local Track Supervisor.

§159.0(STM) Spot Rail Replacement

(a) Rail replacement shall be performed on an as-needed basis as traffic and local conditions warrant.

(b) The replacement of rail is based on:

   (1) The physical condition of the rail.

   (2) The amount of measured wear on the rail compared to an established "wear limit" for that rail is given in Part II, §113.2(M). Switch point to stock rail and moveable point frog to wing rail wear limits as given in this Part take precedence over the maintenance limits given in Part II, §113.2(M).

(c) When changing major components, all work performed shall be reported to the local Track Supervisor.

§160.0(STM) Bolts

(a) During the useful life of trackwork there may be a requirement to replace broken or defective bolts in frogs, heel blocks and at permanently bolted joints.

(b) When evaluating the performance of bolts, the Foreman shall:

   (1) Verify that the bolt is of the correct diameter, length and type.

   (2) Visually inspect the performance of the bolt under load.

   (3) Visually inspect the joint or appliance and look for signs of vertical movement, batter, crushing, excessive flow or excessive wear in the component affixed with the bolt.

   (4) Visually inspect the condition of crib ballast and general line and surface at that location.

   (5) Visually inspect the condition of ties, plates, pads, insulators and clips at bolted locations.

(c) When changing a bolt in a frog or in a switch point, tighten all other bolts in the immediate vicinity.

§161.0(STM) Fastening Systems

(a) During the useful life of trackwork, it may be required to change rail fasteners (clips or spikes) as a normal maintenance activity.

(b) The replacement of fasteners is based on:

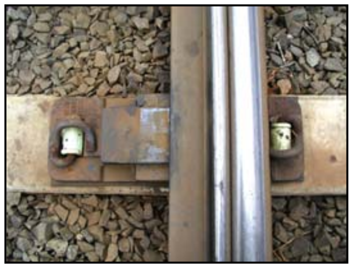
   (1) The physical condition of the fastener (broken or missing).

   (2) The ability of the fastener and the fastening system to minimize the horizontal and vertical movement as well as the longitudinal movement of the rail or components (frogs and guard rail) and to sustain maximum authorized speed.

(c) When evaluating the performance of fasteners, the Foreman shall:

   (1) Verify that the correct type of fastener is being used.

   (2) Visually inspect the fastener for cracks and breaks.



(3) Visually inspect the components being fastened and look for signs of vertical or horizontal movement or excessive wear.

(d) Fasteners used in switches with built-up switch plates, that limit the movement of the stock rail, should be inspected and replaced if broken, missing or loose. There are two types of built-up switch plates in common use:

(1) The PVT clip.

(2) The Schwihag clip

(e) Clips that have repeatedly backed out or fallen out should be replaced with new clips.

§162.0(STM) Insulators and Pads

(a) During the useful life of trackwork, it may be required to replace insulator and pads as a normal maintenance activity.

(b) The replacement of insulator and pads is based on:

(1) The physical condition of the insulators and pads (cracked, broken, or missing).

(2) The ability of the insulator pad system to minimize the horizontal and vertical movement of components (frogs and guard rails) and to sustain maximum authorized speed.

(c) When evaluating the performance of pads and insulators, the Foreman shall:

(1) Verify that the correct type of pads and insulators are being used.

(2) Inspect to see that insulators are installed correctly (not upside-down).

(3) In areas of loose or missing clips, visually inspect for:

(i) Missing or crushed pads

(ii) Twisted pads

(iii) Worn, cracked, or broken insulators

(4) At locations with known insulator and pad problems, inspect ties, ballast and other major components for damage. Perform any additional necessary maintenance as required.

(d) When practicable, when pads are replaced, the insulators shall also be replaced.

Subpart G – General Protection

§170.0(STM) General Procedures (Protection)

When adjusting or working on a main track switch or moveable point frog:

1. Notify the Signal Department.
2. Obtain foul time or exclusive use of track.
3. Block the switch or frog point.
4. Perform the work.
5. Remove blocking.
6. Perform obstruction test (Signal).
7. Return track to service.

Subpart H – Mechanisms, Appliances and Devices

§200.0(STM) Switch and Moveable Point Frog Operating Mechanisms

§200.1(STM) Use of Mechanisms

Switches shall be operated by approved types of mechanisms.

(a) Locking switch stands: Manually operated switch mechanisms (C&S, T20), combined in one unit, that throw the switch points and also provide for locking them in normal and/or reverse positions, referred to as "locking switch stands," may be used as follows:

(1) In main tracks in automatic block territory.

(2) In main tracks, in other than automatic block territory and in other tracks where switches are protected by signals controlled by track circuits.

(b) Manually operated switch mechanisms: Non-automatic types, which throw the switch points, referred to as "switch stands," may be used as follows:

(1) In main tracks, branch lines and secondary tracks, yards and side tracks without restriction.

(2) Standard types of switch stands are: New Century Model 50/51.

(c) Manually operated mechanisms, the position of which is automatically reversed by wheels trailing through a switch set for the opposite route, and referred to as "semi-automatic switch stands" may be used in yards and sidings.

(1) Standard types of stands are Bethlehem No. 22 and Abex No. 22.

(2) The color of the switch stand shall be black.

(d) Manual operated mechanisms shall use the "back saver" type handles for new installations.

§200.2(STM) Installation of Switch Stands

(a) Manually operated switch stands shall be placed so that the operating rod is in tension when the switch is set in normal position.

(b) Whenever possible, the switch stand handle shall be positioned facing the frog when the switch is in the normal position.

(c) Where crossover switches are protected by signals, a switch locking arrangement shall be provided.

(d) Switch stands for all tracks shall be located to serve the safety and efficiency of employees.

§205.0(STM) Switch Point Position Indicators

§205.1(STM) General

(a) Where required, indicators shall be provided to give a clear and distinct indication of the position of the switch points

(b) Switch point targets shall be of the reflectorized low type. The height of the centerline of the target shall not to exceed 20" above the track ties.

§205.2(STM) Installation of Position Indicators

(a) Switch targets may be placed on a low stand connected to the switch points on the opposite side of the track from the switch operating mechanism.

(b) Targets shall be set at right angles to the track and perpendicular to the headblock ties.

§205.3(STM) Maintenance

Switch targets should be kept clean to provide uniform brightness and visibility.

§205.4(STM) Position Indication

(a) In order to give a clear and distinct indication of the position of non-interlocked switch points, colored targets may be provided in addition to the switch stands.

(b) Color indication for main line switch targets shall be green with the switch in the normal position and red in the reverse position.

(c) Color indication for yard switch targets shall be white with the switch in the normal position and yellow in the reverse position.

§205.5(STM) Distance From Rail For Switch Stands And Switch Point Targets

(a) Switch stands must be placed so that the distance from the gage of the nearest rail to the center of the spindle will be 50".

(b) Low target masts placed between tracks must be installed as follows:

Track Center Distance	Minimum Distance From Gage of Nearest Rail to Center of Spindle
12'-2" but less than 13'	3'-8-3/4"
13' or more but less than 14'	4'-1-3/4"
14' or more but less than 17'	4'-7-3/4"
17' or more	7'-0"

§210.0(STM) Switch Stand Maintenance

(a) Switches, switch stands and operating rods must be examined frequently. Broken, damaged, or missing parts shall be renewed immediately.

(b) Regular inspection shall be made as required and if necessary, corrective action must be taken immediately.

(c) Worn switch latches must be replaced before the wear is sufficient to permit the switch lever to be thrown without manually releasing the latch (keeper).

(d) Special attention should be taken to ensure that the cottar pin is maintained at the clevis location at the base of the switch stand.

§220.0(STM) Switch Locks

(a) At all main and secondary track switches, throw levers of switch stands shall be secured by two latches (for normal and reverse positions) and locked by a standard switch lock. The lock is to be fastened by a chain to the switch stand or tie so that the switch can only be locked in the normal position.

(b) The throw levers of switch stands in other than main or secondary track shall be provided with latches, but shall be provided with padlocks only when required.

§300.0(STM) Derails

§300.1(STM) Position

The “normal” position of a derail shall be to derail wheels of rolling equipment away from the main track or structure. The “reverse” position shall permit the unobstructed movement of equipment.

§300.2(STM) Use of Derails

(a) Derails shall be used on all tracks that connect with main tracks

(b) In secondary and yard tracks, derails will be used as required.

(c) When tracks are protected by signal indication, derails may be used if required.

§300.3(STM) Types of Derails

(a) Derails are generally of three kinds: the “single split switch,” the “sliding block,” and the “hinged block” type.

(b) Where derails are prescribed, the split switch type shall be used as follows:

  (1) Within interlocking limits, in main tracks and in secondary tracks.

  (2) In tracks where it is possible for the speed of rolling equipment to exceed 15 MPH.

(c) Approved sliding block type derails shall be used in other than main tracks with speeds less than 15 MPH at other locations than those given in paragraph (b) above.

(d) Hinged block derails are usually used in yard limits or in conjunction with RWP practices.

§300.4(STM) Installation

A derail shall be placed a sufficient distance back of the clearance point, not less than 12' to ensure that derailed rolling equipment will not foul the main or other protected track.

§300.5(STM) Operation of Derails

(a) In signaled territory outside of interlocking limits an independently operated derail at fouling point shall be used, which must be equipped with a track circuit controller, so connected such that the signal protecting the main track switch will display its most restricting indication when the derail is not in the derailing position.

(b) In manual block territory, the derail may be operated by a pipe line connected to the main track switch where considered necessary and as directed by the Signal Department.

(c) Lever stands of approved types may be used for operating derails. Where practicable, the distance from the center line of the lever stand spindle to the gage of the nearest rail shall be at least 50".

(d) Derails shall be provided with standard switch padlocks fastened to the tie by a chain and staple, so that the lever or derail can be locked only in the normal position.

§300.6(STM) Maintenance

(a) Sliding block or hinged block derails shall be painted yellow.

(b) Dirt and weeds must be kept away from derails. Ballast, snow and ice must be kept away from derails.

SUBPARTS A-C

RECOMMENDED PRACTICE FOR THE MAINTENANCE OF MITER RAILS

(INCLUDES EXPANSION JOINTS)

RECOMMENDED PRACTICE FOR THE MAINTENANCE OF MITER RAILS (INCLUDES EXPANSION JOINTS) SUBPARTS A-C
Track Classes 1 - 2

Subpart A - General

§1.0(MRM) Introduction

(a) This subpart is intended to provide employees with basic maintenance guidance.

(b) Maintenance of miter rails and expansion joints must be performed in accordance with the recommended practice and limits given in this subpart and when applicable, other sections of this Part.

§2.0(MRM) Definitions

Miter rail and expansion joint definitions are included in Appendix F, Glossary.

§3.0(MRM) Summary Information

There is presently one design of miter rail system in place: rails with mitered ends.

§4.0(MRM) MNR Moveable Bridges

The following table lists the moveable bridges in place on MNR when MW-4 was published.

MNR MOVEABLE BRIDGES					
Bridge	**LINE**	**Milepost**	**Bridge Type**	**Miter Rail**	**Notes**
“138th Street”	Hudson	4.6	Lift	Mitered rail ends	Motor driven from above
“Cos Cob”	New Haven	30.0	Rolling Lift Bascule	Mitered rail ends	Motor driven from below
“Walk”	New Haven	41.3	Swing	Mitered rail ends	Center-driven
“Saga”	New Haven	44.3	Rolling Lift Bascule	Mitered rail ends	Motor driven from below
“Peck”	New Haven	55.8	Rolling Lift Bascule	Mitered rail ends	Motor driven from below
“Devon”	New Haven	60.7	Rolling Lift Bascule	Mitered rail ends	Motor driven from below

§7.0(MRM) Quality Control

(a) The person in charge of performing the maintenance activity or repair shall be responsible for the overall quality of the work performed.

(b) All maintenance work shall be performed in accordance with appropriate MNR Engineering Practices and the MW-4.

(c) The Track Supervisor shall periodically review the work performed for quality, consistency and adherence to MNR Engineering Practice.

(d) Trackwork repairs that are found to be deficient:

   (1) May be cause for remedial action.

   (2) Shall be brought to the attention of the local Track Supervisor.

(e) The Track Supervisor shall see that any additional work necessary is performed to bring the repair into compliance with MNR practices and procedures.

(f) The Track Supervisor shall be responsible to re-inspect substandard or deficient work to ensure that the corrective work is in compliance with MNR practice, practices and procedures.

(g) MNR Engineering Personnel along with the Track Supervisors and Foreman, are encouraged to make recommendations to the Assistant Vice President - Maintenance of Way as to required modifications to methods, procedures and practices to improve the overall quality of work.

Subpart B – Maintenance Requirements

§10.0(MRM) Introduction

(a) Miter rail and expansion joint systems shall be maintained to ensure acceptable performance at the track class speed designated for that section of railroad.

(b) All maintenance or repair work that is performed on miter rails and sliding rail expansion joints must be accomplished to ensure the safety and long-term performance of these assemblies. Maintenance limits given in this subpart supercede those found in the Track Maintenance Section of this Part.

§11.0(MRM) Responsibilities

Primary responsibility for the maintenance of miter rails and expansion joints rests with the Track Department. Appliances attached to miter rails are the inspection and maintenance responsibilities of the Structures Power_or the Signal Departments. Whenever track maintenance work requires removal, replacement or adjustment of items attached to miter rails belonging to those Departments, assistance shall be requested through the local Track Supervisor.

§12.0(MRM) Maintenance

(a) Track Patrol Foreman shall report deterioration of the miter rail assemblies to the local Track Supervisor.

(b) When repair work is undertaken in the field, it shall be performed in strict accordance with applicable MNR Engineering Practices and should be recorded on the Supervisor's Work Board.

§12.1(MRM) Routine Maintenance

Routine maintenance consists of those activities, other than inspection, that shall be conducted on a regular basis without special scheduling. Examples of routine maintenance include:

(a) Lubrication of sliding and rotating surfaces.

(b) Tightening/re-tightening of bolt assemblies and other threaded connections.

(c) Grinding of metal flow from miter rail and expansion joint assemblies together with their connecting rails. Maintaining the original contours of these special appliances ensures proper wheel/rail contact throughout the moveable bridge.

(d) Other repairs and /or replacement of minor components.

§12.2(MRM) Scheduled Corrective (Heavy) Maintenance

Examples of such maintenance needs include the following:

(a) Weld repairs, as authorized.

(b) Shimming of fastener plates to restore surface.

(c) Adjustment of rail fastenings to restore gage and alignment.

(d) Changing out of supporting timber or fastening systems.

(e) Other major component repair or replacement.

§12.3(MRM) Work Restrictions

(a) Corrective work may be accomplished either by the repair of the defective component or by the replacement with a compatible component.

(b) Field welding of any miter rail or expansion joint bar is prohibited.

(c) In an emergency, replacement with non-similar materials may be done with the authorization of the Supervisor of Track.

Subpart C – Maintenance Limits

§50.0(MRM) Scope

(a) Maintenance is repairing or replacing a component of a miter rail or expansion joint assembly. Maintenance limits are to be used as a triggering mechanism to prompt maintenance or reconstruction.

(b) It is MNR's goal to have a miter rail and expansion joint assembly that stays between construction and maintenance limits. As a miter rail or expansion joint wears down and degrades, maintenance should be programmed before the assemblies reach the maintenance limits.

(c) Maintenance must be executed whenever the maintenance limits are exceeded and completed prior to reaching the safety limits.

(d) Whenever possible, miter rail and expansion joint assemblies should be repaired or reconstructed to construction limits.

§53.0(MRM) Gage

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

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

Miter Rail and Expansion Joint Gage Maintenance Limits			
Class of Track	**Minimum (inches)**	**Maximum (inches)**	**Maximum Rate of Change per 31' (inches)**
1-2	56-1/4	57-1/4	1/2

§55.0(MRM) Alignment

Alignment should not deviate from tangent more than the amount prescribed in the following table:

Class of Track	**Miter Rail and Expansion Joint Alignment Maintenance Limits Tangent Track**
	The deviation of the mid-ordinate from a 62' chord[(1)] may not be more than (inches):
1-2	1
(1) The ends of the line or chord must be at points on the gage side of the line rail, 5/8" below the top of the rail head. Use line rail in accordance with Part II, §55.1(M).	

§63.0(MRM) Track Surface

The surface of track should be maintained within the limits prescribed in the following table:

Miter Rail and Expansion Joint Surface Maintenance Limits		
Track Surface	Class of Track	
	1	2
The deviation from uniform profile on either rail at the mid-ordinate of a 62' chord may not be more than (inches):	1	7/8
The deviation from zero crosslevel at any point on a tangent may not be more than (inches):	1	5/8
The difference in crosslevel between any two points less than 62' apart may not be more than (inches):	1	3/4
Base of Miter Rail Limits		
The deviation from uniform profile on either rail along the base of rail within the appliance may not be more than (inches):	1/8	1/8

§109.0(MRM) Support Systems

(a) It is recognized that the effective operation of miter rails and rail expansion joints depends on a sound timber or concrete deck system.

(b) Every effort must be made to ensure that there are no defective bridge timbers or spalling and deteriorating concrete decking under any miter rail assembly or rail expansion joint.

§115.0(MRM) Rail End Mismatch

Rails shall be maintained so that the mismatch of rail joints at the miter rail and expansion joint may not be more than that prescribed in the following table:

Miter Rail and Expansion Joint Rail End Maintenance Limits		
Class of Track	Any mismatch of rails at joints may not be more than the following:	
	On the head of the rail ends (inch)	On the gage side of the rail ends (inch)
1-2	1/8	1/8

§119.0(MRM) Continuous Welded Rail (CWR)

See Part II, §119.0(M) for the use of CWR track on or about bridges and blocking and hooking of bridge ties.

§120.0(MRM) Field Welding

(a) The Thermite method is acceptable for in-track field welding in the vicinity of miter rails and expansion joints.

(b) Field welding on open deck bridges is permitted provided that proper fire precaution is taken.

§121.0(MRM) Bolts and Braces

(a) During the useful life of a miter rail or expansion joint assembly, it may be required to replace bolts as part of a programmed maintenance activity.

(b) Bolts, braces and blocks found in miter rails and sliding rails (expansion joints) must always be in place and kept tight.

(c) Replacement bolts shall be of the type and size as recommended by the manufacturer of the miter rail or expansion joint assemblies.

(d) Preferred torque values for bolts are given in the following table:

Bolt Maintenance Torque Requirements (Preferred)	
Diameter of Standard Bolt (inches)	**Preferred Dry Thread Torque (ft-lbs)**
7/8	470
1	710
1-1/8	960
1-1/4	1,350
1-3/8	1,750

§125.0(MRM) Rail Anchors/Fasteners

See Part II, §125.0(M) for the rail anchoring fastening requirements in the vicinity of bridges.

§127.0(MRM) Rail Fastening Systems

See Part II, §127.0(M) for fastener requirements in the vicinity of bridges.

§143.0(MRM) Guard Rails and Guard Faces; Gage

Maintenance limits: By design, not all miter rails have guard rails. Whenever possible, and if the assembly has a guard rail, the following limits shall apply:

Track gage	56-1/2"
Guard check gage	54-5/8"
Guard face gage (back to back)	52-3/4"

§155.0(MRM) Production Grinding (Out-of-Face)

(a) When production rail grinding is scheduled for track approaching and over a moveable bridge, the approaches to the bridge should first be properly surfaced and aligned.

(b) The approaches of the bridge for at least 200' should be production ground using a designed grinding wheel pattern to restore the correct rail profile on the bridge rail approaches with the grinding wheels properly aligned to grind through the miter rail or expansion rail joint.

(c) Rail grinding on open deck bridges is permitted provided that proper precaution against fire is taken.

Metro-North Railroad

TRACK DEPARTMENT MW-4

PART III

RECOMMENDED PRACTICE FOR THE CONSTRUCTION OF TRACK, SPECIAL TRACKWORK AND MITER RAILS

SUBPARTS A-D

RECOMMENDED PRACTICE
FOR THE CONSTRUCTION
OF TRACK

RECOMMENDED PRACTICE FOR THE CONSTRUCTION OF TRACK SUBPARTS A-D

Subpart A — General

§1.0(C) Scope

(a) It is not the intent of this section to establish arbitrary procedures or values, but to provide recommended practices that must be considered in the light of experience and the requirements of MNR service.

(b) Construction is new construction or the out-of-face replacement of major components of the track structure and associated appurtenances from sub-grade to top of rail to include drainage structures.

(c) It should always be the goal to complete construction projects to the best industry practices and tolerances. This is not always practical given such variables as manufacturing limitations, existing conditions and the use of relay materials. Therefore, construction tolerances have been developed.

(d) The construction section provides recommended practice that will be used in the construction of track. It provides guidance to Engineering Department forces, contractors and others constructing track.

(e) The construction section contains "construction limits" that are to be used when constructing track and are not to be confused with the "Inspection Limits" (Part I) and "Maintenance Limits" (Part II).

§2.0(C) Design Standards

(a) Track design shall be in accordance with the requirements of the following:

(1) MNR Manual of Recommended Practice for the Inspection, Maintenance and Construction of Track, Special Trackwork and Miter Rails (MW-4).

(2) American Railway Engineering and Maintenance of Way Association (AREMA) Manual for Railway Engineering and Portfolio of Trackwork Plans (current edition).

(b) In cases where more than one railroad is operating on the same track, the requirements of the owner of the track shall be followed.

Subpart B — Roadbed and Right-of-Way

§33.0(C) Drainage

Drainage is of prime importance for the construction of track. Drainage facilities, at a minimum, shall conform to MNR Standard Track Plan 70003 (see Part II).

§34.0(C) Geotextiles

The effectiveness of geotextiles depends on site-specific conditions. Geotextiles should only be used if a geotechnical investigation has been performed and confirms that geotextiles are required.

(a) Application:

(1) The American Railway Engineering and Maintenance Association (AREMA) provides additional information and recommended practice for the use of Geotextiles in Chapter I, Part 10.

§35.0(C) Cross Section (Roadway)

Roadbeds, embankments and excavations should be constructed and maintained in accordance with MNR Standard Track Plan 70003. Any deviations shall be approved by the Director of Track & Structures.

§37.0(C) Vegetation

(a) Growth of vegetation should be encouraged on slopes of embankments, cuts and deep ditches to prevent erosion.

(b) Vegetation materials must be selected and vegetation growth must be controlled in accordance with the requirements of Part I, §213.37.

(c) See AREMA Chapter I, Part 9.

§39.0(C) Signs

(a) Track signs and posts must be placed in accordance with MNR Standard Track Plan and special instructions.

(b) Signs should not be installed so as to interfere with signals or safety appliances.

§41.0(C) Highway Grade Crossings

§41.1(C) Construction Coordination and Preparation

(a) Perform preliminary topographic survey along the railroad and highway alignment. In general, the survey should extend at least 75' along the roadway outside the limits of the crossing and at least 500' off each end of the crossing along the railroad. Design track and highway profiles using recommended practices found in the MW-4, AREMA, state and local ordinances.

(b) Develop plan and profile of the railroad and highway to be used for the construction of the highway grade crossing.

(c) The sight distance from the roadway to the railroad, with particular attention given to the roadway/railway crossing quadrant, should be determined when making the survey. Improvements to the site distance should be made as part of the grade crossing reconstruction project whenever possible.

(d) Coordinate the design and installation of signal and power conduit with the Signal and Power Departments.

(e) Notify local towns, governments, schools, police departments, fire departments, public works and adjacent businesses of proposed crossing renewal or installation.

(f) Notification is given by letter no later than ten (10) business days in advance of construction and includes: dates, proposed detours and duration of road closure. A follow-up call is made to all above parties to confirm within 24 hours of commencement of work.

(g) Notify local highway jurisdiction to update signage and pavement markings in accordance with state DOT and Manual of Uniform Traffic Control Devices (MUTCD) requirements.

§41.2(C) Construction

(a) Public and private grade crossings are to be constructed in accordance with manufacturer's shop drawings unless otherwise approved by the Director of Track & Structures.

(b) Whenever possible, CWR should extend out to a minimum of 120' from each edge of the pavement. It is recognized that in some cases exceptions will have to be made to accommodate insulated joints and turnouts that lie within the 120' envelope. Under no circumstance will a rail joint be located within any grade crossing.

(c) The crossing panel shall have positive end restraints and sloped approach plates.

(d) Typically, crossings are built using predetermined panel lengths which are constructed, field welded and then installed into existing track.

(e) When constructing highway grade crossing panels at a location of significant roadway width, stick rail panels that do not extend the entire width of the crossing may be utilized. After all panels are installed, replace the stick rail with CWR prior to installation of the crossing surface material.

(f) Field welds are not permitted within the crossing surface area and whenever possible no field welds should be made within 10' of the crossing surface ends.

(g) Before excavation begins, mark and cut pavement, locate and mark all public, private and railroad utility locations within the work area. Care should be taken to protect the existing utilities while working.

(h) Existing materials within the crossing area should be removed to a minimum depth of 30" below proposed top of rail.

(i) Care should be taken in loading and disposing of materials to be removed from the crossing area.

(j) After existing materials are removed to the bottom of the proposed sub-ballast elevation, the sub-grade should be inspected to see if additional sub-grade materials need to be removed because of poor soil conditions. If over-excavation of poor materials is required, an approved fill material should be placed and compacted in 6" layers up to the planned top of sub-grade elevation.

(k) If it is necessary to install drainage within the crossing excavation, install 8" diameter (minimum) corrugated perforated pipe. This pipe should be installed a minimum of 12" from the end of tie and run parallel with the track in the crossing area.

(l) Where practical, drainage pipe should extend at least 10' beyond the limits of the crossing. Drainage pipe shall be installed to move water out and away from the crossing.

(m) Bottom ballast shall be 12" in depth, placed on the sub-ballast and compacted.

(n) Once all subgrade, sub-ballast and bottom ballast materials are placed, the track crossing panels should be installed, surfaced, aligned and stabilized.

(o) Crosswalks and grade crossings shall employ panels with flangeways of 2" +/- 1/4" wide, and minimum 1-1/2" in depth.

(p) Install CWR strings if required. Make all field welds outside the ends of the crossing surface area after installing crossing surface materials.

(q) If the crossing is going to be open for roadway traffic before the final paving is completed, cold patch will be temporarily used on the approaches.

(r) Finally, pave roadway approaches.

§41.3(C) Conduct of Work

(a) Work on highway crossings, public streets and roads shall be done with the least inconvenience possible to highway travelers. When necessary to construct temporary footwalks or sidewalks, safety precautions must be taken.

(b) For all crossing construction work, an appropriate maintenance and protection of traffic plan (MPT) should be established that delineates an alternate traffic pattern or detours with the appropriate amount of flagmen, cones, signs, etc.

§41.4(C) Yard Crossings and Crosswalks

(a) Yard crossings and crosswalks shall be designed and installed on a site-specific basis as directed by the Assistant Director of Track.

(b) The crosswalk shall have end approach plates that are sloped and provide positive end restraint.

(c) Cross tie spacing under crosswalks and crossings shall be per manufacturer specifications for the surface material being utilized (usually between 18"-24").

(d) Crosswalks and grade crossings shall employ panels with flangeways of 2” +/- 1/4" wide, and minimum 1-1/2" in depth.

Subpart C — Track Geometry

§53.0(C) Gage

§53.1(C) Standard for Gage

(a) The standard gage for track, measured between the running rails at right angles to the alignment of the track 5/8" below the top of rail, is 56-1/2".

(b) Gage on curves 8° and over, and turnouts with a frog number of 8 or lower, will be specified by the Assistant Vice President - Maintenance of Way

(c) If regaging is required, gage shall be established by adjustment of the rail opposite the line rail (see Part II, §53.1(M)).

§53.2(C) Rail Cant

(a) Rail shall be placed on a tie plate or a rail seat with an inclination (or cant) of 1 in 40 from the vertical toward the gage or centerline of track.

(b) Conventional frogs, switch points and stock rails in special trackwork shall be installed vertically with no inward inclination of the rail.

(c) The stock rails on concrete tie tangential turnouts are canted by design.

§53.3(C) Construction Gage Limits

(a) Gage shall be measured with a standard track gage or other authorized devices. These devices must be checked for accuracy prior to daily use.

(b) When constructing or restoring track, provided that the gage is uniform, the following tolerances apply:

Construction Gage Tolerances	
Parameter	**All Track**
Gage variation[a]	± 1/8"
[a] The difference between the maximum and minimum gage shall not exceed 1/8" within 31' of track.	

(c) If it is necessary to change gage, the rate of change in gage shall not exceed 1/4" per 31'. For example, in an 8° curve where gage is specified at 57" the change in gage from 56-1/2" must not be accomplished in less than 62'.

§55.0(C) Alignment

Alignment is the horizontal location of a railroad as described by curves, spirals and tangents.

§55.1(C) Alignment Tolerances for Construction

(a) The following standards shall be used for the construction of new track and out-of-face rehabilitation of existing track.

Construction Alignment Tolerances			
Parameter	**Main Track Direct Fixation**	**Main Track Ballasted**	**Yard Track Ballasted**
Horizontal track alignment[1,2]			
Total Deviation	± 1/4"	± 1/4"	± 1/2"
Middle ordinate in (62' chord)	± 1/8"	± 1/8"	± 1/4"
[1] Total horizontal deviation in passenger platform areas shall be 0" toward the platform edge and 1/8" away from the platform edge. [2] Total deviation is defined as the measurement between the theoretical and actual alignment at any point on the track.			

(b) For new construction with a new horizontal location and top of rail profile, the track must be designed and then laid out in the field by survey.

(c) MNR Power Department must be notified of all realignment of tracks in electrified territory.

(d) In CWR territory, alignment changes must be made in accordance with Appendix A, Continuous Welded Rail Procedures.

(e) Alignments must be maintained within the prescribed limits given above and must meet minimum roadway clearances prescribed in MNR Standard Track Plan 70051.

(f) Particular attention must be given to aligning track and the resulting clearances at bridge abutments, signals, platforms, signs and at any location of fixed objects.

§55.3(C) Referencing Track for Lining

(a) In multiple-track territory, a track adjacent to the track to be lined shall be used for referencing. This method requires measurement of existing track center distances at each station throughout the curve. Track centers should be recorded during stationing of the curve. The track used for referencing shall not be disturbed until the lining operation on the other track is completed.

(b) After calculating the required throws as per Part II, §55.2(M), the new design track center for each station is determined by adding the throw required for that station to the existing track center distance.

(c) The new design track center shall be marked on the field side web of the near rail of the reference track at each station.

(d) Design track center distances shall be enclosed in parentheses for clear identification and distinction from other marks that may appear on the reference track.

(e) If computer assisted tampers perform the lining, throws may be programmed into the computer and executed automatically. Otherwise, track centers should be measured immediately prior to the initial pass and compared to the marked design track center to determine the required throw at each station.

(f) Following the initial pass, track centers should again be checked and compared to the design track centers and additional passes made if required.

(g) In single-track or multiple-track territory where all tracks are being realigned, survey stakes shall be set for referencing. Offset stakes shall be set at a sufficient distance from the center line of the track to be lined, to ensure they will not be disturbed by other work such as regulating of ballast.

(h) Track center distance in curves shall be measured horizontally from the gage side of the line rail of the reference track to the gage side of the line rail of the track to be worked. Use plumb bobs when measuring distances.

(i) The track centers for tangents on either side of curves shall be measured using the same reference rail as in the curve.

§57.0(C) Curves: Elevation and Speed Limitations

§57.1(C) General

(a) Superelevation is the elevation difference of the outer rail of a curve as compared to the inner rail. Curves are superelevated to overcome or partially overcome the effects of curvature and speed.

(b) Superelevation is required to provide passenger comfort, minimize railwear and rail overturning forces and provide for safety of operation.

(c) Equilibrium superelevation (E_e) is that elevation that exactly overcomes the effect of negotiating a curve at a given speed for any given degree of curvature, by placing the resultant of the centrifugal force and weight of equipment in a direction perpendicular to the plane of the track.

(d) Underbalance elevation (E_u) is the difference between the actual superelevation (E_a) and the equilibrium superelevation (E_e) required for any given combination of speed and curvature. Where $E_u = E_e – E_a$.

(e) Superelevation shall be determined to the nearest 1/4" by the following formula:

$$E_a = (0.0007\ D\ V^2) - E_u = 4.01\ V^2/R - E_u$$

Where:

E_a = Actual track superelevation in inches

E_u = Underbalanced elevation in inches. The design underbalance elevation on MNR is 3".

D = Degree of curve (in decimals).

R = Radius of the curve in feet.

V = Maximum authorized speed in MPH.

(f) Overbalance is the difference between actual superelevation (E_a) and equilibrium superelevation (E_e)

when the actual superelevation exceeds the equilibrium superelevation. Overbalance is produced by over superelevating a curve, operating a train around a curve at less than equilibrium speed or stopping on a curve.

(g) Excessive overbalance may produce accelerated flattening of the low rail, gage widening, rollover of the low rail and the potential for the generation of internal rail defects.

(h) When designing curves, consideration should be given to select an actual superelevation that minimizes the effect of underbalance or overbalance at all speeds while providing for train operations at Maximum Authorized Speed (MAS).

(i) Maximum authorized speed is as specified in the current Employee's Timetable.

§57.2(C) Superelevation and Crosslevel

(a) The Assistant Vice President - Maintenance of Way shall establish the amount of superelevation, underbalance and MAS to be placed and maintained on each curve.

(b) Design superelevation shall not be less than 1/2" or more than 5" unless approved by the Assistant Vice President - Maintenance of Way.

(c) See Appendix C, "Underbalance Tables Maximum Allowable Operating Speed on Curves".

(d) Track construction tolerances for crosslevel and superelevation are given in the following table:

Construction Superelevation and Crosslevel Tolerances	
Parameter	**All Track**
Crosslevel and Superelevation variation(1,2)	±1/8" max total

(1) The maximum variation in crosslevel and superelevation shall not exceed 1/8" within 31' of track.
(2) Superelevation is on curves and crosslevel is on tangents.

§57.3(C) Rate of Change of Superelevation

(a) The change in superelevation should be in uniform increments, and the rate of change per 31' of track should not be more than the following:

Construction Change in Superelevation	
Maximum Authorized Speed (MPH)	**Maximum Rate of Change (inch)**
0-50	1/2
51-90	3/8
91+	1/4

§57.4(C) Spirals and Elevation Runoffs

(a) Spirals shall be provided on all tracks at the ends of curves and between compound curves unless approved by the Assistant Vice President - Maintenance of Way.

(b) A spiral should be used so that the degree of curvature and/or the amount of elevation at any point will change uniformly between the tangent and the full body of the curve.

(c) Elevation runoff must be at a uniform rate and must extend the full length of the spiral. If physical conditions do not permit a spiral long enough to accommodate the minimum length of runoff, part of the runoff may be made on tangent track.

(d) A maximum of 1" superelevation may be runoff on tangent track, but only with the authority of the Assistant Vice President - Maintenance of Way.

(e) Where practical, at least 100' of tangent track, with zero crosslevel, should be provided between the zero superelevation points (ST or TS) in adjacent curves of opposite direction, and between facing same hand turnouts.

(f) The length of spiral is generally determined by the elevation runoff required.

(g) The geometrics of the spiral are usually measured in 31' increments.

(h) Spiral transition curves on main track with a length less than 100' must be approved by the Assistant Vice President - Maintenance of Way.

(i) Spiral transition curves on yard track with a length less than 31' must be approved by the Assistant Vice President - Maintenance of Way.

(j) The minimum length spiral for comfortable high speed train operation should be determined by using the greatest length obtained from the following formulas.

$L = 1.17\ E_aV$

$L = 1.63\ E_uV$ - To be used where track center distances and clearances permit.

$L = 62\ E_a$ (up to 50 MPH)

$L = 82.67\ E_a$ (from 51 to 90 MPH)

$L = 124\ E_a$ (91 MPH and above)

Where:

L = Minimum desirable length of spiral in feet.

E_a = Actual superelevation in inches.

E_u = Underbalance in inches.

V = Maximum authorized speed (MAS) train in MPH.

(k) The Assistant Vice President - Maintenance of Way shall be notified when the minimum length of spiral transition curve provided by the formulas is less than the value obtained from the formula:

$L = 1.63\ E_aV$, where E_a is calculated once maximum allowable E_u is determined.

(l) Curves that have spirals that do not meet minimum standards shall be recorded as variances and require the approval of the Assistant Vice President - Maintenance of Way.

§57.5(C) Curve Tagging

(a) The degree of curve (degrees-minutes-seconds), radius (feet), required superelevation (inches) and the length (feet) for each segment of a curve shall be designated on the design plans for the layout of the curve.

(b) Segment lengths shall be identified using length of spiral (L_s) and length of curve (L_c).

(c) Control points tagged in the field refer to the tangent-spiral (TS), spiral-curve (SC), curve-spiral (CS) and spiral-tangent (ST) for curves with spirals.

(d) When reconstructing existing curves, existing superelevation tags need not be changed until such time as the designated superelevation or spiral lengths for that curve are changed.

§61.0(C) Clearances and Track Centers

§61.1(C) Track Centers

(a) For construction, the following track centers should be used on tangent and then increased for curves in accordance with paragraph (b), unless otherwise approved by the Assistant Vice President - Maintenance of Way.

Construction Track Centers	
Designation of Tracks	**Track Centers on Tangent**
Between:	
Adjacent main tracks	14'
Main Track and any adjacent track, other than another main track or a yard ladder track	17'
Secondary, running, industrial or passing track and any adjacent track, other than a yard ladder track	17'
Yard ladder track and adjacent track, except other yard ladder	18'
Adjacent yard ladder tracks	19'
Adjacent yard, industrial and other side tracks	14'

(b) On curves, to provide clearance between cars and locomotives equivalent to that obtained on adjacent tangent track, track center distances in paragraph (a) should be increased as follows:

(1) Where the amount of superelevation is the same on adjacent tracks or the superelevation of the inner track is greater than that of the outer track,

increase the tangent track center distance 1" for each 0°-30' of curvature.

(2) Where the superelevation of the outer track is greater than that of the inner track, the tangent track center distance should be increased 1" for each 0°-30' of curvature, plus 3-1/2" for each 1" of difference in superelevation between the two tracks considered.

§61.2(C) Clearance Limiting Objects

For allowable design clearances, see MNR Standard Track Plan 70051.

§62.0(C) Grades

§62.1(C) Grade Limitations

(a) The maximum design gradient for MNR shall be 1-1/2% and may be exceeded only with the approval of the Assistant Vice President - Maintenance of Way.

(b) Storage track grades shall be level where existing grades and obstructions permit.

(c) When reconstructing track, the existing profile must be retained except where it is possible to reduce the severity, length or the number of grades.

(d) Frequent changes in gradient shall be avoided as this introduces more vertical curves into the geometry and may degrade ride quality.

(e) The minimum length of constant vertical tangent between changes in grade shall be determined by the formula below.

$L_{VT} = 3V$

Where:

L_{VT} = Minimum length of constant vertical tangent in feet.

V = Train velocity in miles per hour.

Notes:

(1) The preferred minimum length of vertical tangent is 300'**.**

(2) An absolute minimum length of vertical tangent of 100' is required.

(f) For spiraled compound or reverse curves the above minimum tangent length is modified as follows:

(1) A minimum tangent length of 100' on main tracks.

(2) A minimum tangent length of 85' on secondary tracks.

(3) An absolute minimum tangent length of 65', if approved by the Assistant Vice President - Maintenance of Way.

§62.2(C) Grade Compensation for Horizontal Curves

Where a horizontal curve is located on a grade, and combined curve and train resistance control the train load, the grade on the curve should be compensated as follows:

(1) The design grade on curves should be reduced at the rate of 0.04% per degree of curvature to compensate for the horizontal curve.

(2) At places where trains frequently stop and start, the grade should be reduced at the rate of 0.05% for each degree of curvature.

§62.3(C) MNR Vertical Curve Criteria (Current Practice)

(a) Track construction tolerances for vertical curves are given in the following table:

Construction Vertical Curve Tolerances			
Parameter	**Main Track Direct Fixation**	**Main Track Ballasted**	**Yard Track Ballasted**
Vertical track alignment			
Deviation From Specified Design Location[1]	± 1/4"	± 1/4"	± 1/2"
Mid Ordinate Deviation (62' chord)	± 1/8"	± 1/8"	± 1/4"
[1] Total deviation is defined as the measurement between the theoretical and actual alignment at any point on the track.			

(b) Where changes in grade occur, gradient lines should be connected by vertical curves, observing the following provisions:

(1) The length of a vertical curve is determined by the difference in grades to be connected and the rate of change adopted.

(c) Vertical curves shall be used to connect all changes in gradients. These curves shall be parabolic, having a constant rate of change of grade per 100' station.

(d) M series passenger trains: the minimum length of vertical curve shall be the greatest length obtained from the following formulas:

L_{VC} = (G / g) x 100; or

L_{VC} = 3V; or

L_{VC} = 100' (absolute minimum)

Where:

L_{VC} = Length of vertical curve in feet.

G = The absolute value of the algebraic difference in grades approaching and leaving the curves, in percent.

V = Train velocity in miles per hour.

g = The rate of change of grade per 100' station, in percent, determined according to the formulas below.

(1) The rate of change of grade per 100' station (g), in percent, is dependent on design speed, whether the vertical curve is concave upward (a sag) or convex downward (a crest). The following are the maximum values to be used.

$g = 3{,}000 / V^2$ at crest curves on tangent

$g = 4{,}500 / V^2$ at sag curves on tangent

(2) An absolute maximum rate of change of grade of 0.88% per 100' station shall be maintained.

(3) The minimum radius of vertical curve shall be 2,000'. Radius of vertical curve is defined by: $R_{VC} = (100\ L_{VC}) / G$.

(e) Freight trains and mixed service: the rate of change of grade per 100' station shall not be more than 0.10% in sags and not more than 0.20% on crests.

(1) For tracks of lesser importance, the rates of change may be relatively large but not greater than practical conditions permit. In this regard, it is desirable to not exceed a rate of change of grade of 0.30%, though this may be increased to a maximum of 0.83% where necessitated by geometric constrictions with the approval of the Assistant Vice President - Maintenance of Way.

(2) Vertical curve lengths may be calculated for freight trains using paragraph (d).

(f) Reverse vertical curves may be used provided that there is a minimum tangent distance of 100’ between curves. Where restrictions prevent using a tangent distance, the length of the vertical curves shall be calculated by using ‘g’ in paragraph (d).

(g) Vertical curves with a calculated mid-ordinate less than 1/4" (0.021') are difficult to lay out in the field and maintain. Such vertical curves shall be avoided by either lengthening the curve or using a vertical angle point when the algebraic difference of the grades is 0.16% or less.

(h) Proposed AREMA criteria is presented in Part III, §62.4(C). It may be necessary to calculate the minimum length of vertical curve using Part III, §§62.3(C) and 62.4(C).

§62.4(C) AREMA Recommended Practice for Vertical Curves

(a) The length of vertical curve is determined by changes in gradient, vertical acceleration and the speed of the train. See Part III, §62.3(C) for current MNR practice.

(b) Vertical curves as calculated in item (f) below should be used to connect all changes in gradients.

(c) The purpose of the vertical curve is to ease the change of the gradients in order to reduce coupler and diaphram binding and eliminate the danger of breaking trains in two as a direct result of train action. In addition, the proper vertical curve will provide for passenger comfort on passenger trains. Vertical curves should be designed as long as physically and economically possible.

(d) A vertical concave curve shall be denoted as a sag. A vertical convex curve shall be denoted as a summit.

(e) The vertical curve may be either circular or parabolic in shape.

(f) The minimum length of the vertical curve for both sags and summits is determined by the following formulas (except that in no case should the length of the vertical curve be less than 100' long).

$$L = \frac{D \text{ x } V^2 \text{ x } K}{A}$$

Where:

A = Vertical acceleration in feet/sec/sec (ft/sec^2)

D = Absolute value of the difference in rates of grades expressed as a decimal.

K = 2.15 conversion factor to give L in feet.

L = Length of vertical curve in feet.

V = Speed of the train in miles per hour.

(g) The recommended vertical acceleration (A) should be selected based on the type of operations and is the same for both sags and summits.

Freight Operations:

A = 0.10 feet/sec/sec

Passenger and Transit Operations:

A = 0.60 feet/sec/sec

(h) The minimum distance between vertical curves shall not be less than 100'.

(i) The train speed which should be used in the above formula for establishing the length of vertical curve should be the maximum speed found on that particular subdivision or route. Special attention should be paid to locations where local conditions have dictated a speed restriction now in place, but where such a restriction might be removed at a later date.

(j) It is not recommended to place turnouts within the limits of a vertical curve.

(k) Curves constructed to this formula should not present any problems for the current generation of equipment. Slow speed curves, such as hump crests, should, however, be designed with consideration for vertical clearance rather than using this formula.

§62.4.1(C) Example Calculations for Freight Operations

Crest curve with 0.50% ascending grade meeting a 0.50% descending grade. Maximum design speed is 50 MPH.

A = 0.10 feet/sec/sec vertical acceleration (Freight)

D = Absolute value of ((+.005) – (-.005)) = 0.01

K = 2.15 conversion factor to give L in feet

V = 50 MPH design speed

$$L = \frac{D \text{ x } V^2 \text{ x } K}{A} = \text{Length of vertical curve in feet}$$

$$L = \frac{(0.01)(50\text{ MPH})^2 \text{ x } 2.15}{0.10\text{ feet/sec/sec}} = 537.50 \text{ feet} \quad \text{say } 540 \text{ feet}$$

§62.4.2(C) Example Calculations for Passenger and Transit Operations

Sag curve with 0.50% descending grade meeting a 0.50% ascending grade. Maximum design speed is 75 MPH.

A = 0.60 feet/sec/sec vertical acceleration (Passenger and Transit)

D = Absolute value of ((+.005) – (-.005) = 0.01

K = 2.15 conversion factor to give L in feet

V = 75 MPH design speed

$$L = \frac{D \text{ x } V^2 \text{ x } K}{A} = \text{Length of vertical curve in feet}$$

$$L = \frac{(0.01)(75\text{ MPH})^2 \text{ x } 2.15}{0.60\text{ feet/sec/sec}} = 201.56 \text{ feet} \quad \text{say } 205 \text{ feet}$$

§63.0(C) Track Surface

§63.1(C) General

(a) Track surface is the relationship of opposite rails to each other in profile and crosslevel. Track profile is the running surface along the top of the grade rail. Crosslevel is the difference in elevation across opposite rail heads measured at right angles to the track alignment. The ideal surface is a uniform profile consisting of constant grades connected by vertical curves, with zero crosslevel on tangents and predetermined superelevation on curves.

(b) The profile of track being surfaced should not be raised above established grades, except under instructions from the Assistant Vice President - Maintenance of Way, who will give consideration to the required elevations and clearances in tunnels, under catenary systems and overhead structures, and at interlocking plants, undergrade bridges, platforms and highway grade crossings.

(c) Any encroachment upon the published minimum overhead or side clearances from a track will not be permitted. (See MNR Standard Plan 70051.)

§63.2(C) Construction Limits

(a) The following criteria will serve as a practical guide for providing smooth riding track.

(b) The basic tools for determining correct track surface are the standard track level and stringline. The track level should be checked by the Supervisor-Track periodically and by the Foreman-Track, or the employee inspecting track, each day it is used. If found to be incorrect, it must be accurately adjusted or replaced. See Part I, §213.25(i). Other approved devices may be used for determining crosslevel, but their accuracy should be determined by comparison with a standard track level in correct adjustment.

(c) When surfacing or raising track, one rail, the lower rail on curves and usually the line rail on tangents, shall be selected as the grade rail. The other rail must be brought to surface by adjusting the crosslevel as needed.

(d) The construction limits for track surface are contained in the following table:

Surface Construction Limits				
Track Surface	**Track Classes**			
	1	**2**	**3**	**4-5**
The runoff in any 31' of rail at the end of a raise may not be more than (inches):	3/4	1/2	1/4	1/8
The deviation from uniform profile on either rail at the mid-ordinate of a 62' chord may not be more than (inches):	3/4	1/2	1/4	1/8
The deviation from zero crosslevel at any point on a tangent and designated elevation in curves may not be more than (inches)[(1)]	3/4	1/2	1/4	1/8
Except as provided in Part III, §57.4(C), the difference in crosslevel between any two points less than 62' apart may not be more than (inches):	3/4	1/2	1/4	1/8
[(1)] The maximum allowable speeds for a curve as shown in this table is based upon a single point deviation.				

§63.3(C) Surfacing Areas That Require Special Attention

(a) Special attention must be given to the surface and line of track at special trackwork and at the ends and approaches of bridges, crossings and platforms.

(b) When surfacing, installing or tamping ties, particularly in interlocking plants, care must be taken to avoid breaking or damaging bond wires, pipes, cables, wire or other connections to the tracks.

(c) The Signal & Power Departments must be notified prior to any work. Signal & Power appliances such as wires, cables and conduits are to be marked with high-visibility paint by the responsible department. Notify the responsible department immediately if damage occurs. Care shall be exercised to avoid the dropping or laying of metal tools or objects across the rails and causing a shunt of the signal circuits.

(d) In overhead electrified territory care must be exercised to avoid reducing clearance between the top of rail and contact wire at established low points or to establish new low points. Advance notice must be given to the Power Department when it is necessary to raise tracks under overhead structures or low spots under the catenary system.

§63.4(C) Surfacing Track

(a) When track is given a general raise, both rails should be raised simultaneously. When track jacks are used, they should be placed opposite each other and must be placed on the field side except when restricted by third rail or other obstructions.

(b) Track should be mechanically stabilized after surfacing and alignment.

(c) When track is constructed and bottom ballast is placed and compacted on new sub-grade or sub-ballast, it should be at least 3" below the planned bottom elevation of the crossties.

(d) Final surface and aligning should be accomplished with two 1-1/2" passes with stabilizing after each pass. The average finish raise when surfacing and aligning track should not exceed 1-1/2".

(e) Before surfacing track in hot weather, there must be assurance that the track will not warp or buckle (see Appendix A, Continuous Welded Rail Procedures).

(f) Adequate ballast for constructing the required ballast cross section should be distributed in advance of raising.

(g) Track should not be raised through signal appliance locations to include track wires, impedance boxes and special trackwork until notice has been given to the Signal Department.

§70.0(C) Sidings

§70.1(C) General

(a) New side track designs, including alignment, grade and clearances, shall be approved by the Assistant Vice President - Maintenance of Way.

(b) At the end of all stub tracks, a bumping post or wheel stop, of approved type, shall be provided.

(c) Wheel stops shall not be used on tracks used by passenger equipment.

Subpart D — Track Structure

§100.0(C) Track Standards

§100.1(C) General Track Requirements

(a) Trackwork Classifications

The tracks on MNR shall be classified as follows:

(1) <u>Main Track</u>: Main track is for the operation of equipment carrying revenue passengers. Non-revenue tracks which are critical to the system operation, including transfer and pocket tracks, shall also be classified as main track.

(2) <u>Secondary Track</u>: A designated track upon which trains may be operated without timetable authority, train orders or block signals subject to prescribed signals, rules and special instructions.

(3) <u>Passing Siding (Track)</u>: A designated track adjacent to a main track for the meeting or passing of trains.

(4) <u>Freight Siding</u>: A designated track that leaves a MNR owned track (at the derail) and goes to private property to serve a freight railroad consignee. Beyond the derail these tracks are inspected and maintained by others

(5) <u>Yard Track</u>: Yard track is for the purpose of switching, storing or maintaining equipment not carrying revenue passengers

(6) <u>Shop Track</u>: Tracks located in maintenance shops and built either with pits or slightly elevated on pedestals, to permit shop crews to perform maintenance on the cars.

(b) Track shall be either direct fixation, stone ballasted with concrete ties or wood ties, embedded track or posted rail (shop only).

(1) <u>Ballasted Track with Concrete or Wood Ties:</u> Ballasted track with CWR is the preferred design to be used for all at-grade tracks.

(2) <u>Ballasted Track with Wood Ties</u>: Currently MNR has ballasted track with wood ties, with both jointed and CWR rail. MNR plans to selectively upgrade jointed rail with CWR.

(3) <u>Direct Fixation Track:</u> Direct fixation track is for main track in tunnel, cut-and-cover and retained earth sections. The direct fixation track shall be designed to use a second pour concrete plinth method of construction in areas of new track. Track shall have CWR.

(4) <u>Embedded Track</u>: Embedded track is used within the yard limits for shared use between vehicular traffic and MNR.

(5) <u>Posted Rail Track:</u> Posted rail is used within the limits of the maintenance shop along the full

length of the service pits. Example: Brewster Shop.

(c) Reinforced Concrete Approach Slabs

(1) Reinforced concrete approach slabs shall be used where either concrete or wood tie track transitions from ballasted to direct fixation track and from direct fixation to ballasted track in order to provide a smooth transition from one track modulus area to another. The approach slabs shall be below the crossties and shall taper from the direct fixation invert to the top of the sub-ballast elevation. The length and width of the approach slab shall be based upon the site conditions. Adequate drainage shall be provided to avoid ponding of water.

§102.0(C) Roadway Materials/Methods

§102.1(C) Handling and Care of Maintenance of Way Materials at the Construction Site

(a) The unnecessary movement of materials and their subsequent care is inefficient, costly and unsafe. Work should be planned to affect the minimum amount of material necessary with the least amount of handling.

(b) Threaded and/or insulated materials and parts should be protected from the weather.

(c) Other track materials (OTM) should be distributed as near as possible to where they will be used. OTM will be distributed on a daily basis to meet the crew demands.

(d) When distributing CWR in third rail territory, the preferred locations are as follows:

(1) In the gage of track (do not damage impedance bond boxes or wires).

(2) On the shoulder opposite the third rail, a minimum of 36" from the field side of the running rail.

(e) When distributing CWR in non-electrified territory, the preferred locations are as follows:

(1) On the ends of the ties.

(2) Within the gage of track.

(f) So far as practicable, rail should be unloaded in position for laying with minimum further handling.

(g) When distributing CWR in the center of track, the rail must not be left in a position where the top of the new CWR is more than 1" above the top of the running rail.

(h) When distributing CWR on the ends of the ties, the rail must not be left in a position where the top of the new CWR is above the top of the running rail.

(i) Under no circumstances should new CWR, or any other metallic materials, be left between the running rail and the third rail.

§102.2(C) Classification of Materials

Materials are classified as follows:

(a) New – Unused, as manufactured.

(b) Rehabilitated – Materials removed from track that require work for reuse such as:

   (1) Rebuilt frogs, switches and crossings.

(c) Fit – Usable materials, as removed from track that require no work for reuse such as:

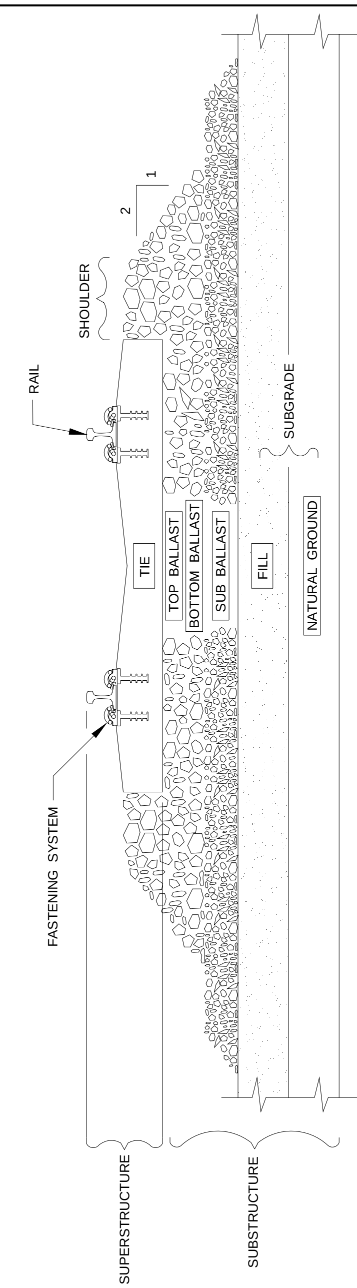
   (1) Joint bars

   (2) Rail.

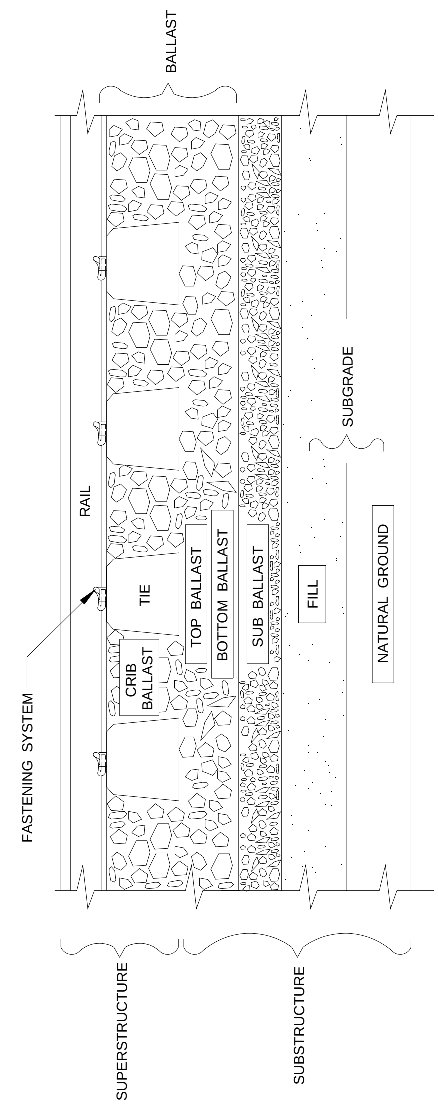
   (3) Special trackwork components.

(d) Scrap.

(e) Typical roadway materials are shown in the following figures.



TRACK STRUCTURE COMPONENTS CROSS - SECTION VIEW



TRACK STRUCTURE COMPONENTS ELEVATION VIEW

§103.0(C) Ballast; General

(a) Sub-grade Compaction

The sub-grade shall be compacted to at least 95% of the maximum dry density as determined by ASTM D 698 (Proctor Test). If the existing material is unsuitable, or the compaction requirements cannot be achieved, the material shall be removed and replaced with clean, sound granular material and compacted to meet density requirements.

§103.1(C) Characteristics

(a) Unless it is otherwise structurally supported, all track must be supported by material that will:

(1) Transmit and distribute the load of the track and railroad rolling equipment to the sub-grade.

(2) Provide restraint for the track in lateral, longitudinal and vertical directions.

(3) Provide drainage for the track structure.

(4) Facilitate maintenance of track crosslevel, surface and alignment.

(b) Ballast for Concrete Ties and Special Trackwork on Concrete Ties

(1) MNR specification which is 1" to 2" ballast shall be used on the mainline and yard tracks.

(2) Ballast for concrete tie installations must be limited to either crushed granite, traprock or quartzite.

(3) Processed ballast must be washed and/or rescreened as necessary to remove fine particle contamination in accordance with AREMA.

(4) A minimum of 12" of ballast shall be used between the bottom of the tie and the top of the sub-ballast beneath the low running rail on main tracks.

(5) The elevation of ballast shall be level or 1" below the top of the tie.

(6) **The shoulder ballast shall extend 12" beyond the end of the ties on tangent and curved track.** The end of the ballast shall be sloped at 2:1 and tapered to meet the grade. The top surface of the ballast shall be parallel to the plane formed by the top of the rails. The ballast section will level out to meet the top of retaining walls and barriers.

(7) A minimum of 6" of ballast shall be placed beyond the end of all third rail ties, on the side of the third rail.

(c) Ballast for Wood Tie Construction

(1) MNR specification which is equivalent to 1" to 2" ballast shall be used on the mainline and yard tracks.

(2) Ballast for wood tie installations must be limited to either crushed granite, traprock or quartzite.

(3) The elevation of crib ballast shall be level to 1" below the top of the tie.

(4) A minimum of 12" of ballast shall be used between the bottom of the tie and the top of the sub-ballast beneath the low running rail on main tracks.

(5) **The shoulder ballast shall extend 12" beyond the end of the ties on tangent and curved track.** The end of the ballast shall be sloped at 2:1 and tapered to meet the grade. The top surface of the ballast shall be parallel to the plane formed by the top of the rails. The ballast section will level out to meet the top of retaining walls and barriers.

(6) A minimum of 6" of ballast shall be placed beyond the end of all third rail ties, on the side of the third rail.

(d) Minimum Depth for Yard Tracks

A minimum of 8" of ballast shall be used between the bottom of the tie and the top of the sub-grade and/or sub-ballast beneath the low running rail on yard tracks.

(e) When the ballast received is of inferior quality, has improper grading, or contains quantities of screenings, dirt or foreign matter, the ballast shall be rejected and a report shall be made to Assistant Director of Materials.

§103.2(C) Ballast Distribution

(a) To the extent practicable, ballast should be unloaded in position for use with a minimum of redistribution and dressing, using special ballast cars when available.

(b) Ballast must be distributed or immediately dressed so that ample clearance below top of rail is provided for rolling equipment, switches are not fouled and guard rails are unobstructed.

(c) Ballast must be unloaded uniformly from each side of the ballast car in order to avoid an unbalanced load condition. This will ensure the stability of the ballast car.

§103.3(C) Sub-ballast

(a) Sub-ballast will be considered as additional structural support and will not reduce the amount of ballast required for the track structure.

(b) Sub-ballast materials and the furnishing and compaction of sub-ballast shall comply with latest specifications provided by the office of the Assistant Vice President - Maintenance of Way.

(c) Main Tracks

An 8" layer of sub-ballast shall be installed on top of the sub-grade on main tracks as directed by the Director of Track & Structures.

(1) The sub-ballast shall conform to AREMA Specifications.

(2) The sub-ballast layer shall be sloped 24:1 downward away from the center point of the tracks.

(d) Yard Tracks

(1) A 6" layer of sub-ballast shall be installed on top of the sub-grade on yard tracks as directed by the Assistant Vice President - Maintenance of Way.

(2) Yard sub-ballast shall be sloped to provide adequate drainage. The sub-ballast shall conform to AREMA Specifications.

(3) The sub-ballast layer shall be sloped 24:1 downward away from the center point of the tracks.

§109.0(C) Crossties

§109.1(C) General

(a) Concrete and Wood ties shall meet the requirements of current MNR specifications.

(b) All concrete ties installed in third rail territory shall be equipped with embedded threaded inserts on both ends for third rail mounting. The threaded inserts shall be capped.

(c) Inserts for restraining rail and bridge guard rail mounting, where required, shall be an integral part of the manufactured tie and are required for every tie over the length of run for guard rail or restraining rail.

(d) The rail seat cant on a concrete tie and tie plate on a wood tie shall provide for a 1:40 cant inward.

(e) Nominal wood tie length shall be no less than 8'-6". Third rail timber tie length shall be 9'-6".

(f) Fasteners for concrete ties shall use a boltless, snap-in type rail fastening spring clip, such as the Pandrol Fastclip. Concrete ties shall have an elastomeric pad placed between the rail and bearing surface and insulators placed between the toe of the clip and against the base of rail.

(g) Tie spacing shall be as follows:

(1)	Main tracks – concrete	24"
(2)	Main tracks – wood	19-1/2"
(3)	Yard and secondary tracks – concrete	24" to 30"
(4)	Yard and secondary tracks – wood	19-1/2"
(5)	Highway crossings – wood/concrete	Per spec.

(h) Third Rail Ties: Every concrete tie in third rail territory is a third rail tie, in the sense that embedded inserts are provided at both ends, for mounting of third rail.

(1) For third rail concrete ties, the third rail extension channel shall be placed on every fifth tie to support the third rail insulator and support bracket.

(2) For wood ties, every sixth tie shall be a third rail tie.

(3) Maximum spacing for all types of third rail ties shall be 10'.

§109.2(C) Tie Installation

(a) Concrete Crossties

(1) Concrete ties damaged during handling, placement, surfacing and derailment shall not remain in track and shall be removed and replaced with undamaged concrete ties.

(b) Wood Crossties

(1) Ties should be placed in track with the wider heart wood face down and square to the line of the rail.

(2) The ends of standard 8'6" ties should be brought to a uniform line 18-1/2" from the edge of the base of rail on the line side as follows:

(i) On single-track roads, and in tracks of unassigned direction, line the north or east ends of the ties.

(ii) Where practical in third rail territory, the end of the tie without the third rail insulator is the line side

(iii) On roads with two or more main tracks, line the field ends of the ties.

(iv) Exceptions may be made where, in the use of tie installation machinery, it is advisable to line the opposite ends or where it is desired to retain an existing line side.

(v) When necessary to use less than standard length ties, they shall be centered in the track.

(c) All Crossties

(1) Ties shall be kept sufficiently spaced and square to the line of rail to permit proper tamping. When necessary, ties should be respaced by suitable machinery as track is rehabilitated or being constructed.

(2) Crossties shall be properly tamped in the tie seat area.

§109.3(C) Damage to Ties

(a) Wood Crossties

(1) When handling or spacing ties, care shall be taken not to damage them with picks or spiking hammers. Tie tongs, lining bars, other suitable tools or tie spacing equipment shall be used.

(2) Minimum necessary adzing will be used to obtain a sound and true bearing for the tie plate.

(3) Standard tie plugs, either square or round, or other means approved by the Director of Track & Structures, must be used to fill holes when spikes or lag screws have been removed if the tie is to be reused.

(b) Concrete Crossties

(1) Concrete ties are easily damaged by mishandling. They must only be handled with equipment or tools intended for the purpose. Care must be exercised to ensure that they are not dropped. Sledges or spike mauls must not be used to align concrete ties. Lining bars may be used to align them provided the concrete ties are not struck with the bars.

(2) Care must be exercised to avoid striking concrete ties when applying or removing elastic fasteners.

(3) Care must be used when drilling holes in concrete ties to apply fastening systems or to replace damaged fast clip shoulders to avoid cutting reinforcing strands.

(4) Holes required for field applied inserts may not be drilled in or attachments made to concrete ties unless approved by the Director of Track & Structures.

§109.4(C) Bridge Ties

(a) Oak ties or other approved materials shall be used on all open deck bridges.

(b) Bridge ties shall be adzed, framed and sized according to framing plans prior to treatment. Suitable holes must be bored for screw spikes that fasten tie spacing bars on timbers. Where ties are bored or adzed in the field, they shall be treated by an approved method.

§113.0(C) Rail

§113.1(C) General

(a) As used in these instructions, jointed rails are conventional rails bolted together. CWR is fabricated into strings longer than 400' by welding and designated by the initials "CWR".

(b) Except as specified by the Assistant Vice President - Maintenance of Way, running rails on all main track shall be 136 RE.

(c) Premium rail shall be head hardened or fully heat treated.

(d) Premium rails shall be used on all curves of 2º or more including their adjoining spirals. Premium rail shall be used on all special trackwork (turnouts, crossovers and diamonds, etc.). Premium rail shall be carried through adjacent locations of installation where the distance separating the locations is 500' or less.

(e) Rails of the same section shall be used through road crossings, station platforms, paved areas of track, switch connections, open deck bridges, trestles, turnouts, crossovers and in areas of other special trackwork.

(f) Rails to be used in jointed track or the end of CWR strings, shall be delivered with drilled ends. The drilling shall be in accordance with the AREMA requirements at 9-1/2" and 15-1/2" from the rail ends.

(g) Rails shall be furnished in nominal lengths of not less than 39'. Minimum rail length shall be 18' except for connections within certain turnouts, crossovers and temporary conditions where the minimum shall be approved by the Assistant Vice President - Maintenance of Way.

§113.2(C) Classifications and Identification – New Rails

(a) Premium rails shall be marked by either a metal plate permanently attached to the neutral axis, hot stamped, or in the brand that gives the manufacturer, type and/or method of treatment.

(b) Rails of a specific metallurgy shall be marked with paint colors acceptable to MNR and to the manufacturer.

(c) Paint marking will appear on the top of the head at one end only, at least 3' from the end.

(d) Rails are classified as follows:

(1) SC – Standard Carbon

(2) MH – Medium Hard

(3) HH – Head Hardened

(4) FT – Fully Heat Treated

(e) All short length rails produced shall have the length identified in a manner acceptable to MNR and the manufacturer on the top of the head approximately 1' from each end.

§113.3(C) Disposition and Shipment

Rails released from renewals and retirements must be disposed of as authorized by the Assistant Director of Track.

§113.4(C) Rail End Bolt Holes

Holes must be provided in accordance with standard plans and the following practice:

(a) When bolt holes are drilled, a uniform feeding pressure should be maintained and then reduced as the cutting tool cuts through the opposite side of the web. Forcing the cutting tool may produce a ragged hole, with the possibility of bolt hole cracks. Lubricant should be used throughout this operation.

(b) After drilling is completed, bolt holes should be brushed out and inspected. Any burns or chipped edges should be removed by grinding or chamfering to a smooth edge around the entire circumference of the hole.

(c) The minimum distance from the end of a rail to the center of the first bolt hole is as shown in AREMA, Chapter 4.

(d) The connection between rail ends should be made using 6-hole joint bars with the four outermost holes bolted (to accommodate future welding).

(e) High strength track bolts shall be used in all rail joints with the accompanying spring washer and nut.

(f) When it is necessary to use a cut rail at a compromise or insulated joint location, the mill or shop-drilled end of the rail should be placed in the compromise or insulated joint. The bolt holes must be accurately drilled in accordance with AREMA, Chapter 4.

(g) If rails with bolt holes are to be welded, the minimum distance from the end of the rail to the centerline of the first bolt hole shall be at least 9-1/2".

(h) A rail end drilling table is found in Part II, §113.1(M).

§113.5(C) Cutting Rail

(a) The tools that may be used for cutting rails are listed below:

    (1) Power rail saws with approved abrasive discs and guide attachments.

    (2) Gas cutting torches may be used for the demolition and removal of track. If torch cut rails are to be reused as fit rail at other locations in track, rail ends must be saw cut back 3" from the torch cut and then inspected.

(b) Rails that are saw cut and are to be joined shall have their rail ends cleaned of metal and dirt before the joint bars are applied.

(c) Any rail damaged by torches must be promptly removed from track and the damaged section cropped by power rail saw.

(d) Torch cut rail ends are prohibited in MNR track.

§113.6(C) Bonding Rails for Track Circuits

(a) When working in a territory where rails are bonded for track circuits, a signal maintainer should be notified if any bonds are damaged or broken. If possible a signal maintainer should be present when bonds are broken and rails are changed.

(b) In electric traction territory, when performing new construction or heavy production work, both a third railman and signal maintainer will be present.

(c) New track construction requires the installation of the bonds by the Signal and Power Departments.

§113.7(C) Third Rail System

The third rail system design shall be based on the trackwork alignment and turnout geometry configuration.

§115.0(C) Rail End Mismatch

New or fit relay rail shall be installed so that the mismatch of rails at joints may not be more than that prescribed in the following table:

Rail End Mismatch Construction Limits		
	Any mismatch of rails at joints may not be more than the following:	
Class of Track	**On the head of the rail ends (inch)**	**On the gage side of the rail ends (inch)**
1 and 2 3, 4 and 5	1/16 1/32	1/16 1/32

§117.0(C) Rail End Batter

Relay or fit rail used in new construction projects may not have rail batter greater than 1/32" (0.030").

§118.0(C) Rail Lubrication

The gage face of all new rail or new trackwork installations that fall under the following categories must be initially lubricated with grease as follows:

1. Gage face of both running rails in curves greater than 3°.
2. Gage face in the milled area of all conventional switch points regardless of turnout size or type.

§119.0(C) Continuous Welded Rail (CWR); General

§119.1(C) Use On MNR

(a) CWR should be installed in new track construction.

(b) CWR may be installed across open deck bridges where bridge ties are spaced with timber blocks between ties, provided that the following conditions are satisfied:

(1) All ties and blocks are tightly jacked and fastened together with spacing bars secured by lag screws in at least every third tie.

(2) Bridge ties are securely fastened to the steel structure by means of hook bolts or other approved holding devices.

(3) The bridge structure is properly anchored to abutments and piers to prevent any movement other than normal expansion.

(4) CWR is anchored to the bridge ties in both directions in accordance with Part III, §125.1(C) or an approved elastic fastening system is used.

(c) After application, timber holding devices must be checked and retightened until ties have fully seated on top flanges of bridge members.

§119.2(C) Welding or Bolting CWR

(a) Rail welding shall meet all AREMA and American Welding Society (AWS) requirements relevant to welding of rail and the additional requirements listed herein.

(1) All joints in running rails shall be welded, except insulated joints and certain joints in turnouts and crossing diamonds.

(2) The neutral temperature for CWR track shall be as specified in Appendix A, Continuous Welded Rail Procedures. In tunnels, a lower neutral temperature may be used with the approval of the Assistant Vice President - Maintenance of Way.

(3) Rails shall not be torch cut. Rail cuts shall be made with rail saws or abrasive discs designed for cutting of rails.

(4) Rails shall be welded into the longest strings practicable by electric flash-butt or field welding methods.

(b) Preferably CWR strings shall be welded together by in-track flash-butt welding, the thermite process, or as approved by the Assistant Vice President - Maintenance of Way.

(c) If it becomes necessary to apply temporary joint bars, the end bolt hole in each rail must not be drilled as this would prevent subsequent field welding. Additional rail anchors must be applied to this joint in accordance with Part III, §125.1(C).

(d) When it is not intended to field weld CWR strings, CWR strings are to be fastened to each other or to other rails with fully bolted rail joints.

(e) Wherever possible, thermite welding shall not be performed within 10' of the end of a highway grade crossing (see Part III, §41.2(C)(g).

(f) Only a power saw may be used to cut rails prior to thermite welding.

§119.3(C) Anchoring CWR

Each CWR string is to be anchored in accordance with Part III, §125.1(C).

§119.4(C) CWR Temperature

(a) A MNR approved rail thermometer shall be used to measure the rail temperature of all CWR before it is laid in track. The thermometer should be laid on the web of the rail, shielded from direct rays of sun and left there long enough to determine the temperature accurately. All thermometers must be checked for accuracy.

(b) MNR desired rail neutral temperature is 95°F. However, CWR may be installed, adjusted or anchored in the temperature range between 100°F and 125°F without further adjustment.

(c) Where CWR has been fastened at a rail temperature below 95°F it should be adjusted as soon as conditions permit. (See Appendix A, Continuous Welded Rail Procedures.)

(d) For all CWR laid or adjusted, the Supervisor in charge of the operation shall be responsible for recording the rail temperature at which each string was fastened. The Supervisor shall forward this information to the Assistant Director of Track Coordination and retain a record copy for one year.

§119.5(C) Calculating The Required Adjustment of CWR

(a) To adjust existing CWR when anchoring temperature was below 95°F, its desired length must be calculated in accordance with paragraph (c) and then properly adjusted by either heating or stretching with a hydraulic rail stretcher. This expansion must be recorded on the "Thermal Log for Rail Expansion" (Report C of the Report of Track Disturbance) given in Appendix A, Continuous Welded Rail Procedures.

(b) If the anchoring or fastening temperature is above 125°F it may require adjustment at the direction of the Assistant Director of Track Production.

(c) The number of inches by which a segment of CWR should be adjusted for a temperature between 95°F and 125°F may be calculated by taking the difference between the actual rail temperature at that time of adjustment and that desired rail neutral temperature, multiplying that difference in degrees Fahrenheit by the length of the CWR in feet and multiplying the product by the coefficient 0.000078.

(1) For example, to adjust a 1,450' length of CWR, anchored at a rail temperature of 50°F to the corresponding length of rail at 100°F, subtract 50 from 100 to obtain a difference of 50 and then multiply as follows:

$A = (T_d – T_a) \times L \times E_s$

A = (100-50) x 1,450 x 0.000078 = +5.65" ~ 5-5/8"

T_d = desired rail temperature (100°F)

T_a = actual rail temperature (°F)

L = length of rail (feet)

E_s = 0.000078 coefficient of expansion for rail steel (inches/foot)

A = Adjustment (inches)

(d) See Rail Expansion Table in Appendix A, Continuous Welded Rail Procedures.

§119.6(C) Adjust CWR by Heating or Mechanical Strain

(a) Rail may be expanded in the tie plates before or after spiking, but must be adjusted before it is anchored. All rail fastening systems must be removed from strings of CWR requiring adjustment to permit the desired expansion or contraction.

(b) The number of inches each CWR string should be adjusted during the rail laying or adjusting operation may be determined by calculation according to Part III, §119.5(C) or by referring to the CWR adjustment table in Appendix A.

(c) When adjusting CWR, prior to removing rail fasteners, ensure that there is a sufficient gap in the CWR to provide for the amount of expansion required.

(1) A minimum of 10 ties should be box anchored (conventional track) or fully clipped on the near end of the adjacent string to hold it in place and avoid closing the expansion gap of the string being heated.

(2) In addition, match marks should be made between the rail and the plate on the near end of the adjacent string to be sure that the adjacent string does not move while the string is being expanded.

(d) When expanding or straining rail, tie plates on wood tie track, should be tapped with a sledgehammer or an approved mechanical device used to free the rail.

(e) When expanding or straining rail on concrete tie track, use an approved mechanical device to free the rail or lightly tap the web of the field side of the rail with a sledgehammer.

(f) Uniformity of expansion is to be controlled by marking each quarter of the string and introducing expansion as follows:

1/4 point – 1/4 of total required expansion

1/2 point – 1/2 of total required expansion

3/4 point – 3/4 of total required expansion

End point – all of the required total expansion

(g) Quarter points should be marked with a continuous line from the base of rail to the tie plate or shoulder of concrete tie so that the amount of expansion can be accurately determined. The reference point must be one that will not move as the rail expands.

(h) CWR that is below 95°F should be heated so that expansion is introduced from one end of the string to the other. Heat should be steadily applied while moving forward until the required expansion has been obtained at the end of the string. In the event any quarter point does not have the required expansion, back the heater over that portion (without applying heat) and then reheat the rail until the necessary expansion is obtained.

(i) As adjusting is progressed, all fasteners must be applied as close to the heater as possible. If this is not possible, a minimum of seven ties should be boxed or fully clipped per 39' of rail to prevent the rail from losing adjustment.

(j) At the end of the completely expanded string, a minimum of 20 ties should be box anchored or fully clipped immediately after the gap is closed to hold the expansion.

(k) All adjusted rail strings must be fully fastened before the end of each work day.

§119.7(C) Maintaining The Desired Neutral Temperature of CWR

(a) It is important to maintain the desired neutral temperature of CWR so that the track remains stable.

(b) When performing maintenance or out-of-face work that has the potential to disturb the neutral temperature of the

CWR refer to Appendix A, Continuous Welded Rail Procedures.

§121.0(C) Rail Joints

(a) When constructing track, bolted rail construction shall not be used, except in special trackwork areas that cannot be welded and in temporary track. All rail ends shall be beveled and end-hardened in accordance with the AREMA Manual. All joint bars shall be 36", six-hole type, conforming to AREMA Specifications. High strength track bolts shall be used in all rail joints.

(b) Bolted rail joints are prohibited within 10' of the abutment of an open deck bridge.

(c) The use of acetylene torches or grinding to modify joint bars is prohibited.

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

(e) If rail end mismatch exists after applying approved joint bars the rail head and gage face surfaces may be adjusted by welding the smaller rail and finish grinding.

(f) If a permanent connection is made between CWR and bolted rail, all joint bar holes must be fully bolted.

(g) Each joint bar must be held in position by track bolts tightened sufficiently to provide firm support for abutting rail ends and to allow longitudinal movement of rails in the joint to accommodate expansion and contraction due to temperature variations. Track bolts should be tightened in accordance with AREMA practice.

(h) In CWR, joints shall be tightened firmly and without regard for longitudinal expansion.

(i) No rail or joint bar having a torch cut or burned bolt hole may be used in track. When new holes are necessary, they must be drilled. Punching and burning with a torch is prohibited.

§121.1(C) Field Welding of Rail Joints

(a) The goal of the Engineering Department is to reduce the quantity of joints in track by laying CWR and field welding of joints.

(b) Thermite and flash butt are acceptable methods for in-track field welding.

(c) Thermite welding shall be performed in accordance with manufacturer’s recommended practice.

(d) If it is necessary to install a plug or buffer rail in CWR strings, the rail shall be at least 18' in length.

(e) Whenever possible, all new turnouts and special trackwork shall be field welded to include frogs, switch points and stock rails.

(f) If it becomes necessary to apply temporary joint bars, the end bolt hole in each rail must not be drilled as this would prevent subsequent field welding. Additional rail anchors must be applied to this joint in accordance with Part III, §125.1(C).

(g) Thermite welding shall not be performed within the limits of a highway grade crossing.

(h) Field welding on open deck bridges is prohibited.

(i) Unless field conditions dictate otherwise for new construction, field welds shall be located as follows:

   (1) At least 14' away from a field weld in the same rail.

   (2) At least 4' from a plant weld in the same rail.

   (3) At least 7'-9" from a bonded insulated joint unless field conditions mandate a shorter distance.

(j) In no case will a field or plant weld be made within 9-1/2" of a bolt hole.

(k) Rail ends with three bolt holes shall not be welded.

(l) Welds in new turnouts may not conform to the above standards in all locations. However, every effort should be made to use the above standards.

(m) In the event that a field weld falls at a wood tie location, the wood tie should be respaced or an approved double shoulder polyurethane plate must be installed under the field weld with the authority of the Assistant Director of Track.

(n) In the event that a field weld falls at a concrete tie location, the concrete tie must be respaced.

§121.2(C) Bolted Rail Joints

(a) General

   (1) Bolted rail joints consist of head contact standard bars and head contact compromise joint bars held in position by track bolts.

   (2) Head contact bars must have the top surface of the bar held tightly against the surface under the rail head but away from the rail head fillet area. Bars must be secured in a vertical position to avoid cocking.

(b) Application

   (1) Joint bars shall be manufactured in accordance with the standard plans and specifications in MNR Standard Plans Book

   (2) New bolts, nuts and spring washers should be used when new or fit joint bars are applied.

(c) Head contact joints

The following procedure should be followed in applying head contact joint bars:

   (1) Set bars in position on rail, insert all the bolts and apply spring washers and nuts by hand.

   (2) See that bars are in a vertical position while tightening the center bolts.

(3) Tighten all bolts working from center of joint bars toward ends, tapping the toe of joint bars with a sledge so that their vertical position is maintained.

§121.3(C) Insulated Rail Joints

(a) Use: For new work or rail renewals in track circuit territory, insulated joints shall be located as follows:

(1) Where track circuits adjoin within limits of interlockings, in cab signal territory, electrified territory or in territory where stray current is likely to be prevalent, insulated joints shall not be staggered.

(2) To provide for effective electric locking, insulated joints shall be located with respect to signals as follows:

(i) No insulated joint shall be placed less than 0" nor more than 60" beyond (in advance) of a signal, except that where there are opposing signals at the same location, the insulated joints shall be placed as near an equal distance (between) opposing signals as practicable.

(3) Insulated rail joints in turnouts and crossovers, and at highway grade crossings, shall be located in accordance with the applicable Track and Signal Standard Plans.

(b) Application of bonded insulated joints (Glued Insulated Joints):

(1) Bonded insulated joints are required on all concrete tie tracks and should be used in all CWR.

(2) Conventional rail joints adjacent to bonded insulated joint rails must be field welded.

(3) All bonded insulated joints are to be installed as suspended joints.

(4) On wood ties rail holding spike heads must be in reverse position and must be carefully driven to ensure that spike head is not in contact with the bar, which could result in the joint’s being short circuited. All bonded insulated joints will have plate holding spikes installed.

(5) Joints installed with elastic fasteners shall have the correct clips applied to prevent possible damage to the joint.

(6) The bonded insulated joints will be considered as welded rail joints for purposes of compliance with the anchoring requirements of Part III, §125.1(C).

(c) Application of Polyurethane-Coated Steel Insulated Joints (Portec):

(1) Bonded insulated joint plugs are the preferred MNR standard, however;

(2) Polyurethane-coated steel insulated joints may be used on tracks where the use of a bonded insulated plug rail is not practical.

(i) Examples include yards, sidings, curved leads in sidings from the main track and interlockings.

(3) Polyurethane-coated steel insulted joints are to be installed as suspended joints.

(4) The top of the polyurethane-coated steel must be set first into the fillet area of the rail, torquing the bolts from the center to the ends.

(5) Appropriate elastic fasteners or reverse rail holding spikes should be used when installing polyurethane-coated steel joints.

§123.0(C) Tie Plates

(a) Tie plates shall be installed under running rails on all wood crossties, switch timber and bridge timber.

(b) Only canted (1:40) double shoulder or elastic fastener tie plates should be used.

(c) Canted tie plates shall be installed so that the rail cants towards the centerline of track.

(d) Tie plates must be placed square to the base of the rail and no portion or part of the shoulder can be under the base of the rail.

(e) No metal object that causes a concentrated load by solely supporting a rail shall be allowed between the base of the rail and the bearing surface of the tie plate. Examples include tie plate shoulders, spikes, etc.

§124.0(C) Tie Pads

(a) Elastomeric tie pads must be used on concrete ties.

(b) Tie pads shall be used on open deck bridges and shall conform to MNR standard plans.

§125.0(C) Rail Anchors/Fasteners

§125.1(C) Fasteners Required

(a) A sufficient number of drive-on anchors must be applied and in a manner to effectively control longitudinal rail movement.

(b) Insufficient anchors may result in improper distribution of expansion allowance, or stresses in CWR, and movement of rail that can result in distortion of line and surface, which can create a hazardous condition.

(c) It should be recognized that when track is raised out-of-face, the resistance to creepage is reduced and additional anchors may be required in order to avoid undue movement.

(d) When constructing conventional wood tie track, every other wood tie shall be fully box anchored.

(e) All jointed rail tracks require that a minimum of twelve (12) anchors per 39' of rail be boxed on six (6) ties spaced uniformly.

(f) A fully fastened wood tie, bridge timber and fully fastened and insulated concrete tie is considered equivalent to a box anchored tie.

(g) The number of anchors to be applied on wood ties (conventional track) when CWR is laid and subsequently maintained is as follows:

   (1) Box anchor every wood tie 200’ in each direction from:

      (i) Ends of CWR strings.

      (ii) Turnouts, crossovers and special trackwork.

      (iii) Highway grade crossings.

      (iv) Tunnel portals.

      (v) Open deck bridges where the timber are hooked and blocked in accordance with Part III, §119.1(C).

   (2) Box anchor every other wood tie:

      (i) Through the remainder of CWR strings.

      (ii) Across open floor decks on timber and steel structures, where the deck has been installed in accordance with Part III, §119.1(C).

   (3) To the extent practical, fully box anchor all CWR within switch, turnout and crossover areas.

(h) Rail anchors shall not be used on open deck bridges, trestles or viaducts, except where the deck and bridge meet the requirements of Part III, §119.1(C).

§125.2(C) Anchor Placement

Rail anchors on conventional track shall be applied as follows:

(a) Anchors shall be applied on both rails and on the same side of the tie. They should be spaced evenly throughout the rail length. Where special applications may be necessary, other spacing may be used with permission of the Assistant Director of Track. Wherever practicable, rail anchors shall be applied from the gage side of the rail.

(b) When ties at a joint cannot be anchored because of interference with a joint bar, no anchors shall be applied to the affected ties.

(c) Drive-on type anchors shall be applied to switch stock rails, applied from the field side of the track. Care must be taken in application of anchors so as not to interfere with switch rods.

§125.3(C) Use

The use of rail anchors should be in accordance with the following service assignment:

(a) Use new anchors in laying:

   (1) New bolted or continuous welded rail.

   (2) Continuous welded fit rail.

   (3) Bolted fit rail.

§127.0(C) Rail Fastening Systems

§127.1(C) Number Required

(a) Track shall be fastened by a system of components that effectively maintains gage within the limits prescribed in Part III, §53(C). Each component of each such system shall be evaluated to determine whether gage is effectively being maintained.

§127.2(C) Installation of Fasteners

(a) All elastic fasteners shall be inserted or removed from the cast-in-place shoulder (concrete tie) or tie plate (wood tie) with an approved device such as a sledgehammer. The use of a spike maul is prohibited.

(b) Elastic fasteners should not be overdriven as overdriving will cause premature failure of the fastener.

(c) Fasteners that have been overdriven or are not performing their intended function of limiting the vertical and longitudinal movement of the rail shall be replaced.

(d) In the case of an “e” clip, a distance of 3/8" (approximate width of a wooden pencil) between the shoulder and the face of the clip is required to prevent overdriving.

(e) In the case of the “fast” clip, the clip shall be driven or inserted until the clip is engaged in the shoulder notch.

(f) When driving clips with a sledgehammer, the tie must be flush with the bottom of the rail or assistance will be required to raise the tie.

(g) Care must be exercised so as not to strike the concrete tie or concrete tie shoulder in order to prevent damage to the tie.

(h) 15/16" diameter lag screws shall be used to secure steel plates (1" diameter holes) with elastic fasteners to wood ties and timber. Lag screws must be screwed into a 11/16" diameter pre-drilled hole, 6" deep. Driving of lag screws with a sledgehammer or spike maul is prohibited.

(i) Spikes must be started vertically and square and driven straight. The shank of rail holding spikes must have full bearing against the base of rail. See MNR Standard Plan 72051.

(j) The use of lock spikes (hair pins) is prohibited.

(k) Care must be taken not to strike the rail, its fastenings or signal appliances when driving spikes.

(l) Throat cut, rusted, deteriorated or bent spikes are not to be used for construction.

(m) Track spikes (cut spikes) shall not be driven into round plate holes.

(n) When performing an out-of-face rail or plate replacement, if the head of the track spike or lock spike is broken off, the replacement spike or lag screw should be inserted in a new location, leaving the stub in the tie.

(1) If a new location is not available the stub shall be driven completely through the tie so a new fastener can be installed.

(o) All old spike holes shall be plugged with treated wood plugs or with an MNR approved product prior to re-spiking.

§127.3(C) Rail Fasteners Required

(a) When spikes and elastic fasteners are used rail shall be fastened to every tie in the following manner:

Conventional Tie Plates	**Rail Holding Spikes**	**Plate Holding Spikes**
Tangent	2[(1)]	1
Curves 2° and over and curved leads on all turnouts and crossovers	2 (1 field side; 1 gage side)[(1)]	2 (1 field side; 1 gage side)[(1)]

Elastic Fastener Tie Plates (e.g. Pandrol, Norfast)[(3)]	**Elastic Fasteners (Clips)**	**Lag Screws**
Tangent	2 Clips	2 (1 field side; 1 gage side)[(2)]
All Curves	2 Clips	4 (2 field side; 2 gage side)

(1) Spikes should be applied diagonally on opposite sides of the rail.
(2) Apply diagonally on opposite side of clip.
(3) Lock spikes (hairpins) are not to be used.

§128.0(C) Direct Fixation Fasteners

(a) The fundamental requirements regarding the design of a direct fixation fastener system is that it must address safety, reliability and function.

(b) The safety requirements of the direct fixation fastener system are given below:

(1) The fastener should have redundancy (i.e., shoulders) and be of a reusable design.

(2) Safety critical fastener components must be visible for visual inspection.

(3) The fastener must be designed to control the amount of rail gap in the event of a broken rail.

(4) The fastener must be designed to control longitudinal, lateral and vertical rail movements within prescribed limits.

(c) The fastener system must be designed to provide:

(1) Geometric constraints.

(i) Maintain Gage: The primary function of the fastener is to retain the rail in its proper geometry relative to the opposing rail.

(ii) Maintain Vertical Position: The fastener shall maintain vertical position through positive vertical support for all load conditions.

(iii) Fastener Spacing: The fastener spacing shall be governed by broken rail gap considerations, longitudinal rail force restraint, rail stress and vertical track stiffness

(iv) Tolerances: The tolerances between the rail, the fastener and the fastener support must be compatible over their full range. Tolerance compatibility means that the range of tolerances for a series of components must be accommodated by any mating component.

(2) Load Capacity

This design criteria requires that the fastener load capacity will accommodate the following:

(i) The distributed vertical and lateral load from the wheel (by the beam strength of the rail) to each fastener.

(ii) The longitudinal rail force generated by thermal expansion of the rail, the vehicle braking and wheel tractive force.

(iii) Seating Force: The rail force to bend a rail to a curve.

(3) Noise and Vibration Mitigation

Where ground borne noise and vibration must be attenuated by a system other than a standard direct fixation system, then soft direct fixation fasteners meeting the same requirements as noted above, except for vertical stiffness, shall be used. If greater noise and vibration mitigation is necessary than can be provided by direct fixation fasteners alone, then other options will be investigated as part of the design process.

§145.0(C) Bridge Guard Rails

§145.1(C) Use

(a) A continuous line of rails, connected by bolted joints or welds, fastened to the crossties or bridge ties adjacent to the gage side of one running rail. One such rail is designated in these instructions as a “Single” Bridge Guard Rail. Two such continuous lines of rail, one adjacent to the gage side of each running rail are designated as “Full” Bridge Guard Rail.

(b) Bridge Guard Rails are applied between the running rails of main tracks at undergrade bridges which meet the below listed criteria.

(c) Full Bridge Guard Rails shall be installed at the following locations:

(1) All open deck bridges in curves.

(2) All truss bridges.

(3) All moveable bridges.

(4) All open deck viaducts.

(5) All direct fixation track on an elevated structure.

(6) Any other locations as directed by the Assistant Vice President - Maintenance of Way.

(d) Existing Bridge Guard Rails applied in accordance to previous standards or practices need not be changed unless instructed by the Assistant Vice President - Maintenance of Way. When it is necessary to remove bridge guard rail to perform maintenance work, bridge guard rail will be reinstalled only where required by the above instruction.

§145.2(C) Materials

(a) Suitable scrap or fit running rails may be used. The installed rail section will be approximately one-half inch, but not more than two inches below the top of the adjacent running rails, and in no case higher than the running rail.

(b) Joints shall be either four or six hole bars with a minimum of four bolts. Joint bars shall not be used within the 21’ curved end section of the guard rail.

(c) An L-6" x 6" x 3/8" angle iron may be used on direct fixation track as a guard rail with the approval of the Assistant Vice President - Maintenance of Way.

§145.3(C) Application

(a) Bridge Guard Rails shall extend a minimum distance of 50' beyond each end of the bridge abutment, unless increased distances have been prescribed for specific territories or locations. Bridge guard rails should be curved and brought to the center of the track for a distance for 21' from each end.

(b) Guard rails shall have the rail ends beveled, bent down, or fitted with bridge guard rail nose, or suitable fitting. Each end shall be fastened to the center of the track so as to divert a derailed wheel and not catch dragging equipment.

(c) The Guarding Face of bridge guard rails on open deck bridges shall be parallel to and 14" from the gage of the running rail.

(d) On direct fixation track a L - 6" x 6" x 3/8" angle may be used as an inner bridge guard rail with the approval of the Assistant Vice President - Maintenance of Way. The distance from the gage face of the running rail to the gage face of the angle is 11".

(e) Guard Rail Ends shall rest on a sound tie and be securely fastened.

SUBPARTS A-C

RECOMMENDED PRACTICE
FOR THE CONSTRUCTION
OF SPECIAL TRACKWORK

RECOMMENDED PRACTICE FOR THE CONSTRUCTION OF SPECIAL TRACKWORK

SUBPARTS A-C

Subpart A — General

§1.0(STC) General

(a) Turnouts shall meet the requirements of MNR and AREMA standards, where applicable, except as modified herein.

(b) Turnouts shall be AREMA standard frog numbers. The preferred frog numbers shall be 8, 10, 15, 20, 26.5 and 32.75. If the above standard turnouts cannot be used, other frog numbers can be used with the approval of the Assistant Vice President - Maintenance of Way.

(c) Tangential geometry turnouts should be used as approved by the Assistant Vice President - Maintenance of Way for No. 15, 20, 26.5 and 32.75 high-speed turnouts.

(d) No. 10 concrete tie spring frog turnouts shall conform to the MNR standard track plan.

(e) Turnout geometry for the conventional MNR No. 8, 10, 15 and 20 shall conform to the MNR Standard Drawings.

(f) Rail Layout

The rail layout shall be such that opposed joints, including opposed welds, do not occur. Joint stagger shall be a minimum of three feet.

(g) Turnouts shall be designed with the 136 RE rail section for mainline tracks and yard tracks. All rails in turnouts and crossovers shall be premium head hardened (HH) or fully heat treated (FT) rails. The same requirements shall apply to rails used in crossing diamonds.

(h) All insulated joints in turnouts and crossovers shall be bonded joints or poly joints. All other joints in turnouts and crossovers shall be welded if possible.

§1.1(STC) Criteria

(a) Turnouts and crossovers are designated by their frog number and should be used as follows or as designated by the Assistant Vice President - Maintenance of Way.

(b) Turnouts with conventional or asymmetrical switch points, moveable point frogs or spring frogs and concrete ties are designated as Premium Turnouts. All rails shall be premium head hardened (HH) or fully heat treated (FT) rails.

(c) Tangential geometry turnouts with moveable point frogs provide superior ride quality as compared to conventional turnouts through the straight and diverging moves.

(1) No 32.75 concrete tie premium turnout – Use in interlocking plants for diverging from one main track to another main track where the desired diverging speed is up to 80 MPH.

(2) No 26.5 concrete tie premium turnout with a moveable point frog – Use for diverging from one main line track to another main line track where

the desired diverging speed is up to 60 MPH. Uses for the No. 26.5 turnout can include situations where the needed diverging speed is greater than 45 MPH and the length of 32.75 will not fit the location.

(3) No 20 concrete tie premium turnout – Use in interlocking plants for diverging from one main line track to another main track where the needed diverging speed is up to 45 MPH.

(4) No. 15 concrete tie premium turnout – Use in interlocking plants for diverging from one main track to another main track where the desired diverging speed is up to 30 MPH.

Note: The No. 15 moveable point frog requires a slip or sliding joint through its diverging side making it a "handed frog."

(5) No. 10 spring frog concrete tie premium turnout – Generally used at wayside locations on main track territory where the diverging speed is up to 15 MPH. Unless otherwise approved by the Assistant Vice President - Maintenance of Way, a spring frog will only be used in locations where diverging moves over the turnout, as measured by wheel axle count, are 30% or less of the total axle count over the turnout.

(d) Construction of conventional turnouts with wood ties is generally limited for use in wood tie territory. It is not desirable to install a wood tie turnout in concrete tie main track.

(e) To further reduce inventory and maintenance costs and to improve ride quality, all new conventional turnouts with wood timber are to be of welded design, with floating heel blocks and approved frogs and guard rails.

(1) No. 20 conventional turnout – Use at interlocking plants for crossing over from one main track to another main track where the desired diverging speed is up to 45 MPH.

(2) No 15 conventional turnout – Use at interlocking plants for crossing over from one main track to another main track where the desired diverging speed is up to 30 MPH, or where the conditions do not justify or afford the lead distances required for No. 20 conventional turnouts.

(3) No 10 conventional turnout – Use in main tracks, sidings, terminals and yards where the desired diverging speed is up to 15 MPH. This is the preferred design over a No. 8 conventional turnout.

(4) No 8 conventional turnout – Use in yards and terminals where the desired diverging speed is up to 10 MPH. Should only be used where the use of a No. 10 or greater size turnout is not practical.

(5) No 8 and No. 10 self-guarded manganese (SGM) frog turnouts – Use in yards and terminals where the desired speed for both straight and diverging is

10 MPH (No. 8) or 15 MPH (No. 10). SGM turnouts are only to be used when the use of another approved frog is not possible.

(6) Turnouts smaller than No. 8 may be used only with the approval of the Assistant Vice President - Maintenance of Way.

(f) Construction of single or double slips is generally limited to terminal and yard usage where the speeds will not exceed 15 MPH. Existing locations that have greater operating speeds are exempt from this requirement. Construction speeds in excess of 15 MPH require the authorization of the Assistant Vice President - Maintenance of Way.

(1) No. 8 slips can consist of either moveable center points with knuckle and easer rail assemblies or solid center frogs. Solid center frog slips are the preferred design as they have fewer moving parts, require less maintenance and have fewer switch machines.

(2) No. 10 slips or greater consist of moveable center points with knuckle and easer rail assemblies. Solid center frogs are not permitted with these slips because of the reduced frog angle.

(3) The use of a slip switch with less than a No. 8 frog angle requires the approval of the Assistant Vice President - Maintenance of Way.

(4) Whenever possible, the approaches to slips should be on tangent. In general, slips are sensitive to the geometry of approaching tracks. Curved tracks increase the maintenance and wear on slip components. If curved approaches are required, slip design and degree of curvature must be approved by the Assistant Vice President - Maintenance of Way.

(g) Crossing diamonds, to the extent practical, shall be straight on both sides and shall be standard turnout frog numbers, except those of angles larger than No. 4 (14° 15' 00") which shall be to full degrees or half degrees. All crossing diamond designs shall be approved by the Assistant Vice President - Maintenance of Way.

(1) AREMA plans should be consulted when designing crossing diamonds to determine the current recommended practice.

§1.2(STC) Diverging Speeds

(a) The MAS through diverging movements on level turnouts, located on tangent track utilizing 3" underbalance will be as follows:

Frog. No.	Length of Switch Point	Maximum Authorized Speed – MPH
Tangential Geometry Turnouts		
32.75	121'-4-1/2"	80
26.5	74'-4-3/4"	60
25.4	76'-7-1/4"	60
20	81'-4-1/2"	60
Conventional Turnouts With Floating Heel Block		
20 Equilateral	59'-6"	60
20	59'-6"	45
15	38'	30
10	27'	15
8	27'	10
6	11'	5

(b) Exceptions to the above table, including special trackwork or frogs greater than a No. 32.75 or less than a No. 8 must have the approval of the Assistant Vice President - Maintenance of Way.

(c) When turnouts or crossovers are located in curved tracks, straight and diverging speeds must be adjusted to agree with Part I, §213.57.

§1.3(STC) Geometry

(a) The introduction of curvature between the heel of frog and the last long turnout tie should be avoided.

(b) The recommended tangent distance between reverse curves or facing same hand turnouts is a minimum of 100'.

(c) To the extent practicable, avoid placing turnouts and crossovers on curves, particularly on spirals or elevation runoffs at the ends of curves unless approved by the Assistant Vice President - Maintenance of Way.

§1.4(STC) Installation

(a) Prefabricated trackwork shipped in panels in accordance with approved plans is preferred.

(b) Care must be used in unloading and handling all trackwork, especially concrete tie turnouts. This includes handling and unloading from flat bed cars and assembling and loading onto transport cars.

(c) Care must be used when installing trackwork panels to prevent rail bending, tie splitting or tie cracking. Concrete tie turnouts are more likely to be damaged during handling and installation because of the weight and type of materials used.

(d) Special trackwork should be constructed on compacted and stable sub-grade properly graded to provide for positive drainage.

(e) Where practicable, a 12" bed of clean compacted ballast shall be provided. to within 3" of the final elevation of the bottom of the switch ties.

(f) Initial surfacing lifts for concrete trackwork shall be limited to 1-1/2" increments. This size lift helps prevent tie breakage and the bending of rail and plates in spring and moveable point frogs.

(g) If possible, special trackwork, when being constructed or renewed in existing main tracks, should be completely installed with switches connected to their operating mechanisms or blocked, spiked and clamped before trains are permitted to move over the trackwork.

(h) Where only one switch point (closed point) has been installed in a turnout under construction or renewal in existing main track, and it is necessary to move trains over the turnout on the main track, the following precautions must be taken:

(1) Any switch component installation in main line track should be done in conjunction with the Signal Department.

(2) All switch plates on the turnout side must be in the correct position and fully fastened.

(3) The main track switch point must be securely held against its stock rail by driving a spike in each of the first two ties back of the point and, where possible, spikes must pass through holes in the switch plates. In addition, the switch point must be secured to the stock rail by standard clamping devices. Unconnected ends of lead rails or the toe of the frog must be protected by a tapered wedge fastened to the tie to protect against dragging equipment.

(4) The free end of stock rail must be fastened to prevent movement.

(5) Facing point train movements shall only be made under a 10 MPH speed restriction unless point detection is provided.

(i) Where both switch points have been installed, but not properly connected to the switch operating mechanism, the following must be done before trains are permitted to move on the main track over the turnout:

(1) Any switch component installation in main line track should be done in conjunction with the Signal Department.

(2) Switch rods must be installed.

(3) The main track switch point must be secured against its stock rail as required by paragraph (h)(3) above.

(4) The open switch point must be blocked by driving a wooden wedge, not less than 18" long, between the switch point and its stock rail and clamped, with an approved clamping device.

(5) If the curved lead is not installed, a short piece of rail (5' minimum) should be installed at the heel end of the switch and bolted so that the heel block functions correctly. The opposite end of the rail should be fastened and nosed down to prevent being caught by dragging equipment.

(6) Train movements shall only be made when point protection is provided.

§2.0(STC) Switch Ties

(a) Switch ties shall conform with the requirements of MNR standards.

(b) To determine the number, size and length of switch ties required, see appropriate Standard Track Plans.

(c) Care should be taken when handling and storing switch ties to prevent warping.

(d) The use of long switch ties should be avoided.

(1) Wood timbers over 22' should be avoided.

(2) Concrete ties over 16' should be avoided. A flexible concrete tie splice shall be used to connect concrete ties in the crossover area.

§3.0(STC) Fasteners

The type of rail fastening spring clip used shall be the E-Clip type fastening system for areas of special trackwork.

§3.1(STC) Application

(a) All elastic fasteners shall be inserted into or removed from the cast-in-place shoulder (concrete tie) or tie plate (wood tie) with an approved device. The use of a spike maul is prohibited.

(b) Elastic fasteners should not be overdriven as overdriving will cause premature relaxation of the fastener. Fasteners that have been overdriven or are not performing their intended function of limiting the vertical and longitudinal movement of the rail shall be replaced.

(c) In the case of the “e” clip, a distance of 3/8" (approximate width of a wooden pencil) between the shoulder and the face of the clip is required to prevent overdriving.

(d) When applying “e” clips with a sledgehammer, the clip must initially be gently tapped to ensure proper insertion before the clip is fully seated. When removing “e” clips with a sledgehammer, the clips must initially be gently tapped to remove the toe load to ensure safe removal of the clip.

(e) Care must be exercised so as not to strike the concrete tie or concrete tie shoulder in order to prevent damage to the tie. Striking a concrete tie to make adjustments in the alignment of the tie with any type device is prohibited.

(f) 15/16" diameter lag screws shall be used to secure plates (1" diameter holes) with elastic fasteners to wood ties and timber. Lag screws must be screwed into a 11/16" diameter pre-drilled hole, 6" deep. Driving of lag screws with a sledgehammer or spike maul is prohibited.

§3.2(STC) Rail Fastening Systems

(a) Track shall be fastened by an elastic fastener system of components that effectively maintains gage and alignment.

(b) Each rail shall be fastened to every tie by four lag screws in each plate in the turnout area.

(c) Lock spikes (hair pins) or cut spikes shall not be used.

(d) Each concrete cross tie must have four elastic fasteners, four insulators and two tie pads in accordance with the MNR Standard Track Plans.

(e) Each wood tie with a elastic fastener system must have four elastic fasteners.

§4.0(STC) Switch Point Designs

§4.1(STC) Asymmetric Point Switches (Premium Turnouts)

(a) Switch points shall be of a Heavy Web Asymmetric design and be fabricated from Head Hardened Rail. The heel end of asymmetric switch points shall be forged to match the adjacent 136 RE rail section.

(b) Switches shall be fabricated with graduated risers.

(c) No hole in the switch point shall exceed 1.50" diameter. All holes shall be located at or near the rail neutral axis.

(d) Switch rods shall be located in the switch point as shown on AREMA Plans (112-55, 126-55, 128-55) or on the shop drawings as provided by the manufacturer and as approved by the Assistant Vice President - Maintenance of Way.

(e) Switch stock rails in mainline turnouts shall be head hardened rails (HH). Stock rails shall be undercut in accordance with AREMA Plan 221, Detail 5100.

(f) Stock rail braces shall be an adjustable and boltless type. There shall be no bolting of or into the stock rail. All spacers and heel blocks shall be attached to the switch point.

(g) Divider blocks past the heel block are bolted to the stock rail and switch point.

§4.2(STC) Conventional Point Switches

(a) Switch stock rails in mainline turnouts shall be high strength rails. Stock rails shall be undercut in accordance with AREMA Plan 221, Detail 5100. The length of the undercut shall be from 12" ahead of the point of switch to the end of the switch side planing.

(b) Stock rail braces shall be an adjustable and boltless type. There shall be no bolting of or into the stock rail. All spacers and heel blocks shall be attached to the switch point.

(c) Gage plates shall be installed at the switch of turnouts as follows:

(1) At the point of switch, gage plates shown per the AREMA plans shall have extensions for the switch machine.

(2) On direct fixation turnouts gage plates will be installed if required according to the manufacturer's design.

(3) Gage plates at the switch points of timber turnouts shall meet AREMA requirements, except that the insulation may be of the flat fiberglass type.

§5.0(STC) Frogs

(a) Conventional turnout frogs shall be heavy wall railbound manganese (RBM) (AREMA Plan 621 series), explosive hardened to not less than 341 Brinell by no less than 3 shots of explosive. Rails in frogs shall be AREMA premium rails (HH). Flangeways shall be 1-7/8" wide. Heel and toe lengths of frogs shall be sufficient to provide adequate width at the heel and toe, to allow the field welding of suspended joints.

(b) A moveable point frog (Premium Turnouts) shall consist of flexible Vee rails in a jointless swing nose crossing assembly. The Vee rail is forged from fully heat treated (HT) rail steel. The point of frog shall be suitably housed into the frog body to prevent wheel flanges from striking the point and must also be vertically restrained to prevent lifting of the point of frog.

(c) At locations where No. 10 Turnouts are used on mainline tracks, spring frogs may be incorporated. Current design practice uses spring frogs that are constructed of explosive hardened manganese with welded heel rails.

§5.1(STC) Frog Uses

(a) Frogs of various angles, as designated by frog number, shall be used with trackwork of the same number in accordance with Part III, §1.0(STC).

(b) The service assignments of the various types of frogs shall be as follows:

(1) Moveable point frogs, spring frogs, welded heel manganese frogs and railbound manganese frogs shall be used in heavy traffic and/or high speed tracks.

(2) No. 10 spring frogs shall be used in main track wayside turnouts to industrial tracks or yards.

(i) Unless otherwise approved by the Assistant Vice President - Maintenance of Way, a spring frog will only be used in locations where diverging moves over the turnout, as measured by wheel axle count, are 30% or less of the total axle count.

(3) Self-guarded frogs (SGM) should be used in yard tracks as conditions dictate and where the speed does not exceed 15 MPH. Whenever possible, RBM frogs are the preferred design.

§6.0(STC) Frog Guard Rails

§6.1(STC) General

(a) Guard rails shall be furnished in accordance with Standard Track Plans and specifications or manufacturer's designs approved for use by the Assistant Vice President - Maintenance of Way.

(b) The distance from the beginning of the guarding face to the point of frog on both the straight and diverging side shall be a minimum of 36".

(c) Lengths of guard rails for turnouts with rigid frogs shall be at least:

(1) 20' for No. 20 and No. 15 Turnouts.

(2) 13' for No. 10 and No. 8 Turnouts.

(d) Lengths of guard rails for turnouts with spring frogs shall be as follows:

(1) 29' on the main line side and 13' on the diverging side for No. 10 spring frog.

§6.2(STC) Guard Rail Use

(a) Special guarding applications shall be approved by the Assistant Vice President - Maintenance of Way.

§6.3(STC) Design

(a) All guard rails should be set in accordance with appropriate turnout standard plans and Standard Track Plans and manufactured shop drawings.

(b) The end of guard rails should be placed upon a tie or be otherwise protected, so that no loose or dragging object may become hooked on the guard rail ends.

Subpart B — Construction Limits

§10.0(STC) General

(a) Construction is the complete replacement of track structure, including turnouts and other trackwork, from sub-grade to top of rail.

(b) It should always be the goal to complete construction projects to the best industry practices and tolerances. This is not always practical given such variables as manufacturing limitations, existing conditions and the use of relay materials. Therefore, construction tolerances have been developed.

(c) The limits and specifications for turnouts and other trackwork are found in this subpart or the applicable sections of Part III (C).

(d) It is recognized that when fit materials are used in the construction of trackwork, it may be more difficult to meet these limits. However, it is always MNR's policy to construct track, trackwork and appliances within the limits specified in this subpart.

§53.0(STC) Gage

§53.1(STC) Gage Standard

(a) The standard gage for track, measured between the running rails at right angles to the alignment of the track, 5/8" below the top of rail, is 56-1/2".

(b) Gage on curves 8° and over, and turnouts with a frog number lower than 8 and in Grand Central Terminal (GTC) will be specified by the Assistant Vice President - Maintenance of Way.

(c) Track and turnouts shall be gaged by adjusting the rail opposite the line rail.

§53.2(STC) Gage Limits

(a) Gage shall be measured with a standard track gauge or other authorized devices. These devices must be checked prior to daily use for accuracy. (See Part I, §§213.250, 213.251.)

(b) For construction, the following deviations from standard gage apply. Provided that the gage is uniform, the following deviations from standard gage apply:

Construction Gage Tolerances		
Class of Track	**Minimum (inches)**	**Maximum (inches)**
1-5	56-3/8	56-5/8

§55.0(STC) Alignment

Alignment is the horizontal location of a railroad as described by curves, spirals and tangents.

§55.1(STC) Alignment Limits

(a) The following standards shall be used for the construction of special trackwork and for the restoration of existing special track:

Construction Alignment Tolerances			
Parameter	**Main Track Direct Fixation**	**Main Track Ballasted**	**Yard Track Ballasted**
Horizontal special trackwork alignment[1]			
Total Deviation	± 1/4"	± 1/4"	± 1/2"
Middle ordinate in (62' chord)	± 1/8"	± 1/8"	± 1/4"
[1] Total deviation is defined as the measurement between the theoretical and actual alignment at any point on the track.			

(b) The alignment of track and superelevation on curves, in overhead electrified territory, must not be changed until proper notice has been given to the Power Department.

§63.0(STC) Surface

§63.1(STC) General

(a) Track surface is the relationship of opposite rails to each other in profile and crosslevel. Track profile is the running surface along the top of the grade rail. Crosslevel is the difference in elevation of opposite rails measured at right angles to the track alignment. The ideal surface is a uniform profile consisting of constant grades connected by vertical curves, with zero crosslevel on tangents and predetermined superelevation on curves.

(b) The profile of track being surfaced should not be raised above established grades, except under instructions from the Director of Track & Structures, who will give consideration to the required elevations and clearances in tunnels, under catenary systems and overhead structures, and at interlocking plants, undergrade bridges, platforms and highway grade crossings.

(c) Any encroachment upon the published minimum overhead or side clearances from a track will not be permitted.

(d) Turnouts shall not be placed in curves without the approval of the Assistant Vice President - Maintenance of Way.

(e) If turnouts must be built in curves, the reverse elevation limits shall comply with Part III, §63.2(C) or be as approved by the Assistant Vice President - Maintenance of Way.

§63.2(STC) Construction Limits

(a) The following criteria will serve as a practical guide for establishing smooth riding conditions for new trackwork.

(b) The construction limits for special trackwork surface are contained below:

Surface Construction Limits			
Track Surface	**Track Classes**		
	1-2	**3**	**4-5**
The runoff in any 31' of rail at the end of a raise may not be more than (inches):	1/2	1/4	1/8
The deviation from uniform profile on either rail at the mid-ordinate of a 62' chord may not be more than (inches):	1/2	1/4	1/8
The deviation from zero crosslevel at any point on a tangent and designated elevation in curves may not be more than (inches)(1)	1/2	1/4	1/8
Except as provided in Part III, §57.4(C), the difference in cross-level between any two points less than 62' apart may not be more than (inches):	1/2	1/4	1/8
(1) The maximum allowable speeds for a curve as shown in this table is based upon a single point deviation.			

§113.0(STC) Rail

(a) See Part III, §113.0(C), Rail.

§115.0(STC) Rail End Mismatch

New or relay (fit) rail used in construction shall be installed so no mismatch between fit rails shall be more than that prescribed in the following table:

Rail End Mismatch Construction Limits New or Fit Rail		
	Any mismatch of rails at joints may not be more than the following:	
Class of Track	**On the head of the rail ends (inch)**	**On the gage side of the rail ends (inch)**
1 and 2	1/16	1/16
3, 4 and 5	1/32	1/32

§118.0(STC) Rail Lubrication

See Part III, §118.0(C), Rail Lubrication.

§119.0(STC) Continuous Welded Rail (CWR)

See Part III, §119.0(C), Continuous Welded Rail.

§121.0(STC) Rail Joints

New bolts shall be used in construction. For bolt size, bolt hole size and rail end drillings see Part III, §121.0(C), Rail Joints and Part II, §121.0(STM), Bolts and Braces.

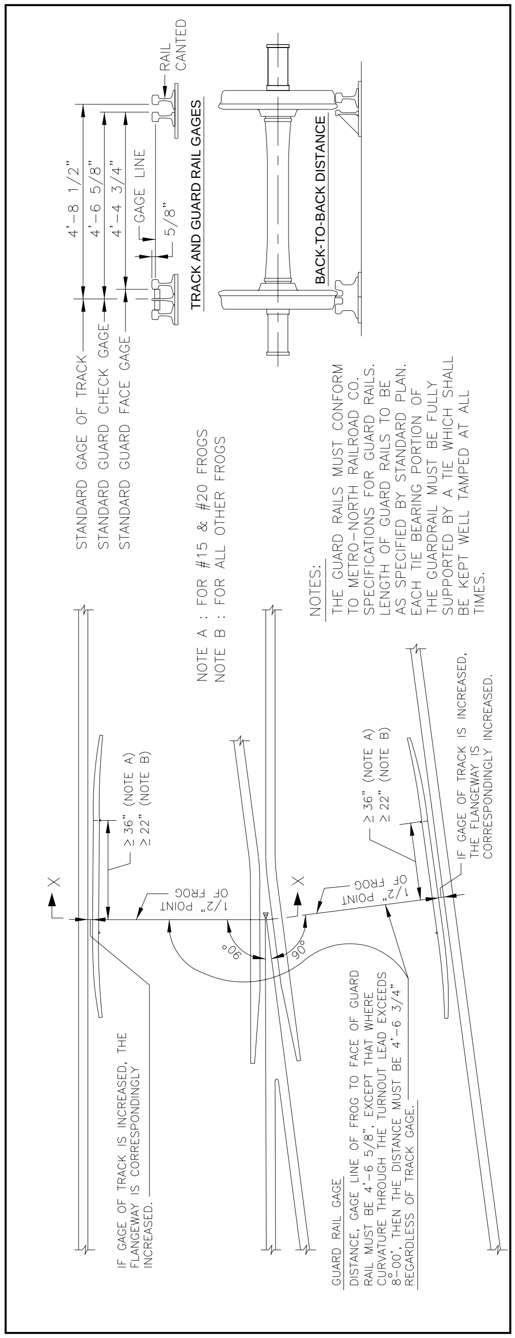
§143.0(STC) Frog Guard Rail and Guard Faces; Gage

(a) When constructing special trackwork, the installation dimensions of guard rails are given in Standard Track Plans. Critical dimensions are as follows:

Track gage	56-1/2"
Guard check gage (may not be less than)	54-5/8"
Guard face gage (back to back) (may not be more than)	52-3/4"

(b) Construction limits contained in Paragraph (a) are more restrictive than those found in Part I, §213.143.

(c) See following diagram showing guard check gage and guard face.



Guard Check and Guard Face Gage

Subpart C — Miscellaneous Appliances

§200.0(STC) Switch and Moveable Point Frog Operating Mechanisms

See Part II, §200.0(STM) for Switch and Moveable Point Frog Operating Mechanisms

§300.0(STC) Derails

§300.1(STC) Position

The "normal" position of a derail shall be to derail the wheels of rolling equipment away from the main track or structure. The "reverse" position shall be to leave the rails unobstructed for the free movement of the equipment.

§300.2(STC) Derail Use

Derails shall be used as follows:

(a) In main tracks, controlled sidings and sidings, only where required by the Code of Federal Regulations (CFR 213), State Authorities or where authorized by the Assistant Vice President - Maintenance of Way.

(b) At other points (as car repair yards) where deemed necessary and authorized by the Assistant Vice President - Maintenance of Way.

(c) Any track, when temporarily used to store cars or equipment, may require the placement of a derailing device or other approved protection close to the stored cars.

§300.3(STC) Derail Types

(a) There are three types of derails on MNR:

    (1) Switch point type (single)

    (2) Sliding block type

    (3) Hinged type

(b) The derails shall be placed in a manner as to derail equipment away from the main track or track being protected.

(c) The switch point type derail is directional and all others can be either directional or bi-directional.

(d) When using sliding block and hinged type derails, they shall be sized for the rail on which they are placed.

(e) Sliding block, hinged and portable type shall be located at least 12' back from the clearance point they are protecting.

(f) The switch point type derail shall have a deflector rail of at least 18' in length located 4" from the field side of the running rail nearest the derail and 12" from the field side of the running rail farthest from the derail.

(g) All the derails, except for the switch point type, should be painted yellow and highly visible.

§305.0(STC) Padlocks

Use only standard issued MNR switch locks.

§310.0(STC) Switch Heaters

(a) New switches and moveable point frogs should be equipped as directed by MNR.

(b) The preferred type of switch heaters shall be electric and produce sufficient heat to keep the switch free of ice.

(c) Heating elements shall be provided in switch rod troughs so that the operating mechanisms do not get locked in ice.

§315.0(STC) Friction Buffers and Bumping Posts

(a) The friction buffers shall be capable of stopping a 12 car M-7 train without damage to any of the cars at speed of 5 MPH.

(b) The friction buffers shall have a hydraulic ram to absorb slow speed impacts of 5 MPH or less.

(c) Only the friction buffer head shall contact the passenger car.

(d) Contact between the passenger car and the buffer head shall not cause lifting or derailment of the car.

(e) Friction buffer shoes shall not extend past the buffer housing.

(f) Additional rails between the running rails may be used for additional storage of buffer shoes.

(g) Bumping posts shall be placed as directed at the end of all yard and secondary tracks. The bumping post shall be capable of stopping a 12 car M-7 train at a speed of 5 MPH.

§320.0(STC) Rail Lubricators

(a) Rail lubricators shall be installed on all curves with a radius less than 2,000' and in other locations of expected high rail wear.

(b) The lubrication tanks for rail lubricators shall not be placed between tracks.

SUBPART A

RECOMMENDED PRACTICE
FOR THE CONSTRUCTION
OF MITER RAILS

(INCLUDES
EXPANSION JOINTS)

RECOMMENDED PRACTICE FOR THE
CONSTRUCTCION OF MITER RAILS
(INCLUDES EXPANSION JOINTS)
SUBPART A
Track Classes 1 and 2

Subpart A — Construction Limits

§50.0(MRC) Scope

(a) Miter rail and expansion joint construction is the complete replacement of all components from the deck to the top of rail.

(b) It should always be the goal to install appliances to the design tolerances. This is not always practical given such variables as rail rolling tolerances and manufacturing limitations. Therefore, construction tolerances have been developed.

(c) This subpart prescribes construction requirements for the gage, alignment and surface of miter rails and expansion joints.

§53.0(MRC) Gage

§53.1(MRC) Standards for Gage

(a) The standard gage for track, measured between the running rails at right angles to the alignment of the track 5/8" below the top rail, is 56-1/2".

(b) Gage shall be changed by adjustment of the rail opposite the line rail.

§53.2(MRC) Setting of Gage

(a) Gage shall be measured with a standard track gauge or other authorized devices. These devices must be checked daily for accuracy prior to use.

(b) For construction, provided that the gage is uniform, the following deviations from standard gage are permitted:

Gage Construction Tolerances		
Class of Track	**Minimum (inches)**	**Maximum (inches)**
All	56-3/8	56-5/8

§55.0(MRC) Alignment

(a) General track alignment, as viewed from above, consists of a series of straight lengths of track, referred to as tangents, connected by simple, compound and reverse curves.

(b) Alignment (line) is the condition of track with regard to uniformity of direction over short distances on tangents and in curves.

§55.1(MRC) Alignment Tolerances for Construction

The following standards shall be used for the construction of new track and restoration of existing track that includes miter rails and expansion joints.

Class of Track	Alignment Construction Standard for Tangent Track
	The deviation of the mid-ordinate from a 62' chord may not be more than (inches):
All	3/8
	Base of Miter Rail Limits
	The deviation from uniform alignment within the base of the miter rail may not be more than (inches):
All	1/16

§63.0(MRC) Track Surface

§63.1(MRC) General

Track surface is the relationship of opposite rails to each other in profile and crosslevel. Track profile is the running surface along the top of the grade rail. Crosslevel is the difference in elevation of the tops of heads of opposite rails, measured at right angles to the track. The ideal surface is a uniform profile consisting of constant grades connected by vertical curves, with zero crosslevel on tangents and predetermined superelevations on curves.

§63.2(MRC) Tolerances

The construction limits for track surface through miter rails and expansion joints are given below:

Construction Track Surface Limits	All Class of Tracks
The deviation from uniform profile on either rail at the mid-ordinate of a 62' chord may not be more than (inches):	1/4
The deviation from zero crosslevel at any point on a tangent may not be more than (inches):	1/4
The difference in crosslevel between any two points less than 62' apart may not be more than (inches):	1/2
Base of Miter Rail Limits	
The limits given below are for base of the miter rail	
The deviation from uniform profile on either rail along the base of rail within the appliance may not be more than (inches):	1/16
The deviation from zero crosslevel at any point along the appliance may not be more than (inches):	1/8

§109.0(MRC) Miter and Expansion Joint Support Systems

(a) It is recognized that the effective operation of miter rails and rail expansion joints depends on a sound timber or concrete deck system.

(b) When installing new miter rail or expansion joint assemblies ensure that all the bridge timbers are replaced.

(c) Spalling and deteriorating concrete decking under any miter rail assembly or rail expansion joint shall be repaired.

(d) Fastening components, such as inserts, bolts, lags and clips, shall be replaced with new materials.

(e) Corrosion resistant full-width, full-depth shims shall be furnished as required to achieve the construction tolerances indicated above.

§115.0(MRC) Rail End Mismatch

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

Rail End Mismatch Construction Limits		
Class of Track	**On the head of the rail ends (inch)**	**On the gage side of the rail ends (inch)**
All	1/16	1/16

§119.0(MRC) Continuous Welded Rail

See Part III, §119.0(C) for the construction requirements for CWR track on or about bridges and blocking and hooking of bridge ties.

§121.0(MRC) Bolt Torque

Preferred torque values for bolts are given in the following table:

Construction Bolt Torque Requirements (Preferred)	
Bolt Diameter (inches)	**Preferred Dry Thread Torque (ft-lbs)**
7/8	470
1	710
1-1/8	960
1-1/4	1,350
1-3/8	1,750

§125.0(MRC) Rail Anchoring (Bridges)

See Part III, §125.0(C).

§127.0(MRC) Rail Fastening Systems (Bridges)

See Part III, §§125.0(C) and 127.0(C).

§143.0(MRC) Guard Rails and Guard Faces; Gage

By design, not all miter rails have guard rails. If the assembly has a guard rail, the following limits shall apply:

Track gage	56-1/2"
Guard check gage (may not be less than)	54-5/8"
Guard face gage (back to back) (may not be more than)	52-3/4"

§145.0(MRC) Inner Bridge Guard Rails

See Part III, §145.0(C) for the construction requirement for the use of guard rails on bridges.

Metro-North Railroad

APPENDIX A

CONTINUOUS WELDED RAIL (CWR) PROCEDURES

Revised 10/10/2011

APPENDIX A CONTINUOUS WELDED RAIL (CWR) PROCEDURES

SECTION I. INTRODUCTION

§1.1 General

(a) Buckled track has always been a major concern in the railroad industry. Incidents within the industry and derailments due to buckled track have been steadily increasing since the introduction of CWR. Throughout the United States, railroads are experiencing numerous buckled track derailments each year.

(b) Metro-North by the nature of its passenger operations, cannot tolerate risk of buckled track. Buckled track is, in reality, not a cause but the result of some deficiency in the track structure or track maintenance procedures. A properly constructed and maintained piece of track will not buckle from thermal loading during normal seasonal variations of temperature. Something else must be present for buckling to occur, such as misalignment, substandard ballast section, loss of neutral temperature, rail anchor deficiency, etc.

(c) Current research has shown that the critical parameters or conditions influencing track buckling are:

1. Rail Neutral Temperature
2. Track Lateral Resistance
3. Track Longitudinal Resistance
4. Track Curvature
5. Alignment Deviation
6. Dynamic Train Loading

(d) The operations of the Track Department in its construction and maintenance activities have complete control over the first five critical items and substantial influence on the sixth item. If track buckling is to be prevented, all six items must be controlled and maintained within the recommended practices in MW-4.

(e) Rail lengths welded together that exceed 400 feet are considered CWR. Rail installed as CWR remains CWR, regardless of weather a joint or plug is installed into the rail at a later time.

§1.2 Track Curvature

Curved track is more prone to buckling than tangent track. As curvature is increased, the temperature at which a track will buckle is decreased.

§1.3 Alignment Deviation

Any alignment deviation significantly reduces the temperature at which a track will buckle. As an example, a deviation increase from 1" to 1-1/2" may reduce the buckling temperature by as much as 40ºF.

§1.4 Rail Neutral Temperature

Shifts in rail neutral temperature are hard to detect and measure. Shifts of 30ºF to 40ºF from the established neutral temperature for a territory can be critical and lead directly to buckling. Factors influencing rail neutral temperature shifts are:

1. Improper rail installation
2. Inadequate rail anchors/clips (insufficient, improperly installed or damaged/worn)
3. Lateral movements in curves through lining operations
4. Inadequate ballast section
5. Skeletonized track

All of the above items, if improperly executed or allowed to exist in a deficient condition, will cause a downward shift in the neutral rail temperature and produce a potential for buckled track.

§1.5 Lateral and Longitudinal Restraint

Longitudinal Restraint		
Operation	**Temperature Condition**	**Potential Result**
Undercutting Surfacing Cribbing Tie Renewal Anchor/Clip Removal and Application	Above Neutral Temperature	Allows longitudinal track movement, thereby altering neutral temperature producing a potential for immediate buckling at fixed objects or the potential for buckling during the following hot season.
	Below Neutral Temperature	Allows movement in curve territory producing potential for buckling when the rail temperature exceeds Proper Rail Laying Temperature (PRLT) range.
Lateral Restraint		
Operation	**Temperature Condition**	**Potential Result**
Undercutting Cribbing Surfacing	Above Neutral Temperature	Potential buckling immediately or shortly after operation.
Tie Renewal Rail Renewal	Below Neutral Temperature	Contributes by allowing track movement in curve territory, lowering neutral temperature with potential for buckling when the rail temperature exceeds Proper Rail Laying Temperature (PRLT) range.

§1.6 Dynamic Train Loading

(a) Studies indicate that most buckling occurs under the train. Therefore train loading of the track structure plays a role in the buckling of track. There are a number of ways in which dynamic train loads influence track buckling:

1. Train induced uplift of the track structure can cause a large reduction in buckling temperature.
2. High L/V ratios accelerate the growth of alignment deviations.
3. Braking and traction forces typically produce an additional 10 tons of compressive force in the track.

(b) Metro-North must recognize the effects of train traffic when planning and executing track work.

(c) The track buckling countermeasures establish procedures and controls to minimize the possibility of adversely affecting the track structure, producing a potential for buckling.

(d) The following is a brief description of the relationship of various maintenance of way activities to critical items that influence track buckling. Track buckling may result if work is not executed in accordance with MNR recommended practices.

SECTION II. TRACKWORK METHOD AND CRITERIA

Adherence to the following work methods and restrictions are required to establish and maintain a neutral temperature in CWR territory that will prevent buckled track.

§2.1 Procedure for Destressing CWR

If measured rail temperature is higher than installation or latest adjusted rail temperature, CWR may be adjusted before or during track work using the following procedures:

1. Disconnect or cut and line the ends of CWR strings out of the tie plates to clear adjoining rail ends.
2. Remove all rail anchors in the area to be adjusted.
3. After the track has been raised, tamped and lined, rail closures should be made, adjusting the CWR as needed.
4. All rail anchors must be reapplied in accordance with prescribed practices before the track is returned to normal service.
5. The established ballast section must be restored before the track is returned to normal service.
6. In the event work is performed through only part of a CWR string, the entire string is to be freed, and the unworked portion of the string is to be loosened in its tie plates by operating a heavy self-propelled unit of M.W. equipment over the unworked portion, or tapping the tie plates with a hammer before making closure and anchoring.
7. The rail temperature of each CWR string that is adjusted is to be measured and recorded, using a standard rail thermometer. The thermometer should be laid on the base of the rail, shielded from the direct rays of the sun and left there long enough to determine the rail temperature accurately. Complete Report A, Record of Disturbance of Main CWR Track, indicating the temperature. Forward one copy to the Supervisor of Track, and one copy to the Assistant Director of Track Coordination for filing.
8. If the rail is adjusted before or during the maintenance operation, as outlined above, the track may be placed in service with an appropriate Slow Order not to exceed 30 MPH on all track worked that day. The appropriate Slow Order, not to exceed 30 MPH must remain in effect for 24 hours.

§2.2 Installing CWR

All CWR must be installed in accordance with Part II, §119.0(MW4) thru 127.3
To install CWR at a temperature other than that specified, written approval must be obtained from the Assistant Vice President - Maintenance of Way. This approval will specify track number, milepost location, and protective action.

§119.0(M) Continuous Welded Rail (CWR);

General
§119.1(M) Use on MNR

(a) CWR fabricated by an approved process may be laid anywhere on MNR

(b) CWR may be laid across open deck bridges where bridge ties are spaced with timber blocks between ties, provided that the following conditions are satisfied:

(1) All bridge ties are blocked and are tightly jacked and fastened together with spacing bars secured by lag screws in at least every third tie.

(2) Bridge ties are securely fastened to steel structure by means of hook bolts, tie anchors or other approved holding devices.

(3) The bridge structure is properly anchored to abutments and piers to prevent any movement other than normal expansion.

(4) CWR is anchored to the bridge ties in both directions in accordance with Part II, §125.1(M); or

(5) Approved elastic fastening systems are used under the running rails when all bridge timber is renewed and properly secured.

(c) After application, timber holding devices must be checked and retightened, until ties have fully seated on the top flanges of bridge members.

§119.2(M) Welding or Bolting CWR

(a) CWR strings may be field welded by the electric flash butt or thermite methods. See Part II, §120.0(M), Field Welding.

(b) When field welding is not possible, CWR strings are to be fastened to each other or to other rails with fully bolted rail joints.

(c) If it becomes necessary to apply joint bars temporarily, the end bolt hole in each rail must not be drilled to permit subsequent field welding. Rail anchors must be applied at this joint location in accordance with Part II, §125.1(M).

§119.3(M) Anchoring CWR

Each CWR string is to be anchored in accordance with Part II, §125.1(M).

§119.4(M) CWR Temperature

(a) An approved rail thermometer or other approved device shall be used to measure the rail temperature of all CWR. The thermometer should measure temperatures on the web, shielded from direct rays of the sun after being left there long enough to determine the temperature accurately. All thermometers must be checked for accuracy.

(b) CWR must be adjusted by heating or mechanical straining (stretching) and anchored to a neutral rail temperature between 95°(F) to 125°(F). The desired neutral temperature on MNR is 95°(F).

(c) The supervisor installing CWR shall be responsible for recording the rail temperature at which each CWR string is anchored for all CWR laid or adjusted. Rail temperature installation is recorded on Report C.

§119.5(M) Calculate Required Adjustment of CWR

(a) To adjust existing CWR when anchoring temperature is below 95°(F), the amount of rail expansion must be calculated in accordance with paragraph (c). The rail then must be properly adjusted by expanding or straining.

(b) If the anchoring temperature is above 125°(F), it may require adjustment at the direction of the Assistant Director of Track.

(c) The number of inches by which a segment of CWR should be adjusted to achieve a temperature between 95°(F) to 125°(F) may be calculated by taking the difference between the actual rail temperature at time of adjustment and desired rail temperature, multiplying that difference in degrees Fahrenheit by the length of the CWR in feet and multiplying the product by the coefficient 0.000078.

(d) For example, to adjust a 1,450' length of CWR, anchored at a rail temperature of 45°(F) to the corresponding length of rail at 95°(F), subtract 45 from 95 to obtain a difference of 50 and then multiply as follows:

$A = (T_d - T_a) \times L \times \alpha_s$

$A = (95-45) \times 1450 \times 0.000078 = +5.65'' \sim 5\text{-}5/8''$

where:

T_d = desired rail temperature (95°F)

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T_a = actual rail temperature (°F)

L = length of rail (feet)

α_s = 0.000078 coefficient of expansion for rail steel (inches/foot)

A = Adjustment (inches)

§119.6(M) Adjust CWR by Heating or Mechanical Strain

(a) Rail must be adjusted before it is anchored. All rail fastening systems must be removed from strings of CWR requiring adjustment to permit the desired expansion or contraction.

(b) The number of inches each CWR string should be adjusted during the rail laying or adjusting operation may be determined by calculation according to Part II, §119.5(M) or referring to the CWR adjustment in the back of this section.

(c) Prior to removing rail fasteners ensure that there is a sufficient gap in the CWR to provide the amount of expansion required.

(d) Tie plates should be tapped with a sledgehammer or approved mechanical device used to free the rail. Be aware of the location of field welds so that they do not interfere with the movement of CWR.

(e) On concrete crosstie track, lightly tap the head of the field side of the rail with a sledgehammer or use an approved mechanical device to free the rail.

(f) A uniform expansion of CWR is to be controlled by marking each quarter of the string and introducing expansion as follows:
1/4 point - 1/4 of total required expansion
1/2 point - 1/2 of total required expansion
3/4 point - 3/4 of total required expansion

(g) Quarter points should be marked with a continuous line from the base of rail to the tie plate or shoulder of concrete tie so the amount of expansion can be accurately determined. The reference point must be one that will not move as the rail expands.

(h) CWR that is below 95°(F) should be heated so that expansion is introduced uniformly from one end of the string to the other end. Heat should be steadily applied while moving forward until the required expansion has been obtained at the end of the string. In the event any quarter point does not achieve the required expansion, move the heater back over that portion (without applying heat) and then reheat the rail until the necessary expansion is obtained.

(i) CWR that is below 95°(F) may be expanded by mechanical means with a hydraulic rail stretcher. The expansion induced by strain is introduced uniformly from one end of the string to the other end. In the event any quarter point does not achieve the required expansion, vibrate the rail to ensure it can move freely.

(j) As adjusting is progressed, a minimum of four ties should be boxed or have rail fasteners applied per 39' of rail to prevent the rail from losing adjustment.

§119.7(M) Maintaining the Desired Neutral Temperature of CWR

(a) It is important to maintain the desired neutral temperature of CWR so that the track remains stable.

(b) When performing maintenance or out-of-face work it is important to recognize activities that may or may not significantly change the neutral temperature of CWR.

§119.8(M) Replacement of Defective Rails or Welds
Defective rails or welds shall be removed and classified in accordance with Part II, §113.3.1(M).

§121.0(M) Rail Joints

§121.1(M) Field Welding of Rail Joints

(a) The goal of the Engineering Department is to reduce the quantity of joints in track by laying CWR and field welding joints wherever possible.

(b) Thermite and flash butt are acceptable methods for intrack field welding.

(c) Thermite welding shall be performed in accordance with the manufacturer's recommended procedure.

(d) When it is necessary to install plug rails, the plug rails should be at least 18' in length.

(e) Bonded insulated joint rail assemblies shall be field welded.

(f) Whenever possible it is desirable to field weld all new turnouts and special trackwork.

(g) For a concrete tie turnout or crossover, it is required to field weld all joints.

(h) If it becomes necessary to apply temporary joint bars, the end bolt hole in each rail must not be drilled as this would prevent subsequent field welding. Additional rail anchors must be applied to this joint in accordance with Part II, §125.1(M).

(i) Field welding on open deck bridges is permitted provided that proper precaution against fire is taken.

(j) Wherever possible, field welds shall be located:

(1) At least 14' away from a field weld in the same rail.

(2) At least 4' from a plant weld in the same rail.

(3) At least 7'-9" (the short leg on a 19'-6" staggered bonded insulated joint) from a bonded insulated joint unless field conditions mandate a shorter distance.

(k) The rail should be installed to ensure placement of the weld in the center of the crib. If a weld cannot be made at the center of a crib, the weld may be located at a minimum of 4" from the nearest tie plate or rail seat. If the above conditions cannot be met, ties shall be respaced.
(l) Field welds will not be made within 6" of a bolt hole.

§121.2(M) Bolted Rail Joints

(a) Rail ends shall be fastened together by bolted standard, compromise, insulated or glued joints.

(b) The use of shims or spring washers between the web of the rail and the joint bar to align the gage sides of rail heads is prohibited.

(c) The use of acetylene torches or grinding to manufacture or change the dimensions of compromise joint bars is prohibited.

(d) Compromise joint bars of an approved design shall be used to join rails of the respective sections.

(e) Where a straight bar is used to join 115RE to 119RE sections, care must be used to avoid rail end mismatch. Refer to limits given in the table in Part II, §115(M).

(f) Compromise joints are specified as left or right hand as shown in the following diagram. To determine where a left hand ("LH") or right hand ("RH") lays, stand in the center of the track and face the joint to be compromised.

(g) If rail end mismatch exists after applying approved joint bars, the rail head and gage face surfaces may be adjusted by electric arc welding the smaller rail and grinding to finish the weld.

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

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

(j) In main line track construction with conventional jointed rail, each rail must be bolted with at least two bolts in each rail, or with all joint bar bolt holes filled.
(k) If a permanent joint connection is made between CWR and bolted rail, all joint bar holes must be filled.

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

(m) No rail or joint bar having a torch cut or burned bolt hole may be used in track.

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

(o) When a bolt is changed in a joint in track Classes 1-5 or a frog bolt is changed, then all bolts in the connections shall be checked and retightened as required.

(p) Whenever possible, new bolts, nuts and spring washers should be used when new or fit joint bars are applied.

(q) Tighten all bolts, working from center of joint bars outward. During this final tightening, drive the toes of the bars inward by tapping with a sledgehammer.

(r) In locations of elastic fasteners, the appropriate clip will be used (i.e., "j" clip, modified "e" clip, "c" clip) to properly fasten the ties through the joint area.

§121.3(M) Insulated Rail Joints

(a) **Position**
For new work or rail renewals in track circuit territory, insulated joints shall be located as follows:

(1) Insulated joints shall not be staggered if possible.

(2) To provide for effective electric locking, insulated joints, as prescribed in paragraph (1) above, shall be located with respect to signals as follows:

(i) No insulated joint shall be placed less than 0" nor more than 60" in advance of a signal, except that where there are opposing signals at the same location, the insulated joints shall be placed as near an equal distance (between) opposing signals as practicable.

(3) Insulated rail joints in turnouts and crossovers and at highway grade crossings shall be located in accordance with the applicable Signal Standard Plans.
(4) Insulated rail joints located in accordance with former railroad specifications need not be relocated until rail is renewed.

(b) **Application of Armored Insulated Joints (Paper Joint)**

(1) An insulated joint should not be applied to rails with battered or rough cut edges as they will damage insulating fibers. Such edges that come in contact with the insulated parts of the joint, i.e., under the rail head, web and top and bottom of the rail base should be rounded to approximately 1/8" radius by grinding or filing.

(2) Rails should be spaced so that the ends will bear firmly against the insulated end post to avoid damage to bolts and insulated bushings. If the opening between rail ends is too small, the rail ends should be forced apart with an approved rail expander. The end posts should not project above or beyond rail heads. Use of a wedge is not permitted.

(3) Ties under 24" or 36" armored type insulating joint should be spaced and tamped to provide uniform support.

(4) Abrasion plates must be used under insulating joints.

(5) Before insulated joints are applied, the parts of the rails to be covered by the insulated joint should be thoroughly cleaned to remove all rust, scale and thoroughly cleaned.

(c) **Application of Bonded Insulated Joints (Glued Insulated Joints)**

(1) All bonded insulated joints are to be installed as suspended joints.

(2) Conventional rail joints adjacent to bonded insulated joint rails should be field welded.

(3) Double shoulder tie plates or elastic fastener tie plates should be used on the two wood crossties supporting suspended bonded insulating joints.

(4) Rail holding spike heads must be in reverse position and must be carefully driven to ensure that spike head is not in contact with the bar, which could result in the joint's being short circuited. All bonded insulating joints will have plate holding spikes installed. An approved type fastener shall be used where insulated joints are installed in concrete crosstie track.

(5) Joints installed with elastic fasteners shall have the correct clips (modified "e" clips) applied to prevent possible damage to the joint.

(6) No attempt should be made to tighten bolts in bonded insulated joints. In the event the bolts in the joint become loose, the joint should be replaced.

(7) Any rail head overflow at a bonded insulated joint is to be removed by grinding. Extreme care must be exercised to ensure that the end post is not damaged. The overflow should be ground only to the rail end, so that the joint gap will not be greater than the original gap.

(8) The bonded insulated joints will be considered as welded rail for purposes of compliance with the anchoring requirements of Part II, §125.1(M).

(d) **Application of Polyurethane Coated Steel Insulated Joints (Poly Joints)**

(1) Polyurethane-coated steel insulated joints may be used permanently in track where the use of a bonded insulated jointed rail is not practical.

(2) Whenever possible, polyurethane-coated steel insulated joints are to be installed as suspended joints.

(3) The top of the polyurethane-coated steel must be set first into the fillet area of the rail. Bolts should be applied and tightened from the center out to the end of the bar.

(4) Rail holding spikes shall be reversed and not driven up against the polyurethane coated steel.

§123.0(M) Tie Plates
(a) Tie plates shall be installed under running rails on all wood crossties, switch timber and bridge timber.
(b) Tie plates with different cants and flat plates shall not be mixed.
(c) Canted tie plates shall be installed so that the rail cants towards the centerline of track.

(d) Tie plates must be placed square to the base of the rail and no portion or part of the shoulder can be under the base of the rail.

(e) No metal object that causes a concentrated load by solely supporting a rail shall be allowed between the base of the rail and the bearing surface of the tie plate. Examples include tie plate shoulders, spikes, etc.

§124.0(M) Tie Pads (Wood and Concrete Ties)
(a) The use of tie pads, under the tie plates on open deck bridges, may be used only with the approval of the Director of Track & Structures.

(b) Elastomeric tie pads shall be used on concrete ties. There are several designs such as those used with the "e" clip and "5-1/2" and 6" fast" clip assemblies.

§125.0(M) Rail Anchors/Fasteners

§125.1(M) Fasteners Required

(a) Insufficient anchors may result in improper distribution of expansion allowance, stresses in CWR, and movement of rail resulting in distortion of line and surface, which could create a hazardous condition.

(b) A sufficient number of anchors must be applied to effectively control longitudinal rail movement.

(c) Additional anchors must be applied when there is evidence that rails are moving longitudinally under traffic.

(d) See next pictures for typical fastening and anchoring systems on MNR.

(e) It should be recognized that when track is raised out-of-face, the resistance to creepage is reduced and additional anchors may be required to avoid undue rail movement.

(f) Every other tie shall be box anchored in all CWR tracks.

(g) All jointed rail tracks require a minimum of twelve (12) anchors per 39' rail and be boxed on six (6) ties.

(h) A fully clipped wood tie, bridge timber or fully clipped and insulated concrete tie is considered equivalent to a box anchored wood tie.

(i) On main tracks the number of anchors to be applied when CWR is laid and maintained is as follows:

(1) When using conventional fasteners, box anchor every wood tie 200' in each direction from:

(i) Ends of CWR strings.

(ii) Joints.

(iii) Turnouts, crossovers and other special trackwork.

(iv) Rail track crossings.

(v) Public and private highway grade crossings.

(vi) Additional anchors may be added if longitudinal movement of the rail is detected.

(vii) Transitions to locations with elastic fasteners.

(viii) Open decks on bridges, where the timber are hooked and blocked in accordance with Part II, §119.1(M).

(2) To the extent practical, fully box anchor all CWR within switch, turnout and crossover areas.

(j) Rail anchoring systems shall be used on open deck bridges, trestles and viaducts, except when the deck does not meet the requirements of Part II, §119.1(M), or their use is prohibited by the Director of Track & Structures

§125.2(M) Anchor Placement
Rail anchors shall be applied as follows:

(a) Anchors shall be applied at both ends and on the same side of the tie. Where special applications may be necessary, other spacing may be used with permission of the Assistant Director of Track. Wherever practicable, rail anchors shall be applied from the gage side of the rail.

(b) When adjusting or laying rail, the necessary anchors shall be applied immediately after the rail is adjusted.

(c) Anchors should be tightly applied against sound ties.

(d) When ties at a joint cannot be anchored because of interference with a joint bar, there shall be no anchors applied to the affected joint.

(e) In conventional turnouts, drive on type anchors shall be applied to switch stock rails from the field side of the track. Care must be taken in application of anchors so as not to foul switch rods or damage rails.

§125.3(M) Maintenance
(a) Rail anchors must have full bearing against the tie or tie plate when applied.

(b) In order to avoid damage, only proper tools or machines should be used in applying and removing rail anchors. Anchors should not be driven along the base of the rail.

(c) When the bearing of rail anchors against the tie is disturbed by renewing or re-spacing ties or moving rail, the anchors must be taken off and then reapplied in proper position. All anchors removed must be reapplied replacing any broken or defective anchors and adding additional anchors, as necessary.

(d) Proper opening between rail ends is maintained by the use of adequate rail anchors.

§125.4(M) Use

New or fit rail anchors may be used at any location on MNR as long as they perform as intended.

§127.0(M) Rail Fastening Systems

§127.1(M) Number Required

(a) The requirements of Part I, §213.127 must be satisfied as to minimum number and location of effective track fasteners.

(b) Additional fasteners may be used where they are needed to hold gage and/or restrain the movement (both longitudinal and lateral) of rail.

§127.2(M) Installation of Fasteners

(a) All elastic fasteners shall be inserted or removed from the cast-in-place shoulder (concrete tie) or tie plate (wood tie) with an approved device such as a sledgehammer. The use of a spike maul is prohibited.

(b) Elastic fasteners should not be overdriven as overdriving will cause premature relaxation of the fastener.

(c) Fasteners that have been overdriven or are not performing their intended function of limiting the vertical and longitudinal movement of the rail shall be replaced.

(d) In the case of an “e” clip, a distance of 3/8" (approximate width of a wooden pencil) between the shoulder and the face of the clip is required to prevent overdriving.

(e) In the case of the “fast” clip, the clip shall be driven or inserted until the clip is engaged in the shoulder notch.

(f) When applying clips with a sledgehammer, the clip must be gently tapped to ensure proper insertion before the clip is fully seated. When removing clips with a sledgehammer, secure clip with foot and gently tap clip to remove the toe load to ensure safe removal of the clip.

(g) When installing clips the tie must be flush with the base of the rail before driving the clip so as not to damage the clip. The clip is not to be used to pull the tie up to the base of the rail.

(h) Striking a concrete tie to make adjustments in the alignment of the tie with any type device is prohibited.

(i) 15/16" diameter lag screws shall be used to secure elastic fastener plates (1" diameter holes) with elastic fasteners to wood ties and timber. Lag screws must be screwed into a 11/16" diameter, pre-drilled hole, 6" deep. Driving of lag screws with a sledgehammer or spike maul is prohibited.

(j) All spikes (cut spikes) shall be driven with the head pointed toward the rail, except that spikes driven against the sides of insulated joints, shall be driven with the head pointing away from the rail and not in solid contact with the joint bars.

(k) Spikes should not be driven at ends of insulated joints in any manner that would cause the insulated joint bar to become electrically connected to the rail.

(l) Spikes must be started vertically and squarely and driven straight. The shank of rail holding spikes must have full bearing against the base of rail. Do not overdrive spikes

(m) The use of lock spikes (hair pins) are prohibited.

(n) Care must be taken not to strike the rail, its fastenings or signal and electric traction appliances when driving spikes.

(o) Spikes in main tracks, that have a cut throat or are deteriorated due to rust, should be replaced.

(p) All old spikes, when pulled, shall be picked up and scrapped.

(q) Track spikes shall not be driven into round plate holes.

(r) On all open deck bridge structures, when the head of the track spike is broken off, the replacement spike should be inserted in a new location, leaving the spike stub in the tie. The stub shall be driven below the bottom of the plate.

(s) All spike holes shall be plugged with wood plugs.

§127.3(M) Rail Fasteners Required

(a) Track shall be fastened by a system of components that effectively maintains gage within the limits prescribed in Part I, §213.53.

(b) When spikes and elastic fasteners are used, unless otherwise ordered by the Director of Track & Structures, each rail shall be fastened to every tie in the following manner:

Conventional Tie Plates	**Rail Holding Spikes**	**Plate Holding Spikes**
Tangent	2(1)	1
Curves 2° and over and curved leads on all turnouts and crossovers	2 (1 field side; 1 gage side)(1)	2 (1 field side; 1 gage side)(1)
Elastic Fastener Tie Plates (e.g. Pandrol, Norfast)(3)	Elastic Fasteners (Clips)	Lag Screws
Tangent	2 Clips	2 (1 field side; 1 gage side)(2)
All Curves	2 Clips	4 (2 field side; 2 gage side)
(1) Spikes should be applied diagonally on opposite sides of the rail. (2) Apply diagonally on opposite side of clip. (3) Lock spikes (hairpins) are not to be used.		

(c) Each concrete crosstie must have four elastic fasteners, four insulators and two tie pads.

(d) Each wood or concrete tie must have four elastic fasteners and meet the requirements of Part I, §213.127.

§2.3 Installing Rail Plugs in CWR Territory

When it is necessary to install rail plugs in CWR territory, a hydraulic expander or approved heating device must be used to ensure the amount of rail installed is equal to or less than the length of rail removed. When installing plugs, the rail and joints shall be anchored in accordance with §125.0(MW-4) before returning the track to MAS. The Foreman in charge must accurately complete the information required in Section III of this procedure under Report A, Part B (Rail Cut in CWR Territory). If the requirements of this section cannot be met, the Foreman must report the reasons for non-compliance to his supervisor and the local track supervisor. In addition, the Foreman must place a 40 MPH speed restriction on the affected portion of track until corrected.

§2.4 Field Welding Without Rail Plug Installation

When field welding CWR that has been temperature adjusted and whose rail temperature is less than the neutral temperature, the necessary gaps for each weld will not be developed by allowing the rail to contract. It is critical that no additional rail is added.

§2.5 Undercutting: Out-of-Face Surfacing and Lining, Out-of-Face Tie Renewal

The above operations will be performed at rail temperatures greater than 30°F. To perform work at rail temperatures less than 30°F, written approval must be obtained from the Assistant Vice President - Maintenance of Way. This approval will specify track number, milepost, location, and protective action.

§2.6 Panel Turnout or Panel Track Installation in CWR Territory

(a) The installation of panelized track in CWR territory must be done in accordance with Part II, §119.0(M)(MW-4). It is essential that the amount of track removed is exactly the same length as the panel being installed. Any adjustments required must be to the CWR string on either side of the panel being installed.

(b) The Foreman in charge must accurately complete the information required in Section III of this procedure under Report A, Part B (Rail Cut in CWR Territory). If the requirements of this section cannot be met, the Foreman must report the reasons for non-compliance to his supervisor and the local track supervisor.

§2.7 Cut and Throw of Track

When CWR is cut and thrown at rail temperature less than 95ºF, it will be considered to have lost its temperature adjustment and will have to be adjusted in accordance with Part II, §119.0(MW4).

§2.8 Curve Realignment (Out-of-Face)

(a) When a curve is realigned out-of-face (shifting a curve consistently in one direction at all throw points) it will be considered to have lost its temperature adjustment when it exceeds the limits shown in the chart below. The foreman will protect the track with a speed restriction of 40 MPH or less until the curve is readjusted in accordance with Part II, §119.0(MW4). The foreman will indicate the total track movement on Report B.

Curves Under 2º	more than 3" to the outside. more than 1-1/2" to the inside.
Curves 2º and Over	more than 1-1/2" to the outside. more than 1-1/2" to the inside.

(b) The normal balancing of throws performed during high speed surfacing operations does not constitute out-of-face curve realignment.

§2.9 CWR Joint Installation and Maintenance Procedures

(a) CWR joint installation and maintenance procedures which require that-

(1) Each rail shall be bolted with at least two bolts at each CWR joint;

(2) In the case of a bolted joint installed during CWR installation the track owner shall either, within 60 days-

(i) Weld the joint;

(ii) Install a joint with six bolts; or

(iii) Anchor every tie 200 feet in both directions from the joint.

(3) In the case of a bolted joint in CWR experiencing service failure or a failed bar with a rail gap present, the track owner shall either-

(i) Weld the joint;

(ii) Replace the broken bar (s), replace the broken bolts, adjust the anchors and, within 30 days weld the joint ;

(iii) Replace the broken bar (s), replace the broken bolts, install one additional bolt per rail end, and adjust anchors;

(iv) Replace the broken bar (s), replace the broken bolts, and anchor every tie 200 feet in both directions from the CWR joints: or

(v) Replace the broken bar (s), replace the broken bolts, add rail with provisions for later adjustment and reapply the anchors.

(4) Joint Fracture Report

(i) As part of the daily FRA Track Inspections, all qualified Track Patrol Inspectors are to inspect all CWR joints for cracked or broken bars. If a broken or cracked bar is identified the CWR Joint Bar Fracture Report (see Section V) must be filled out.

(ii) All information must be completed and sent to the Track Supervisor’s Office within 24 hours of inspection.

SECTION III. RECORD OF DISTURBANCE IN CWR TERRITORY - PURPOSE

§3.1 General

The purpose of this section is to maintain a record of any disturbance of track in CWR territory that can cause a downward shift in the neutral temperature of continuous welded rail. This downward shift of neutral temperature can occur when any of the following operations are conducted below the established neutral temperature:

1. Undercutting
2. Out-of-face tie replacement
3. Out-of-face surfacing
4. Field welding
5. Rail replacement
6. Anchor removal or clip removal (more than eight ties per 39' section of rail)
7. Cribbing operations (in excess of eight cribs per 39' section of rail)
8. Panel track installation
9. Panel turnout installation
10. Cutting and throwing of track

§3.2 Report of Track Disturbance (Report A)

When any of the above operations are performed, a "Record of Disturbance of Main CWR Track" (Report A) will be made by the Foreman in charge. Part A of this form will be completed for all work listed above. Part B will be completed whenever CWR track is cut or broken for any reason. The Record of Disturbance of Main CWR Track with instructions is attached to this procedure as Report A (see Section V). When this report is completed by the Foreman, one copy shall be forwarded to the Supervisor of Track, Assistant Director of Track Coordination and one copy shall be retained by the Foreman.

§3.3 Report of Track Movement Due To Surfacing and Lining (Report B)

For track receiving out-of-face surfacing and lining, a "Report of Track Movement Due To Surfacing" will be made for each curve worked. The Foreman or Designated Qualified Employee and Track Supervisor on whose territory the work is being performed will complete this report. The Report of Track Movement Due To Surfacing form with instructions is attached to this procedure as Report B (see Section V). When this report is completed, one copy will be forwarded to the Assistant Director of Track Coordination and Track Supervisor and one copy will be retained by the Foreman.

§3.4 Responsibility of Compliance

It will be the responsibility of the Asst. Director of Track to see that this policy is adhered to in his territory and that corrective action is scheduled and executed when required. It will be the responsibility of the Deputy Director-Track Maintenance to ensure compliance with this procedure over the Metro-North properties.

§3.5 Instructions for Thermal Buckling Counter-measures Thermal Log for Rail Expansion (Report C)

(a) Report C (see Section V) will be filled out every time rail is expanded to increase the neutral temperature.

(b) The Supervisor or Foreman in charge will retain a copy of the report and make the appropriate distribution of Report C to the local Supervisor and Director T&S.

SECTION IV. PROTECTIVE AND CORRECTIVE ACTION

§4.1 Spring and Fall Track Inspections

(a) In the Spring, between March 1 and April 30, a visual inspection of all main track will be conducted. Assistant Director of Track in the company of the Track Supervisor or Assistant Track Supervisor will make this inspection. The inspection will concentrate on compliance with standards in the following areas:

1. Anchor Pattern
2. Anchor Position
3. Ballast Section
4. Evidence of longitudinal and lateral rail movement, particularly at fixed locations, such as turnouts and grade crossings (high-compressive forces)
5. Fasteners
6. Drainage and Roadbed Stability

(b) In the Fall, between September 1 and October 30, a visual inspection of all main track will be conducted. Asst. Director of Track in the company of the Track Supervisor or Assistant Track Supervisor will make this inspection. The inspection will concentrate on compliance with instructions in the following areas:

1. Winterization Needs
2. Fasteners
3. Drainage and Roadbed Stability
4. Anchor Pattern
5. Anchor Position
6. Ballast Section
7. Evidence of longitudinal and lateral rail movement, particularly at fixed locations, such as turnouts and grade crossings (high-tensile forces)

(c) A speed restriction of 40 MPH or less will be placed where there is insufficient ballast to provide a stable track.

(d) The Track Supervisor will, upon completion of the inspection, submit to the Deputy Director Track – Maintenance, a MW-49 Daily Track Inspection Report.

§4.2 Special Inspection In Extreme Weather Conditions

(a) When the air temperature is 95ºF or above, all main tracks will be inspected by qualified Track Inspectors (§213.7). The Track Inspector will make out a MW-49 Daily Track Inspection Report for this inspection and submit it to the Supervisor of Track. During this inspection, the Track Inspector must be particularly alert for wavy track, longitudinal rail movement, kinked joints in compression and evidence of lateral track movement. The inspector must also be aware that the following conditions increase the possibility of buckling:

1. Recently worked track (track worked within 7 days)
2. Mud spots
3. Existing deviations in line and surface
4. Fixed facilities (i.e., turnouts, road crossings, bridges, etc.)
5. Sub-standard ballast section
6. Sub-standard anchor pattern
7. Missing clips on concrete tie track; if both clips are missing on each side of a rail on one tie at a rate of more than four ties per 39' of rail.

(b) If any track is identified as having any conditions that indicate the possibility of buckling, immediate protective action must be taken in the form of a slow order not exceeding 25 miles per hour. or, depending on severity, removal from service.

(c) When air temperature is -5 degrees F. or below all main tracks will be inspected by qualified Track Inspectors

§4.3 Joint Inspections

(a) All joints in CWR territory shall be visually inspected on foot to detect cracks and other indications of potential joint failure. Joints imbedded in Highway Crossings, or otherwise imbedded, must have all material removed from both sides to allow for the inspections listed in this section to be performed. Specific joint inspection reference can be made to the MW-4 sections 213.109 (e) Crossties,213.115 Rail End Mismatch, 213.117 Rail End Batter, 213.121 Rail Joints, 121.2 (M) Bolted Rail Joints and 121.3 (M) Insulated Rail Joints. General conditions to inspect for include, but are not limited to, the following:

(1) Joint bars with visible or otherwise detectable cracks:

Cracks can progress at an unpredictable rate, leading to the eventual failure of the joint bar and possible misalignment of the rails.This misalignment has the potential for damage to the rails or a derailment.

(2) Loose, bent, or missing joint bolts:

Bolts are used to keep the joint bars firmly attached to the rails. Where bolts are missing, loose, or bent, they will fail to keep the joint bars firmly in contact with the rails. The rails are then liable to pull apart when cold weather causes high-tension forces in the adjoining rails. This will cause the bolts to bend. When the bolts bend beyond their elastic limit, they lose their design tension, and are no longer capable of holding the joint bars firmly against the rail. The loose bars then allow the rails to move in relation to each other under the weight of passing wheels, causing increased impact loads on the joint and battering of the adjoining rail ends. This can lead to cracks and eventually fracture of the joint bars or rail ends.

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

Rail end batter refers to the displacement of the rail steel in the tread at the end of the rail. Rail end batter occurs when wheels pass over a joint and (1) the rails are pulled apart to the extent that the wheels can drop slightly into the gap, and / or (2) the rail ends are mismatched. Rail ends can be mismatched because joint bolts are loose or because the rails do not match when installed. Excessive rail end batter causes high impact forces on all components of the joint; and can cause the joint bar or the rail to fail. Also, vibrations at a battered joint can cause loss of consolidation of the ballast at the joint, leaving the joint vulnerable to thermal buckling (heat kink) when high compressive forces are generated in the rails.

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

Longitudinal rail movement is evidence that the rails might not be securely anchored, that excessive tension forces are developing in the rail when it is cold, or that the bolts have lost their ability to properly support the bars (paragraph 2). As wheels pass over and drop into the gap, there are high impact forces on the joint. This can have the same consequences as described above for rail end batter. These tension forces, combined with additional impact loads, have a tendency to cause cracks and subsequent failure of the joint bars and rail.

(5) Missing or broken elastic rail fasteners:

Elastic rail fasteners are critical components of the track structure in that they restrain the movement of rail in both longitudinal and lateral direction.

(b) Specific joint inspections in Track Classes 2, 3, and 4 shall be conducted by a person qualified under 213.7 every 6 months, and Track Class 5 shall be done every 4 months. The inspection interval shall not exceed 180 days between inspections for Track Classes 2, 3, and 4 and 120 days for Track Class 5. The inspections shall be conducted in April and October of each year for Track Classes 2,3, and 4 and in April, August and December for Track Class 5.

§4.4 Protective Slow Ordering of Track - General

(a) An employee designated under the provisions of §213.7 of the FRA Track Safety Standards must ensure that track conditions meet the minimum requirements of the slow order speed applied.

(b) Track treated with a dynamic track stabilizer must have both vibration units fully operational and frequency of oscillation shall be in the range of 30-35 Hz, with a minimum vertical loading pressure of 60 bar (870 psi) and working speed shall be in the range of 0.6 to 1.3 kM/h (1.0-2.1 MPH).

§4.5 Protective Slow Order after Surfacing or Lining

(a) Out-Of-Face Surfacing or Lining (greater than 200')

(1) Track must be inspected by the supervisor of the operation prior to returning track for service.

(2) The first train will operate over the work area not to exceed 40 MPH.

(3) Following steps (1) and (2), track will be restricted as follows:

(i) 40 MPH speed restriction for a 72-hour period for track not worked with a dynamic track stabilizer.

(ii) MAS for track worked with a dynamic track stabilizer.

(4) After (a)(1) above, and re-inspection of the work area by an employee qualified under §213.7, the track may be returned to MAS.

(b) Spot surfacing, smoothing or lining operations (200' or less) will be protected as follows:

(1) Up to 40' of work, no slow order is required.

(2) 41' to 200' - 40 MPH slow order for 72 hours (Track Classes 3-9). A designated qualified employee will make a ground inspection of the work area prior to returning the track to scheduled speed to determine that no deficiencies exist in the track structure that will prevent the safe passage of trains at scheduled speed (i.e., full ballast section, proper anchoring, etc.).

§4.6 Protective Slow Order After Out-Of-Face Tie Renewal, Undercutting, TLM Operation, Switch & Track Panel Renewal - Installation

(a) A 30 MPH protective slow order will be applied until the affected track is surfaced.

(b) After the above criteria has been satisfied and the work area has been re-inspected by a designated qualified employee, the track may be returned to MAS.

§4.7 Protective Slow Order After Spot Tie Renewal

Replacing up to four ties in 39' of track where there are at least four adjacent ties on each side of the tie to be placed, no protection is required.

§4.8 Out-of-Face Shoulder Ballast Cleaning

(a) With full restoration of the standard ballast section and when the air temperature is not expected to exceed 95ºF, the track may be returned to scheduled speed.

(b) If the air temperature exceeds 95ºF, the track will be protected as follows:

(1) Concrete Tie Track: 80 MPH during the period the temperature exceeds 95ºF until 24 hours elapses.

(2) Wood Tie track: 60 MPH during the period the temperature exceeds 95ºF until 24 hours elapses.

§4.9 Protective Slow Order After Spot Undercutting

(a) When spot undercutting one tie where there are at least four adjacent undisturbed ties on each side of the tie to be undercut (four or less undercut in 39' of track), no protection is required.

(b) For additional spot undercutting, protect as in §4.7.

§4.10 General Speed Restrictions and Suspension of Work

(a) When air temperatures are 95ºF or above, a general speed restriction of 80 MPH will be placed over the affected territory for the period that the air temperature is 95ºF or above. The restriction will be placed and removed by the Assistant Vice President - Maintenance of Way or his representative, specifying the affected territory.

(b) In addition, the following work will be suspended when air temperatures are expected to be 95ºF or above during a 24-hour period:

(1) Out-of-face surfacing or lining (except for working on concrete tie track treated with the dynamic track stabilizer)

(2) In Track Classes 1-5, spot surfacing or lining (from 11:00 am to 8:00 pm)

(3) Out-of-face tie renewal and undercutting (except under a continuous track outage)

§4.11 Working Under a Continuous Track Outage

When undercutting, renewing ties out-of-face, and other work that disturbs the ballast is in progress under a continuous track outage, and it is expected that the air temperature will be 95ºF or above at the time track is returned to service, the 60 MPH speed restriction will remain in effect until the air temperature drops below 95ºF.

SECTION V. REPORTS

REPORT A

INSTRUCTIONS FOR PREPARATION OF THE REPORT OF DISTURBED TRACK

This report of disturbed track will be made out as required by Section II of the Policy on Track Buckling Countermeasures. The report will be completed by the Foreman in charge of the work as follows:

Part A - This part will be completed in its entirety any time track is worked.

Part B - This part will be completed any time main track CWR is cut or broken for any reason. The distance over which rail movement occurred (distance between the cut or break and the mark on the rail and tie plate showing no movement) will be measured as follows:

1. Prior to cutting the rail or removing bolts from a joint and using marking crayon, make a mark on the base of the rail and tie plate. These marks will be made on every twentieth tie for 200' in each direction.
2. After the rail is cut or the joint is broken, inspect the marks and identify the last mark showing movement in each direction from the work.
3. Measure the total distance between the marks identified in No. 2 above and record on the form.
4. In the event of a rail weld or joint service failure, the movement must be estimated by inspecting in each direction for anchor movement. After identifying the last anchors showing movement, measure and record the distance between the cut or the break and the location of no anchor movement.

REPORT A
RECORD OF DISTURBANCE OF MAIN
CWR TRACK

PART A:

Division ____________________Date: _____________

M.P. Location _______to _________Track No. _________

Type Work Executed: ______________________________

Rail Temperature:

Temp: _________Time: _________
Temp: _________Time: _________
Temp: _________Time: _________

Anchoring Pattern in Accord. With MW-4: (Yes/No)

If NO, explain _____________________________________

____

____

Ballast Section Per Standard Plan: (Yes/No)

If NO, explain _____________________________________

____

____

PART B: Rail Cut in CWR Territory

Rail: _________________________(No/So/East/West)

Amount of Rail Removed: ___________________________

Amount of Rail Installed: ____________________________

Direction of Rail Movement Occurred: _________________

Length of Rail Movement: ___________________________

Remarks: ____

____

____
Foreman (PRINT)

____
Foreman (SIGNATURE)

1 copy to Supervisor

1 copy to Director of Track & Structures

REPORT B

INSTRUCTIONS FOR PREPARATION OF REPORT OF TRACK MOVEMENT DUE TO SURFACING OR LINING OF CURVES

This report must always be filled out. Field measurements between 7 and 10 days are only required to be taken when the rail temperature is below 40ºF during surfacing operations.

Prior to the start of out-of-face surfacing and lining in a block, the Foreman or Designated Qualified Employee will set a minimum of three reference points in the full body of each curve. The Forman or Designated Qualified Employee will measure and record the distance from the reference points. When placing reference points special attention should be give to areas of greatest track movement/ disturbance. As a minimum, points to be staked are the tangent to spiral (TS), spiral to curve (SC), curve to spiral (CS), spiral to tangent (ST) and any point of compound curve (PCC). In no case may the points be more than 200' apart. These points will be set out of the way of regulators or other equipment. A reference point on the adjacent track (if the track will not be disturbed), a cat pole foundation, or a stake may be used.

Immediately after surfacing, the Foreman or Designated Qualified Employee will measure and record the distance from the reference points.

The first train over the work area will not exceed 40 MPH.

Between 24 and 72 hours, the Foreman or Designated Qualified Employee will again measure and record the distances from the reference point.

Between 7 and 10 days, the Foreman or Designated Qualified Employee will again measure and record the distances from the reference point.

After the curve is surfaced, measurements shall be taken to establish the new location of the curve. If uniform movement of more than 3/4" to the inside or outside is detected from the new measurements established after curve was surfaced, the Foreman or Designated Qualified Employee in every case must notify the local Track Supervisor and protect with a 40 MPH slow order until the curve is readjusted in accordance with Part II, §119.0 and other applicable sections of the MW-4.

The Foreman or Designated Qualified Employee should ensure that all the above recorded measurements are cumulative and none exceed the values given on the table in Section II, paragraph 7. If movement in excess of the table limits is detected, the curve will be considered to have lost its temperature adjustment. The Foreman or Designated Qualified Employee will protect the track with a speed restriction of 40 MPH or less until the curve is readjusted in accordance with Part II, §119.0(MW4). The supervisor of operation will indicate the total track movement on Report B.

The Track Supervisor and the Foreman or Designated Qualified Employee will sign Report B.

REPORT B
RECORD OF TRACK MOVEMENT DUE TO SURFACING AND LINING OF CURVES

DIVISION: ______________________________________

DATE WORK DONE: __________GANG NO.: _______

RAIL TEM. AT WHICH SURFACING WAS DONE: ____

M.P. LOCATION: ______________TO: ______________

TRACK #: ____________________CURVE NO.: _______

Point No.	Before Surfacing	Immediately After Surfacing (1)	24 to 72 Hours	7 to 10 Days	Curve Movement in or out
TS					
SC					
CS					
ST					

Foreman (PRINT) __________________________

Foreman (SIGNATURE) __________________________

Track Supervisor (SIGNATURE) ____________________

1 Copy Track Supervisor
1 Copy Director T&S

NOTE:
(1) The measurements taken "immediately after surfacing" are to be used as the reference for measurements taken between 24 and 72 hours. Measurements between 7and 10 days are only required to be taken when the rail temperature is below 40ºF during surfacing operations.

REPORT C

INSTRUCTIONS FOR PREPARATION OF THE THERMAL LOG FOR RAIL EXPANSION IN CONTINUOUS WELDED RAIL (CWR)

This form is to be filled out any time CWR is cut or broken and adjusted in accordance with Part II, §119.

REPORT C
THERMAL LOG FOR RAIL EXPANSION IN CONTINUOUS WELDED RAIL (CWR)

DATE: ________DIVISION: _____________TRACK: ________
FOREMAN: ______________________SUB-DIV: __________
WEATHER: ______________________AIR TEMP: _________
WHICH RAIL: __RAIL WT:__________M.P._______to ________
LENGTH: ______________ACTUAL TEMP:______
DESIRED TEMP: ________

EXPANSION	ACTUAL	CALCULATED
1/4 POINT:		
1/2 POINT:		
3/4 POINT:		
END POINT:		
TOTAL:		

ANCHORING TEMP.

REMARKS: ____

____

____
==
DATE: ________DIVISION: _____________TRACK: ________
FOREMAN: ______________________SUB-DIV: __________
WEATHER: ______________________AIR TEMP: _________

LENGTH: ______________ACTUAL TEMP:________________
DESIRED TEMP: ________

EXPANSION	ACTUAL	CALCULATED
1/4 POINT:		
1/2 POINT:		
3/4 POINT:		
END POINT:		
TOTAL:		

ANCHORING TEMP.

REMARKS: ____

____

____

CWR JOINT BAR FRACTURE REPORT

FRACTURE REPORT INSTRUCTIONS

TYPE OF INSPECTION – Indicate the type of inspection being performed when fracture was found.

LINE – Hudson, Harlem, New Haven, Port Jervis, Danbury, New Canaan or Waterbury

SUBDIVISION – Subdivision number.

MILEPOST – Milepost at the location of the fracture to nearest 1/10 th.

DATE FOUND – Date the fracture is found

ANNUAL MGT – Million Gross Tons (from previous year) for the specific track with the fracture.

TRACK CLASS – FRA Class for track with the fracture.

TANGENT/CURVE/SPIRAL/INNER/OUTER – Indicate whether fracture found on tangent, curve (include degree of curvature) or spiral and if inner or outer rail, if applicable.

RAIL SECTION – Indicate each rail section comprising the joint (e.g. for a standard bar, enter 136/ or for a compromise bar, enter 132/115).

ANNUAL JOINT INSPECTION FREQUENCY – Number of times per year that walking joint bar inspection is performed.

DATE OF LAST JOINT BAR INSPECTION – Date the last walking joint bar inspection was performed.

BAR TYPE/HOLES – Indicate bar type: standard, insulated, or compromise bar and number of holes.

BROKEN THROUGH – For each bar, field and gage, check appropriate box if broken completely through and indicate the location of the break (through center, through inner bolt hole or other location).

CRACKED – For each bar, field and gage, indicate the crack location(s) and corresponding length(s).

GAP BETWEEN RAIL ENDS – Measure and record the distance between the rail ends. If joint is pulled apart or separated, estimate the gap prior to separation.

RAIL END BATTER OR RAMP – Measure and record the ***height and length of the batter or ramp for each rail end*** and record even if found to be zero.

TREAD MISMATCH – Measure and record the tread mismatch.

JOINT VERTICAL MOVEMENT – Record the vertical movement of the rail joint (not track surface) according to 213.13.

GAGE RAMP – In curves only, measure and record the gage ramp distance out and length.

GAGE MISMATCH – In curves only, measure and record the gage mismatch.

JOINT LATERAL MOVEMENT – In curves only, record the lateral movement of the rail joint (not gage) according to 213.13.

OTHER COMMENTS: - Other comments, including any other factors or conditions that may have contributed to the fracture of the bar(s).

Metro-North Railroad

MW 42-12/06

CWR JOINT BAR FRACTURE REPORT

TYPE OF INSPECTION ☐ PERIODIC JOINT INSPECTION ☐ TRACK INSPECTION ☐ TURNOUT INSPECTION	LINE:	SUBDIVISION:		MILEPOST:
	DATE FOUND:	TRACK#	ANNUAL MGT:	TRACK CLASS:

TANGENT ☐	CURVE ☐ DEGREE: ________ LOW RAIL ☐ IN SPIRAL ☐ HIGH RAIL ☐	RAIL SECTION(S): ________/________

ANNUAL JOINT INSPECTION FREQUENCY FOR THIS SEGMENT: 2X ☐ 3X ☐ OTHER:	DATE OF LAST INSPECTION:

BAR TYPE	STANDARD JOINT ☐	INSULATED JOINT ☐	COMPROMISE JOINT ☐
(CHECK ALL THAT APPLY)	NUMBER OF HOLES: 4 ☐	5 ☐	6 ☐

FIELD SIDE BAR	**GAGE SIDE BAR**
BROKEN THROUGH CHECK LOCATION OF BREAK: CENTER ☐ INNER BOLT HOLE ☐ OTHER ☐	BROKEN THROUGH CHECK LOCATION OF BREAK: CENTER ☐ INNER BOLT HOLE ☐ OTHER ☐
CRACKED CHECK LOCATION(S) AND RECORD LENGTH(S): TOP CENTER ☐ ________ INCHES BOTTOM CENTER ☐ ________ INCHES INNER BOLT HOLE ☐ ________ INCHES OTHER BOLT HOLE ☐ ________ INCHES OTHER ☐ ________ INCHES	CRACKED CHECK LOCATION(S) AND RECORD LENGTH(S): TOP CENTER ☐ ________ INCHES BOTTOM CENTER ☐ ________ INCHES INNER BOLT HOLE ☐ ________ INCHES OTHER BOLT HOLE ☐ ________ INCHES OTHER ☐ ________ INCHES

GAP BETWEEN RAIL ENDS ________ INCHES

RAIL END BATTER OR RAMP

NORTH OR ☐ EAST RAIL END ☐ ________ INCHES HIGH ________ INCHES LONG

SOUTH OR ☐ WEST RAIL END ☐ ________ INCHES HIGH ________ INCHES LONG

TREAD MISMATCH ________ INCHES

JOINT VERTICAL MOVEMENT ________ INCHES

IF JOINT IS IN CURVE OR SPIRAL:

GAGE RAMP ________ INCHES OUT ________ INCHES LONG

GAGE MISMATCH ________ INCHES

JOINT LATERAL MOVEMENT ________ INCHES

OTHER COMMENTS: ________________________________

SECTION VI.
EXPANSION TABLE FOR CWR

Change in Rail Length Due to Change in Rail Temperature

C= Change in Length in Inches = 0.000078LT

L= Length of Rail in Feet

T =Change in Temperature in Degrees Fahrenheit

Length of Rail (ft)	Change in Temperature in Degrees Fahrenheit															
	5	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**
	Change in Rail Length in Inches															
100	1/8	1/8	1/8	1/4	1/4	1/4	3/8	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	5/8
150	1/8	1/8	1/4	1/4	3/8	3/8	1/2	1/2	5/8	5/8	3/4	3/4	7/8	7/8	1	1
200	1/8	1/4	1/4	3/8	1/2	1/2	5/8	5/8	3/4	7/8	7/8	1	1 1/8	1 1/8	1 1/4	1 1/4
250	1/8	1/4	3/8	1/2	1/2	5/8	3/4	7/8	1	1	1 1/8	1 1/4	1 3/8	1 3/8	1 1/2	1 5/8
300	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	1 7/8
350	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4
400	1/4	3/8	1/2	5/8	7/8	1	1 1/8	1 1/4	1 1/2	1 5/8	1 3/4	1 7/8	2 1/8	2 1/4	2 3/8	2 1/2
450	1/4	3/8	5/8	3/4	1	1 1/8	1 1/4	1 1/2	1 5/8	1 7/8	2	2 1/8	2 3/8	2 1/2	2 3/4	2 7/8
500	1/4	1/2	5/8	7/8	1	1 1/4	1 3/8	1 5/8	1 7/8	2	2 1/4	2 3/8	2 5/8	2 3/4	3	3 1/8
600	1/4	1/2	3/4	1	1 1/4	1 1/2	1 3/4	1 7/8	2 1/8	2 3/8	2 5/8	2 7/8	3 1/8	3 3/8	3 5/8	3 3/4
700	3/8	5/8	7/8	1 1/8	1 3/8	1 3/4	2	2 1/4	2 1/2	2 3/4	3 1/8	3 3/8	3 5/8	3 7/8	4 1/8	4 3/8
800	3/8	5/8	1	1 1/4	1 5/8	1 7/8	2 1/4	2 1/2	2 7/8	3 1/8	3 1/2	3 3/4	4 1/8	4 3/8	4 3/4	5
900	3/8	3/4	1 1/8	1 1/2	1 7/8	2 1/8	2 1/2	2 7/8	3 1/4	3 5/8	3 7/8	4 1/4	4 5/8	5	5 3/8	5 5/8
1000	1/2	7/8	1 1/4	1 5/8	2	2 3/8	2 3/4	3 1/8	3 5/8	4	4 3/8	4 3/4	5 1/8	5 1/2	5 7/8	6 1/4
1100	1/2	7/8	1 3/8	1 3/4	2 1/4	2 5/8	3 1/8	3 1/2	3 7/8	4 3/8	4 3/4	5 1/4	5 5/8	6 1/8	6 1/2	6 7/8
1200	1/2	1	1 1/2	1 7/8	2 3/8	2 7/8	3 3/8	3 3/4	4 1/4	4 3/4	5 1/4	5 5/8	6 1/8	6 5/8	7 1/8	7 1/2
1300	5/8	1 1/8	1 5/8	2 1/8	2 5/8	3 1/8	3 5/8	4 1/8	4 5/8	5 1/8	5 5/8	6 1/8	6 5/8	7 1/8	7 5/8	8 1/8
1400	5/8	1 1/8	1 3/4	2 1/4	2 3/4	3 3/8	3 7/8	4 3/8	5	5 1/2	6 1/8	6 5/8	7 1/8	7 3/4	8 1/4	8 3/4
1440	5/8	1 1/8	1 3/4	2 1/4	2 7/8	3 3/8	4	4 1/2	5 1/8	5 5/8	6 1/4	6 3/4	7 3/8	7 7/8	8 1/2	9
1500	5/8	1 1/4	1 7/8	2 3/8	3	3 5/8	4 1/8	4 3/4	5 3/8	5 7/8	6 1/2	7 1/8	7 5/8	8 1/4	8 7/8	9 3/8
1600	5/8	1 1/4	1 7/8	2 1/2	3 1/8	3 3/4	4 3/8	5	5 5/8	6 1/4	6 7/8	7 1/2	8 1/8	8 3/4	9 3/8	10

Table shows actual values rounded up the nearest 1/8"

EXAMPLE: You are the Foreman on a CWR job. The rail temperature at the time of installation is 65 degrees F and the length of rail is 1440. To determine the proper change in rail length (in inches) in order to establish the proper neutral temperature.

First, calculate the change in rail temperature: 95 degrees F – 65 degrees F = 30 degrees F

Second go to the expansion table and locate where the “length of rail” is equal to 1440 and the change in temperature is equal to 30 degrees F.

Finally read the “change in rail” length where 1440 row and 35 degree column meet. The correct answer is 3 3/8”

The new CWR will need to be heated or stretched by 3 3/8” to achieve the proper neutral temperature of 95 degrees F.

SECTION VII.
CWR TRAINING & RE-QUALIFICATION

§6.1 CWR Qualification

(1) All employees responsible for the inspection, installation, adjustment or maintenance of CWR track must complete training on CWR procedures according to Appendix “A” of the MW-4 annually.

(2) All qualified employees will be given a copy of Appendix “A”, which incorporates all procedures and documents related to the maintenance, inspection, adjustment and installation of CWR. In addition, all qualified employees are required to have this policy in their possession at all times.

Metro-North Railroad

APPENDIX C

UNDERBALANCE TABLES
MAXIMUM ALLOWABLE
OPERATING
SPEED ON CURVES

APPENDIX C

UNDERBALANCE TABLES
MAXIMUM ALLOWABLE OPERATING SPEED ON CURVES

Notes:

(a) The enclosed tables can be used to determine V_{max} in accordance with §213.57.

(b) The Assistant Vice President - Maintenance of Way shall maintain a list of curves and the designated “underbalance” to be used.

(c) The preferred underbalance to be used on MNR is 3” (E_u).

(d) To operate at speeds which use “underbalance” greater than 3", the equipment must be qualified and approved by the Federal Railroad Administration.

(e) The maximum authorized speed (MAS) in curves on MNR, regardless of degree curve (D) or elevation (E_A) is 90 MPH.

(f) The Assistant Vice President - Maintenance of Way shall authorize all curve speeds in excess of 80 MPH.

(g) The Assistant Vice President - Maintenance of Way shall authorize all elevations in excess of 5".

(h) In ballasted track, whenever possible, curves should have a minimum of 1/2" superelevation so there will always be positive superelevation. See Assistant Director of Track Maintenance for guidance in superelevating curves requiring minimum superelevation (1/2").

Table 1. Maximum Allowable Operating Speed on Curves Underbalance = 3" (E_u)					
Degree Curve (D)[1]	**Degree Curve (D)**[2]	**Superelevation in inches (E_a)**			
		0-0	**0-1/4**	**0-1/2**	**0-3/4**
		Speed in Miles Per Hour (V_{max})			
0° 10'	0.17	90	90	90	90
0° 20'	0.33	90	90	90	90
0° 30'	0.50	90	90	90	90
0° 40'	0.67	80	83	86	89
0° 50'	0.83	71	74	77	80
1° 00'	1.00	65	68	70	73
1° 15'	1.25	58	60	63	65
1° 30'	1.50	53	55	57	59
1° 45'	1.75	49	51	53	55
2° 00'	2.00	46	48	50	51
2° 15'	2.25	43	45	47	48
2° 30'	2.50	41	43	44	46
2° 45'	2.75	39	41	42	44
3° 00'	3.00	37	39	40	42
3° 15'	3.25	36	37	39	40
3° 30'	3.50	34	36	37	39
3° 45'	3.75	33	35	36	37
4° 00'	4.00	32	34	35	36
4° 15'	4.25	31	33	34	35
4° 30'	4.50	30	32	33	34
4° 45'	4.75	30	31	32	33
5° 00'	5.00	29	30	31	32
5° 30'	5.50	27	29	30	31
6° 00'	6.00	26	27	28	29
6° 30'	6.50	25	26	27	28
7° 00'	7.00	24	25	26	27
7° 30'	7.50	23	24	25	26
8° 00'	8.00	23	24	25	25
8° 30'	8.50	22	23	24	25
9° 00'	9.00	21	22	23	24
9° 30'	9.50	21	22	22	23
10° 00'	10.00	20	21	22	23
10° 30'	10.50	20	21	21	22
11° 00'	11.00	19	20	21	22
11° 30'	11.50	19	20	20	21
12° 00'	12.00	18	19	20	21
12° 30'	12.50	18	19	20	20
13° 00'	13.00	18	18	19	20
13° 30'	13.50	17	18	19	19
14° 00'	14.00	17	18	18	19
14° 30'	14.50	17	17	18	19
15° 00'	15.00	16	17	18	18

(1)In degrees and minutes (2)In decimals

Table 1.
Maximum Allowable Operating Speed on Curves
Underbalance = 3" (E_u)

Degree Curve (D)[1]	Degree Curve (D)[2]	Superelevation in inches (E_a) 1	1-1/4	1-1/2	1-3/4
		Speed in Miles Per Hour (V_{max})			
0° 10'	0.17	90	90	90	90
0° 20'	0.33	90	90	90	90
0° 30'	0.50	90	90	90	90
0° 40'	0.67	90	90	90	90
0° 50'	0.83	82	85	87	90
1° 00'	1.00	75	77	80	82
1° 15'	1.25	67	69	71	73
1° 30'	1.50	61	63	65	67
1° 45'	1.75	57	58	60	62
2° 00'	2.00	53	55	56	58
2° 15'	2.25	50	51	53	54
2° 30'	2.50	47	49	50	52
2° 45'	2.75	45	46	48	49
3° 00'	3.00	43	44	46	47
3° 15'	3.25	41	43	44	45
3° 30'	3.50	40	41	42	44
3° 45'	3.75	39	40	41	42
4° 00'	4.00	37	38	40	41
4° 15'	4.25	36	37	38	39
4° 30'	4.50	35	36	37	38
4° 45'	4.75	34	35	36	37
5° 00'	5.00	33	34	35	36
5° 30'	5.50	32	33	34	35
6° 00'	6.00	30	31	32	33
6° 30'	6.50	29	30	31	32
7° 00'	7.00	28	29	30	31
7° 30'	7.50	27	28	29	30
8° 00'	8.00	26	27	28	29
8° 30'	8.50	25	26	27	28
9° 00'	9.00	25	25	26	27
9° 30'	9.50	24	25	26	26
10° 00'	10.00	23	24	25	26
10° 30'	10.50	23	24	24	25
11° 00'	11.00	22	23	24	24
11° 30'	11.50	22	22	23	24
12° 00'	12.00	21	22	23	23
12° 30'	12.50	21	22	22	23
13° 00'	13.00	20	21	22	22
13° 30'	13.50	20	21	21	22
14° 00'	14.00	20	20	21	22
14° 30'	14.50	19	20	21	21
15° 00'	15.00	19	20	20	21

(1)In degrees and minutes (2)In decimals

Table 1. Maximum Allowable Operating Speed on Curves Underbalance = 3" (E_u)					
Degree Curve (D)[1]	**Degree Curve (D)[2]**	**Superelevation in inches (E_a)**			
		2	**2-1/4**	**2-1/2**	**2-3/4**
		Speed in Miles Per Hour (V_{max})			
0° 10'	0.17	90	90	90	90
0° 20'	0.33	90	90	90	90
0° 30'	0.50	90	90	90	90
0° 40'	0.67	90	90	90	90
0° 50'	0.83	90	90	90	90
1° 00'	1.00	84	86	88	90
1° 15'	1.25	75	77	79	81
1° 30'	1.50	69	70	72	74
1° 45'	1.75	63	65	67	68
2° 00'	2.00	59	61	62	64
2° 15'	2.25	56	57	59	60
2° 30'	2.50	53	54	56	57
2° 45'	2.75	50	52	53	54
3° 00'	3.00	48	50	51	52
3° 15'	3.25	46	48	49	50
3° 30'	3.50	45	46	47	48
3° 45'	3.75	43	44	45	46
4° 00'	4.00	42	43	44	45
4° 15'	4.25	40	42	42	43
4° 30'	4.50	39	40	41	42
4° 45'	4.75	38	39	40	41
5° 00'	5.00	37	38	39	40
5° 30'	5.50	36	36	37	38
6° 00'	6.00	34	35	36	37
6° 30'	6.50	33	33	34	35
7° 00'	7.00	31	32	33	34
7° 30'	7.50	30	31	32	33
8° 00'	8.00	29	30	31	32
8° 30'	8.50	28	29	30	31
9° 00'	9.00	28	28	29	30
9° 30'	9.50	27	28	28	29
10° 00'	10.00	26	27	28	28
10° 30'	10.50	26	26	27	27
11° 00'	11.00	25	26	26	27
11° 30'	11.50	24	25	26	26
12° 00'	12.00	24	25	25	26
12° 30'	12.50	23	24	25	25
13° 00'	13.00	23	24	24	25
13° 30'	13.50	23	23	24	24
14° 00'	14.00	22	23	23	24
14° 30'	14.50	22	22	23	23
15° 00'	15.00	21	22	22	23

(1)In degrees and minutes (2)In decimals

Table 1. Maximum Allowable Operating Speed on Curves Underbalance = 3" (E_u)					
Degree Curve (D)[1]	**Degree Curve (D)[2]**	**Superelevation in inches (E_a)**			
		3	**3-1/4**	**3-1/2**	**3-3/4**
		Speed in Miles Per Hour (V_{max})			
0° 10'	0.17	90	90	90	90
0° 20'	0.33	90	90	90	90
0° 30'	0.50	90	90	90	90
0° 40'	0.67	90	90	90	90
0° 50'	0.83	90	90	90	90
1° 00'	1.00	90	90	90	90
1° 15'	1.25	82	84	86	87
1° 30'	1.50	75	77	78	80
1° 45'	1.75	69	71	72	74
2° 00'	2.00	65	66	68	69
2° 15'	2.25	61	62	64	65
2° 30'	2.50	58	59	60	62
2° 45'	2.75	55	56	58	59
3° 00'	3.00	53	54	55	56
3° 15'	3.25	51	52	53	54
3° 30'	3.50	49	50	51	52
3° 45'	3.75	47	48	49	50
4° 00'	4.00	46	47	48	49
4° 15'	4.25	44	45	46	47
4° 30'	4.50	43	44	45	46
4° 45'	4.75	42	43	44	45
5° 00'	5.00	41	42	43	43
5° 30'	5.50	39	40	41	41
6° 00'	6.00	37	38	39	40
6° 30'	6.50	36	37	37	38
7° 00'	7.00	34	35	36	37
7° 30'	7.50	33	34	35	35
8° 00'	8.00	32	33	34	34
8° 30'	8.50	31	32	33	33
9° 00'	9.00	30	31	32	32
9° 30'	9.50	30	30	31	31
10° 00'	10.00	29	29	30	31
10° 30'	10.50	28	29	29	30
11° 00'	11.00	27	28	29	29
11° 30'	11.50	27	27	28	28
12° 00'	12.00	26	27	27	28
12° 30'	12.50	26	26	27	27
13° 00'	13.00	25	26	26	27
13° 30'	13.50	25	25	26	26
14° 00'	14.00	24	25	25	26
14° 30'	14.50	24	24	25	25
15° 00'	15.00	23	24	24	25

[1]In degrees and minutes [2]In decimals

Table 1. Maximum Allowable Operating Speed on Curves Underbalance = 3" (E_u)					
Degree Curve (D)[1]	**Degree Curve (D)[2]**	**Superelevation in inches (E_a)**			
		4	**4-1/4**	**4-1/2**	**4-3/4**
		Speed in Miles Per Hour (V_{max})			
0° 10'	0.17	90	90	90	90
0° 20'	0.33	90	90	90	90
0° 30'	0.50	90	90	90	90
0° 40'	0.67	90	90	90	90
0° 50'	0.83	90	90	90	90
1° 00'	1.00	90	90	90	90
1° 15'	1.25	89	90	90	90
1° 30'	1.50	81	83	84	85
1° 45'	1.75	75	76	78	79
2° 00'	2.00	70	71	73	74
2° 15'	2.25	66	67	69	70
2° 30'	2.50	63	64	65	66
2° 45'	2.75	60	61	62	63
3° 00'	3.00	57	58	59	60
3° 15'	3.25	55	56	57	58
3° 30'	3.50	53	54	55	56
3° 45'	3.75	51	52	53	54
4° 00'	4.00	50	50	51	52
4° 15'	4.25	48	49	50	51
4° 30'	4.50	47	47	48	49
4° 45'	4.75	45	46	47	48
5° 00'	5.00	44	45	46	47
5° 30'	5.50	42	43	44	44
6° 00'	6.00	40	41	42	42
6° 30'	6.50	39	39	40	41
7° 00'	7.00	37	38	39	39
7° 30'	7.50	36	37	37	38
8° 00'	8.00	35	35	36	37
8° 30'	8.50	34	34	35	36
9° 00'	9.00	33	33	34	35
9° 30'	9.50	32	33	33	34
10° 00'	10.00	31	32	32	33
10° 30'	10.50	30	31	31	32
11° 00'	11.00	30	30	31	31
11° 30'	11.50	29	30	30	31
12° 00'	12.00	28	29	29	30
12° 30'	12.50	28	28	29	29
13° 00'	13.00	27	28	28	29
13° 30'	13.50	27	27	28	28
14° 00'	14.00	26	27	27	28
14° 30'	14.50	26	26	27	27
15° 00'	15.00	25	26	26	27

(1)In degrees and minutes (2)In decimals

Table 1.
Maximum Allowable Operating Speed on Curves
Underbalance = 3" (E_u)

Degree Curve (D)[1]	Degree Curve (D)[2]	Superelevation in inches (E_a)				
		5	5-1/4	5-1/2	5-3/4	6
		Speed in Miles Per Hour (V_{max})				
0° 10'	0.17	90	90	90	90	90
0° 20'	0.33	90	90	90	90	90
0° 30'	0.50	90	90	90	90	90
0° 40'	0.67	90	90	90	90	90
0° 50'	0.83	90	90	90	90	90
1° 00'	1.00	90	90	90	90	90
1° 15'	1.25	90	90	90	90	90
1° 30'	1.50	87	88	89	90	90
1° 45'	1.75	80	82	83	84	85
2° 00'	2.00	75	76	77	79	80
2° 15'	2.25	71	72	73	74	75
2° 30'	2.50	67	68	69	70	71
2° 45'	2.75	64	65	66	67	68
3° 00'	3.00	61	62	63	64	65
3° 15'	3.25	59	60	61	62	62
3° 30'	3.50	57	58	58	59	60
3° 45'	3.75	55	56	56	57	58
4° 00'	4.00	53	54	55	55	56
4° 15'	4.25	51	52	53	54	55
4° 30'	4.50	50	51	51	52	53
4° 45'	4.75	49	49	50	51	52
5° 00'	5.00	47	48	49	50	50
5° 30'	5.50	45	46	46	47	48
6° 00'	6.00	43	44	44	45	46
6° 30'	6.50	41	42	43	43	44
7° 00'	7.00	40	41	41	42	42
7° 30'	7.50	39	39	40	40	41
8° 00'	8.00	37	38	38	39	40
8° 30'	8.50	36	37	37	38	38
9° 00'	9.00	35	36	36	37	37
9° 30'	9.50	34	35	35	36	36
10° 00'	10.00	33	34	34	35	35
10° 30'	10.50	32	33	34	34	34
11° 00'	11.00	32	32	33	33	34
11° 30'	11.50	31	32	32	32	33
12° 00'	12.00	30	31	31	32	32
12° 30'	12.50	30	30	31	31	32
13° 00'	13.00	29	30	30	31	31
13° 30'	13.50	29	29	29	30	30
14° 00'	14.00	28	29	29	29	30
14° 30'	14.50	28	28	28	29	29
15° 00'	15.00	27	28	28	28	29

(1)In degrees and minutes (2)In decimals

Table 2
Maximum Allowable Operating Speed on Curves
Underbalance = 1-1/2" (E_u)

Degree Curve (D)[1]	Degree Curve (D)[2]	Superelevation in inches (E_a)			
		0-0	**0-1/4**	**0-1/2**	**0-3/4**
		Speed in Miles Per Hour (V_{max})			
0° 10'	0.17	90	90	90	90
0° 20'	0.33	80	86	90	90
0° 30'	0.50	65	70	75	80
0° 40'	0.67	56	61	65	69
0° 50'	0.83	50	54	58	62
1° 00'	1.00	46	50	53	56
1° 15'	1.25	41	44	47	50
1° 30'	1.50	37	40	43	46
1° 45'	1.75	34	37	40	42
2° 00'	2.00	32	35	37	40
2° 15'	2.25	30	33	35	37
2° 30'	2.50	29	31	33	35
2° 45'	2.75	27	30	32	34
3° 00'	3.00	26	28	30	32
3° 15'	3.25	25	27	29	31
3° 30'	3.50	24	26	28	30
3° 45'	3.75	23	25	27	29
4° 00'	4.00	23	25	26	28
4° 15'	4.25	22	24	25	27
4° 30'	4.50	21	23	25	26
4° 45'	4.75	21	22	24	26
5° 00'	5.00	20	22	23	25
5° 30'	5.50	19	21	22	24
6° 00'	6.00	18	20	21	23
6° 30'	6.50	18	19	20	22
7° 00'	7.00	17	18	20	21
7° 30'	7.50	16	18	19	20
8° 00'	8.00	16	17	18	20
8° 30'	8.50	15	17	18	19
9° 00'	9.00	15	16	17	18
9° 30'	9.50	15	16	17	18
10° 00'	10.00	14	15	16	17
10° 30'	10.50	14	15	16	17
11° 00'	11.00	13	15	16	17
11° 30'	11.50	13	14	15	16
12° 00'	12.00	13	14	15	16
12° 30'	12.50	13	14	15	16
13° 00'	13.00	12	13	14	15
13° 30'	13.50	12	13	14	15
14° 00'	14.00	12	13	14	15
14° 30'	14.50	12	13	14	14
15° 00'	15.00	11	12	13	14

(1)In degrees and minutes (2)In decimals

Table 2. Maximum Allowable Operating Speed on Curves Underbalance = 1-1/2" (E_u)					
Degree Curve (D)(1)	**Degree Curve (D)(2)**	**Superelevation in inches (E_a)**			
		1	**1-1/4**	**1-1/2**	**1-3/4**
		Speed in Miles Per Hour (V_{max})			
0° 10'	0.17	90	90	90	90
0° 20'	0.33	90	90	90	90
0° 30'	0.50	84	88	90	90
0° 40'	0.67	73	76	80	83
0° 50'	0.83	65	68	71	74
1° 00'	1.00	59	62	65	68
1° 15'	1.25	53	56	58	60
1° 30'	1.50	48	51	53	55
1° 45'	1.75	45	47	49	51
2° 00'	2.00	42	44	46	48
2° 15'	2.25	39	41	43	45
2° 30'	2.50	37	39	41	43
2° 45'	2.75	36	37	39	41
3° 00'	3.00	34	36	37	39
3° 15'	3.25	33	34	36	37
3° 30'	3.50	31	33	34	36
3° 45'	3.75	30	32	33	35
4° 00'	4.00	29	31	32	34
4° 15'	4.25	28	30	31	33
4° 30'	4.50	28	29	30	32
4° 45'	4.75	27	28	30	31
5° 00'	5.00	26	28	29	30
5° 30'	5.50	25	26	27	29
6° 00'	6.00	24	25	26	27
6° 30'	6.50	23	24	25	26
7° 00'	7.00	22	23	24	25
7° 30'	7.50	21	22	23	24
8° 00'	8.00	21	22	23	24
8° 30'	8.50	20	21	22	23
9° 00'	9.00	19	20	21	22
9° 30'	9.50	19	20	21	22
10° 00'	10.00	18	19	20	21
10° 30'	10.50	18	19	20	21
11° 00'	11.00	18	18	19	20
11° 30'	11.50	17	18	19	20
12° 00'	12.00	17	18	18	19
12° 30'	12.50	16	17	18	19
13° 00'	13.00	16	17	18	18
13° 30'	13.50	16	17	17	18
14° 00'	14.00	15	16	17	18
14° 30'	14.50	15	16	17	17
15° 00'	15.00	15	16	16	17

(1)In degrees and minutes (2)In decimals

Table 2. Maximum Allowable Operating Speed on Curves Underbalance = 1-1/2” (E_u)					
Degree Curve (D)(1)	**Degree Curve (D)**(2)	**Superelevation in inches (E_a)**			
		2	**2-1/4**	**2-1/2**	**2-3/4**
		Speed in Miles Per Hour (V_{max})			
0° 10'	0.17	90	90	90	90
0° 20'	0.33	90	90	90	90
0° 30'	0.50	90	90	90	90
0° 40'	0.67	86	89	90	90
0° 50'	0.83	77	80	82	85
1° 00'	1.00	70	73	75	77
1° 15'	1.25	63	65	67	69
1° 30'	1.50	57	59	61	63
1° 45'	1.75	53	55	57	58
2° 00'	2.00	50	51	53	55
2° 15'	2.25	47	48	50	51
2° 30'	2.50	44	46	47	49
2° 45'	2.75	42	44	45	46
3° 00'	3.00	40	42	43	44
3° 15'	3.25	39	40	41	43
3° 30'	3.50	37	39	40	41
3° 45'	3.75	36	37	39	40
4° 00'	4.00	35	36	37	38
4° 15'	4.25	34	35	36	37
4° 30'	4.50	33	34	35	36
4° 45'	4.75	32	33	34	35
5° 00'	5.00	31	32	33	34
5° 30'	5.50	30	31	32	33
6° 00'	6.00	28	29	30	31
6° 30'	6.50	27	28	29	30
7° 00'	7.00	26	27	28	29
7° 30'	7.50	25	26	27	28
8° 00'	8.00	25	25	26	27
8° 30'	8.50	24	25	25	26
9° 00'	9.00	23	24	25	25
9° 30'	9.50	22	23	24	25
10° 00'	10.00	22	23	23	24
10° 30'	10.50	21	22	23	24
11° 00'	11.00	21	22	22	23
11° 30'	11.50	20	21	22	22
12° 00'	12.00	20	21	21	22
12° 30'	12.50	20	20	21	22
13° 00'	13.00	19	20	20	21
13° 30'	13.50	19	19	20	21
14° 00'	14.00	18	19	20	20
14° 30'	14.50	18	19	19	20
15° 00'	15.00	18	18	19	20

(1)In degrees and minutes (2)In decimals

Table 2. Maximum Allowable Operating Speed on Curves Underbalance = 1-1/2" (E_u)					
Degree Curve (D)[1]	**Degree Curve (D)[2]**	**Superelevation in inches (E_a)**			
		3	**3-1/4**	**3-1/2**	**3-3/4**
		Speed in Miles Per Hour (V_{max})			
0° 10'	0.17	90	90	90	90
0° 20'	0.33	90	90	90	90
0° 30'	0.50	90	90	90	90
0° 40'	0.67	90	90	90	90
0° 50'	0.83	87	90	90	90
1° 00'	1.00	80	82	84	86
1° 15'	1.25	71	73	75	77
1° 30'	1.50	65	67	69	70
1° 45'	1.75	60	62	63	65
2° 00'	2.00	56	58	59	61
2° 15'	2.25	53	54	56	57
2° 30'	2.50	50	52	53	54
2° 45'	2.75	48	49	50	52
3° 00'	3.00	46	47	48	50
3° 15'	3.25	44	45	46	48
3° 30'	3.50	42	44	45	46
3° 45'	3.75	41	42	43	44
4° 00'	4.00	40	41	42	43
4° 15'	4.25	38	39	40	42
4° 30'	4.50	37	38	39	40
4° 45'	4.75	36	37	38	39
5° 00'	5.00	35	36	37	38
5° 30'	5.50	34	35	36	36
6° 00'	6.00	32	33	34	35
6° 30'	6.50	31	32	33	33
7° 00'	7.00	30	31	31	32
7° 30'	7.50	29	30	30	31
8° 00'	8.00	28	29	29	30
8° 30'	8.50	27	28	28	29
9° 00'	9.00	26	27	28	28
9° 30'	9.50	26	26	27	28
10° 00'	10.00	25	26	26	27
10° 30'	10.50	24	25	26	26
11° 00'	11.00	24	24	25	26
11° 30'	11.50	23	24	24	25
12° 00'	12.00	23	23	24	25
12° 30'	12.50	22	23	23	24
13° 00'	13.00	22	22	23	24
13° 30'	13.50	21	22	23	23
14° 00'	14.00	21	22	22	23
14° 30'	14.50	21	21	22	22
15° 00'	15.00	20	21	21	22

[1]In degrees and minutes [2]In decimals

Table 2. Maximum Allowable Operating Speed on Curves Underbalance = 1-1/2" (E_u)					
Degree Curve (D)[1]	Degree Curve (D)[2]	Superelevation in inches (E_a)			
		4	4-1/4	4-1/2	4-3/4
		Speed in Miles Per Hour (V_{max})			
0° 10'	0.17	90	90	90	90
0° 20'	0.33	90	90	90	90
0° 30'	0.50	90	90	90	90
0° 40'	0.67	90	90	90	90
0° 50'	0.83	90	90	90	90
1° 00'	1.00	88	90	90	90
1° 15'	1.25	79	81	82	84
1° 30'	1.50	72	74	75	77
1° 45'	1.75	67	68	69	71
2° 00'	2.00	62	64	65	66
2° 15'	2.25	59	60	61	62
2° 30'	2.50	56	57	58	59
2° 45'	2.75	53	54	55	56
3° 00'	3.00	51	52	53	54
3° 15'	3.25	49	50	51	52
3° 30'	3.50	47	48	49	50
3° 45'	3.75	45	46	47	48
4° 00'	4.00	44	45	46	47
4° 15'	4.25	42	43	44	45
4° 30'	4.50	41	42	43	44
4° 45'	4.75	40	41	42	43
5° 00'	5.00	39	40	41	42
5° 30'	5.50	37	38	39	40
6° 00'	6.00	36	37	37	38
6° 30'	6.50	34	35	36	37
7° 00'	7.00	33	34	34	35
7° 30'	7.50	32	33	33	34
8° 00'	8.00	31	32	32	33
8° 30'	8.50	30	31	31	32
9° 00'	9.00	29	30	30	31
9° 30'	9.50	28	29	30	30
10° 00'	10.00	28	28	29	29
10° 30'	10.50	27	27	28	29
11° 00'	11.00	26	27	27	28
11° 30'	11.50	26	26	27	27
12° 00'	12.00	25	26	26	27
12° 30'	12.50	25	25	26	26
13° 00'	13.00	24	25	25	26
13° 30'	13.50	24	24	25	25
14° 00'	14.00	23	24	24	25
14° 30'	14.50	23	23	24	24
15° 00'	15.00	22	23	23	24

(1) In degrees and minutes (2) In decimals

Table 2.
Maximum Allowable Operating Speed on Curves
Underbalance = 1-1/2" (E_u)

Degree Curve (D)[1]	Degree Curve (D)[2]	Superelevation in inches (E_a) 5	5-1/4	5-1/2	5-3/4	6
		Speed in Miles Per Hour (V_{max})				
0° 10'	0.17	90	90	90	90	90
0° 20'	0.33	90	90	90	90	90
0° 30'	0.50	90	90	90	90	90
0° 40'	0.67	90	90	90	90	90
0° 50'	0.83	90	90	90	90	90
1° 00'	1.00	90	90	90	90	90
1° 15'	1.25	86	87	89	90	90
1° 30'	1.50	78	80	81	83	84
1° 45'	1.75	72	74	75	76	78
2° 00'	2.00	68	69	70	71	73
2° 15'	2.25	64	65	66	67	69
2° 30'	2.50	60	62	63	64	65
2° 45'	2.75	58	59	60	61	62
3° 00'	3.00	55	56	57	58	59
3° 15'	3.25	53	54	55	56	57
3° 30'	3.50	51	52	53	54	55
3° 45'	3.75	49	50	51	52	53
4° 00'	4.00	48	49	50	50	51
4° 15'	4.25	46	47	48	49	50
4° 30'	4.50	45	46	47	47	48
4° 45'	4.75	44	45	45	46	47
5° 00'	5.00	43	43	44	45	46
5° 30'	5.50	41	41	42	43	44
6° 00'	6.00	39	40	40	41	42
6° 30'	6.50	37	38	39	39	40
7° 00'	7.00	36	37	37	38	39
7° 30'	7.50	35	35	36	37	37
8° 00'	8.00	34	34	35	35	36
8° 30'	8.50	33	33	34	34	35
9° 00'	9.00	32	32	33	33	34
9° 30'	9.50	31	31	32	33	33
10° 00'	10.00	30	31	31	32	32
10° 30'	10.50	29	30	30	31	31
11° 00'	11.00	29	29	30	30	31
11° 30'	11.50	28	28	29	30	30
12° 00'	12.00	27	28	28	29	29
12° 30'	12.50	27	27	28	28	29
13° 00'	13.00	26	27	27	28	28
13° 30'	13.50	26	26	27	27	28
14° 00'	14.00	25	26	26	27	27
14° 30'	14.50	25	25	26	26	27
15° 00'	15.00	24	25	25	26	26

[1]In degrees and minutes [2]In decimals

APPENDIX D

BRAKING DISTANCE TABLE FOR MNR

APPENDIX D

BRAKING DISTANCE TABLE FOR MNR

(a) For the placement of speed limit and stop signs determine the type of equipment operating in the area of proposed sign placement and use the maximum distance from the tables given below.

PASSENGER AND FREIGHT TABLE

Speed Reduction (MPH)			
From	**To**	**Passenger**	**Freight**
90	80	1300	
90	70	2800	
90	60	4050	
90	50	5100	
90	40	5950	
90	30	6600	
90	20	7100	
90	10	7300	
90	0	7500	
80	70	1507	
80	60	2066	
80	50	2540	
80	40	2927	
80	30	3229	
80	20	3444	
80	10	3573	
80	0	3746	
70	60	1245	
70	50	1719	
70	40	2106	
70	30	2407	
70	20	2623	
70	10	2752	
70	0	2940	
60	50	1250	
60	40	1638	
60	30	1939	
60	20	2154	
60	10	2283	
60	0	2476	
50	40	933	
50	30	1234	
50	20	1449	
50	10	1578	
50	0	1822	

PASSENGER AND FREIGHT TABLE (Continued)			
Speed Reduction (MPH)			
From	**To**	**Passenger**	**Freight**
45	30	940	3250
45	20	1150	4200
45	10	1325	5750
45	0	1525	6700
40	30	697	2100
40	20	912	3500
40	10	1041	4500
40	0	1220	5500
30	20	550	1500
30	10	679	2400
30	0	841	3300
20	10	359	900
20	0	513	1900
15	10	150	475
15	0	350	1425
10	0	199	950

(b) To determine the distance between Approach Speed Signs and Speed Limit or Stop Signs for descending grades, the appropriate distance from the table in paragraph (a) above should be increased as follows:

PASSENGER AND FREIGHT TABLE FOR DESCENDING GRADES			
Distance from Approach Speed Signs To Speed Limit Signs and Stop Signs			
Descending Grade (%)			**Increase Distance in Paragraph (a) by:**
0.00	To	0.71	10%
0.72	To	1.31	20%
1.32	To	1.82	30%
1.83	To	2.25	40%
2.26	To	2.63	50%
2.64	To	2.95	60%
2.96	To	3.25	70%

(c) Locations requiring the placement of temporary speed restriction signs should have signs placed in accordance with Appendix E, “Placement of Temporary Speed Signs.”

(d) Procedures for utilizing Braking Distance Tables:

(1) Determine type of train traffic utilizing track adjacent to work area where slow order is to be imposed.

(2) Determine the Maximum Authorized Speed (MAS) from Employee Timetable Special Instructions.

(3) Determine if any speed restriction is required on adjacent track.

(4) Determine worst case distance for sign placement.

EXAMPLE:

Passenger: 80 MPH MAS to 30 MPH = 3,229 feet

Freight: 45 MPH MAS to 30 MPH = 3,250 feet

(5) Determine the grade for the area the restriction is to be applied in from the System Road Chart.

Example: Point A to B has a 0.5% descending grade towards the restriction area. Looking at the table in paragraph (b), we find that for a 0.5% grade, we increase the stopping distance by 10%. Therefore, we multiply 3,592 by 1.1 to obtain 3,951 feet.

(6) The distance from the 30 MPH approach sign to the restriction area = 3,951 feet.

Metro-North Railroad

APPENDIX E

PLACEMENT OF TEMPORARY SPEED SIGNS

APPENDIX E

PLACEMENT OF TEMPORARY SPEED SIGNS

1.0 Temporary Speed Restriction

(a) Protection shall be provided for any track that is considered not satisfactory for the passage of trains at maximum authorized speed, including placing an appropriate temporary speed restriction and notification of the Block Station and/or RTC.

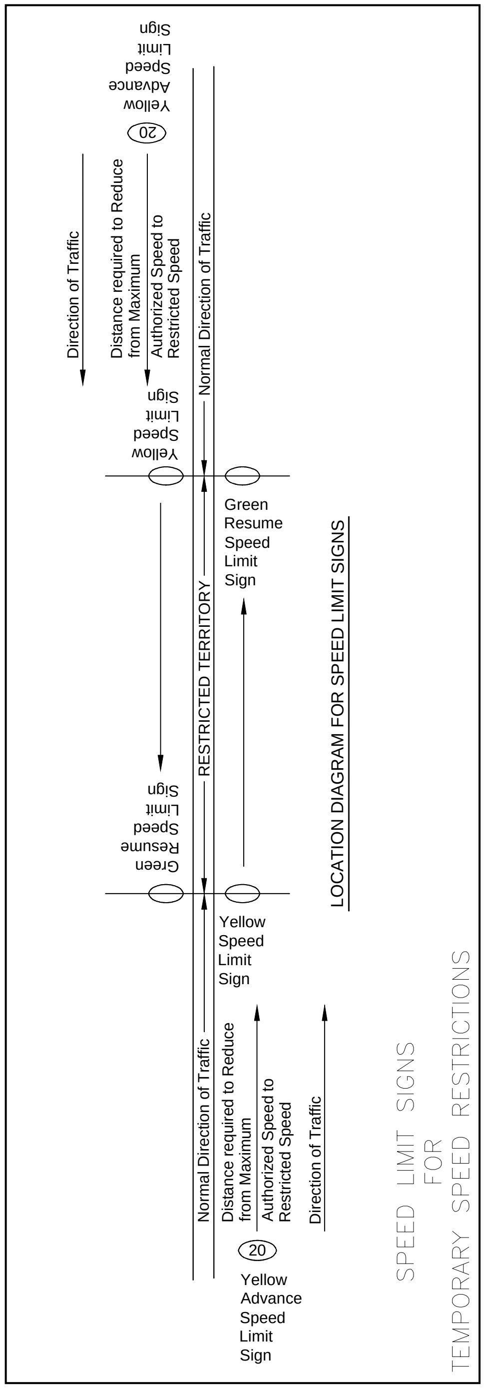
(b) Portions of Tracks, on which temporary speed restrictions have been placed, are to be marked by placing a reflectorized Advanced Speed Limit sign, and Speed Limit and Resume Speed signs to the right of each track for both directions of traffic.

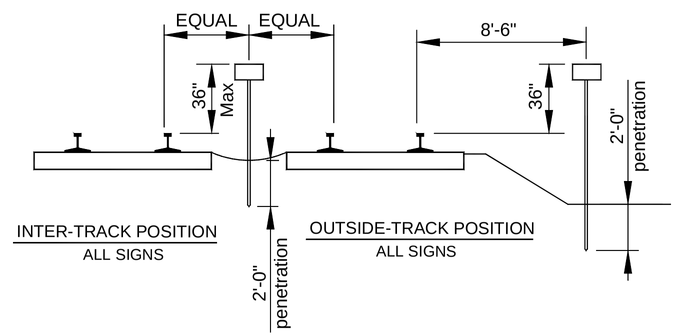
(1) The general arrangement, details of construction and assembly, height and distance from the track, of signs, shall be as shown on the following plans.

(2) Signs are to be placed so as to give the greatest practical unobstructed view considering alignment and other local physical conditions. Reflecting surfaces of signs must be kept clean to preserve their reflecting ability.

(3) Speed Limit and Resume Speed signs are to be placed with the Speed Limit sign at the point where the actual restriction begins and the Resume Speed sign at the point where it ends.

(4) Advanced Speed Limit signs, with numerals indicating the speed restriction, are to be placed far enough ahead of the Speed Limit signs in the direction from which trains are approaching to permit trains to reduce from normal speed to the speed permitted by the restriction, but not less than the distances shown in Appendix D, “Braking Distance Table for MNR”, for passenger and freight trains on level or ascending grades. For descending grades, the distances shown should be increased as shown in Appendix D.


SPEED LIMIT SIGNS FOR TEMPORARY SPEED RESTRICTIONS
LOCATION DIAGRAM FOR SPEED LIMIT SIGNS
RESTRICTED TERRITORY
Normal Direction of Traffic
Direction of Traffic
Distance required to Reduce from Maximum Authorized Speed to Restricted Speed
20
Yellow Advance Speed Limit Sign
Yellow Speed Limit Sign
Green Resume Speed Limit Sign
Normal Direction of Traffic
Direction of Traffic
Distance required to Reduce from Maximum Authorized Speed to Restricted Speed
20
Yellow Advance Speed Limit Sign
Yellow Speed Limit Sign
Green Resume Speed Limit Sign



SPEED LIMIT SIGNS
FOR
TEMPORARY SPEED RESTRICTIONS

Note:
Where local conditions make it desirable, the Resume Speed Sign and The Speed Limit Sign may be mounted back to back on the same support

Temporary Speed Limit Signs

Advance Speed Limit sign with numerals indicating restricted speed shall be placed a sufficient distance in advance of restricted territory to permit a train to reduce from maximum authorized speed to the restricted speed. See MW 2000 Appendix E.

Speed Limit sign shall be placed to mark the entrance to the restricted territory.

Resume Speed sign shall be placed to mark the end of restricted territory. When entire train has passed this point, speed may be resumed.

Advance Speed Limit sign shall have background of Flat Top Yellow Scotchlite. Superimposed on the yellow background shall be 7" high x 11-1/2" wide black numerals showing speed permitted over restricted territory. Numerals shall be furnished in multiples of 10 miles per hour.

Speed Limit sign shall have background of Flat Top Yellow Scotchlite.

Resume Speed sign shall have background of Flat Top Green Scotchlite.

(c) When a condition arises requiring a speed restriction, the following must be done:

(1) Notification must be given to the block operator or RTC governing movement on the track where restriction is required.

(2) Notification must also be given to Track Supervisor, or Assistant Track Supervisor.

(3) Notification must include:

(i) Limits of restriction by milepost, CP, station or cat pole.
(ii) Speed to which track is restricted.
(iii) Reason for restriction.
(iv) Action being taken to correct condition.

(4) Immediate action must be initiated to remove restriction.

(d) Marking of Temporary Speed Restrictions:

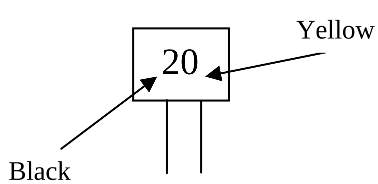
(1) Where it is anticipated that restriction will be of other than the most temporary nature, reflectorized slow boards will be used.

(2) Information concerning slow orders:

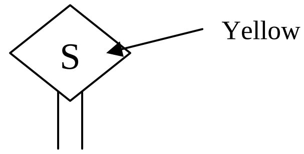
(i) Will be communicated to train and engine service personnel by Form M, line 5 or Daily Train Operations Bulletin Order.
(ii) Limits of slow orders in Form M or DTOBO must be consistent with placement of slow boards on the ground, and order must so state.
(iii) Where slow order is of short duration and is issued on Form M, slow boards need not be displayed.

(3) Slow board placement:

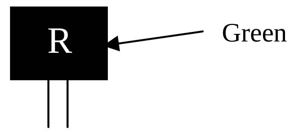
(i) Slow boards will be of reflectorized material, clean and in good repair.
(ii) They will be located to the right of and adjacent to the track protected, where they are unobstructed and can be clearly seen.
(iii) Advance Speed Limit Sign – a yellow sign with the speed to which trains are restricted displayed thereon in black numerals will be placed ahead of the point of restriction to allow a train moving at maximum authorized speed to reduce to the restricted speed at the point of restriction (see Appendix D).



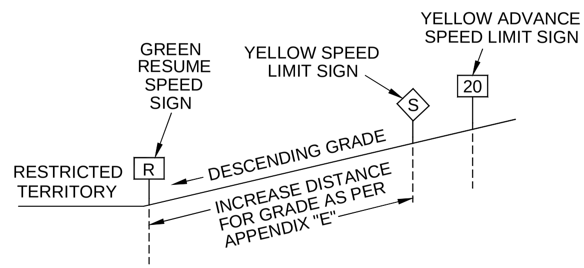
(iv) Yellow Speed Limit Sign – placed at the point at which restriction begins:



(v) Green Resume Sign – placed at the point at which restriction ends:



(vi) Distances to approach speed signs will be increased for descending grades as per Appendix D.



SPEED LIMIT SIGNS
ON DESCENDING GRADES FOR
TEMPORARY SPEED RESTRICTIONS

Metro-North Railroad

APPENDIX F

GLOSSARY

APPENDIX F

GLOSSARY

APPENDIX F

GLOSSARY

- A -

Action Items
The rail joint conditions that track owners identify in their CWR plans pursuant to paragraph (g)(3) which require the application of a corrective action.

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

Alignment – General
The physical appearance of the railroad as viewed from above, which consists of a series of straight lengths of track, referred to as tangents and spirals, connecting simple, compound or reverse curves.

Alignment-Line
The condition of track in regard to uniformity of direction over short distances on tangents and in curves.

Aggregate
The sand, gravel, broken stone or combinations thereof with which the cementing material is mixed to form a mortar or concrete. The fine material used to produce mortar for stone and brick masonry and for the mortar component of concrete is commonly termed "fine aggregate," while the coarse material used in concrete only is termed "course aggregate."

- B -

Ballast
Select material placed on the roadbed to support and hold track in line and surface. Ballast preferably consists of sized hard particles that distribute the load, drains well and maintains proper line and surface.

Ballast Cleaning
The process of separating contaminants from the ballast by shaking and then depositing stone back onto the track.

Ballast Section
The cross section of a track between and under the crossties and between the ballast shoulders.

Ballast Shoulder
The portion of ballast between the end of the tie and the bottom of the ballast slope. It distributes the traffic load over a greater width of roadway and helps hold the track in alignment by providing lateral resistance.

Bar - Joint
Bars that are used to physically connect two rail ends and ensure proper rail head and gage face alignment. Also called a joint bar.

Bascule Bridge
A moveable bridge span that is hinged at one end. When being raised or lowered, the end of the span opposite the hinge follows the arc of a circle.

Batter - Rail
Deformation of the surface of the rail head, usually close to the end of the rail, caused generally by wheel impact loads.

Braking Force
The longitudinal and lateral force induced into the rail as a result of the brake application of a train.

Bridge - Ballast Deck
A bridge with a solid floor provided with drains and covered with ballast to provide uniform support for track.

Bridge Timber
A sawed tie usually pre-framed on all four sides and of the size and length required for track on an open deck bridge.

Buckling Incident
The formation of a lateral misalignment sufficient in magnitude to cause a general instability of track which may constitute a deviation from Class requirements specified in §213.55 of Part I. These normally occur when rail temperatures are relatively high and are caused by high longitudinal compressive forces.

- C -

Cant
Tilt or inclination of the base of the rail. Canting of the rail is achieved with the use of a tie plate or rail seat designed to cant the rail inward towards the center-line of track and should be installed accordingly. Typical MNR cant is 1:40.

Clip
An elastic fastener that is applied parallel or perpendicular to the base of the rail and replaces and eliminates the need for a cut spike and anchor. A clip can be used on wood or concrete ties.

Clip - Switch
The device by which the switch rod is joined to the switch points. It is normally connected to the switch points by bolts protected by cotter keys or pins. It sometimes has staggered bolt holes in the horizontal leg for making detailed adjustments in the positions of the switch points.

Closure Rail
The lead rails connecting the heel end of the switch with the toe ends of a frog.

Coefficient of Thermal Expansion – Rail
A multiplier based on the physical properties of rail steel used to calculate the change in rail length with change in temperature. The coefficient is 0.000078 when the length of the rail is in feet.

Compression
A uniform axial force within the rail caused by equal and opposite forces pushing at the ends of the rail.

Compromise Joint Bar
See Joint Bar – Compromise

Continuous Welded Rail (CWR)
Rail that has been welded together into lengths exceeding 400 feet. See Part I, §213.119.

Continuous Welded Rail Joint
Any joint directly connected to CWR, and any joint(s) in a segment of rail between CWR strings that are less than 195 feet apart.

Corrective Actions
Those actions which track owners specify in their CWR plans to address conditions of actual or potential joint failure, including, as applicable, repair, restrictions on operations, and additional on-foot inspections.

Crossing – At Grade (Highway)
A crossing or intersection of a railroad and a highway at the same level or grade.

Crossing – At Grade (Track)
A structure, used where one track crosses another at grade, which consists of four connected frogs. Crossing angles can be defined as:

Low angle:	Up to and including 30°
Medium angle:	31° to 60°
High angle:	61° to 90°

Crossing - Bolted Three Rail
A rail crossing in which the end frogs and center frogs and the connections between them consists of rolled running rails, guard rails and easer rails.

Crossing - Bolted Two Rail
A rail crossing in which the end frogs and center frogs and the connection between them consists of rolled running rails and guard rails.

Crossing - Moveable Point
A crossing of small angle in which each of the two center frogs consists essentially of a knuckle rail and two-opposed moveable center points with the necessary fixtures.

Crosslevel
The difference in elevation between the rails at the same location.

Crossover
Two turnouts with the track connected at their frogs, arranged to form a passage between two nearby and generally parallel tracks.

Curvature - Degree of
A measure of the sharpness of a simple curve where a 1" offset at the mid-point of a 62' chord is equal to 1°.

Curve - Compound
A curve composed of two or more simple curves that are joined by easement spirals and that lead in the same general direction (i.e., to left or right, but each with different radii).

Curve - Reverse
A curve composed of two simple curves that are joined by a common tangent point or by a short tangent track which bear in opposite directions.

Curve - Simple (Horizontal)
A curve in the form of a circular arc that is bounded by two tangents. By definition these curves do not have spirals and may be found in yards and on secondary track.

Curve - Vertical
A curve in the profile of a track to connect intersecting grade lines and to permit safe and smooth operation of trains over summits and across sags.

- D -

Derail
A track device to guide rolling stock off the rails at a selected spot and divert the rolling stock away from the track that is being protected. Derails provide protection against collisions or side swipes. Derails are generally of three kinds: the "split switch," the "sliding block," and the "hinged block" type.

Derailment
Anytime a wheel of a car or engine comes off the head of the rail.

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

Desired Rail Neutral Temperature Range (See Appendix A)
The rail temperature range, within a specific geographical area, at which forces in CWR should not cause a buckling incident in extreme heat, or a pull-apart during extreme cold weather.

Deviation
Difference between a design or published standard and actual measurement at any one location.

Disturbed Track
The disturbance of the roadbed or ballast section, as a result of track maintenance or any other event, which reduces the lateral and longitudinal resistance of the track.

Dynamic Train Loading
Vertical, horizontal and longitudinal forces that are imparted to the track structure during the passing of a train due to wheel action and vehicle response.

- E -

Easer Rail
A rail placed with its head along the outside and close-up to the head of the running rail and sloped at the end to provide a bearing for the overhanging portion of the wheel tread. Easer rails are used in slip switches.

Elastomeric Rail Fastener
A rail hold down system that secures the running rail to wood or concrete ties and/or a concrete slab. The fastener uses rail clips and a base plate with or without resilient pads. This system provides lateral, longitudinal and vertical rail restraint during the passage of trains. (See additional information under "Rail Fastening System.")

Engine Burn
Damage to the rail head metal caused by slipping or "spinning" powered wheels. Engine burn fracture is a rail break caused by an engine burn.

Expansion Joint
A device that allows thermal movement in rail to be relieved by allowing the rail on one side of the joint to freely expand and contract. Often installed on the approaches to moveable bridges so that thermal forces and movements in continuous welded rail adjacent to the bridge cannot be transferred into the bridge or the miter rail assembly, where it could jam and prevent needed movement.

- F -

Facing Point
A facing point move is one where the rail vehicle moves over the switch points and then the frog.

Federal Railroad Administration (FRA)
A government agency in the U.S. Department of Transportation.

Fishing Space
Space between the head and base of a rail occupied by a splice bar (angle bar, joint bar).

Fit Material
Useable secondhand rail, ties or other track material (OTM).

Flangeway
Measured space between running rail, guard rail, frog casting, frog wing rail and road crossing to provide clearance for passage of wheel flanges.

Flow of Metal (Rail)
Deformation of the top of the rail head on the crown of a rail toward the gage or field side. Common on the low side of a curve where trains run at less than balanced speed.

Fracture – Detail
A progressive transverse fracture originating in the head of a rail.

Frog
A device used where two running rails intersect, with flangeways to permit wheels and wheel flanges on either rail to cross one another.

Frog – Moveable Point (MPF)
An assembly that consists of a frog housing and “vee” rails that are forged as one piece to form a moveable point. This point is moved to the normal position or reversed by a switch machine(s) to direct wheels through the frog area. This frog type is used in a No. 15 or higher turnout. The MPF design provides for a continuous bearing surface for the wheel tread as it traverses through the frog.

Frog – 1/2" Point
The 1/2" point of frog is the point at which the spread between gage lines is 1/2". All measurements in the field are usually made from the 1/2" point of frog.

Frog – Railbound Manganese (RBM)
A frog assembly that consists of wing rails surrounding a manganese casting with a rigid frog point and flangeways. A conventional guard rail is used with this type of frog.

Frog – Self-Guarded (SG)
A frog with a guard member for guiding the flange of a wheel past the point of frog by engaging the tread rim of the wheel in a horizontal plane above the top of the running surface of the frog. This makes a conventional guard rail unnecessary.

Frog – Spring
An appliance that contains, among other things, a fixed frog point, a moveable spring wing rail, a rigid wing rail, frog hold-down assemblies, and spring box. The frog makes use of a long guard rail (on the straight side). The spring frog design provides a continuous bearing surface for the wheel tread as it traverses through the frog point area on the straight side of the turnout.

Frog – Theoretical Point
The theoretical point of the intersection of the gage lines. The theoretical frog point is at a distance, in inches, ahead of the 1/2" point which is equal to one-half the frog number (i.e., number 10 frog is 5").

Frog – Throat of
Point at which the converging wings of a frog are closest together.

Frog – Welded Heel Manganese (WHM)
A frog where the heel of the manganese insert is flash butt welded to the heel rails. A stainless steel section is used to facilitate welding between the manganese insert and rail steel heel rails.

Frogs – Center
The two frogs at the opposite sides of the short diagonal of a crossing or slip.

Frogs – End
The two frogs at the opposite ends of the long diagonal of a crossing or slip.

Frog Angle
Angle formed by intersecting gage lines of the rails in a frog.

Frog (Moveable Point) Lug
The machined part of the forging that is attached to the "vee" rail to which the switch machine rod and basket and circuit controller rod assemblies are attached. The integrity of this lug is critical for the safe operation of the moveable point frog.

Frog Number
The frog angle expressed as the number of units of centerline length in which the spread is one unit (i.e., 10:1 is a number 10 frog).

- G -

Gage Line
A line 5/8" below the running surface of a rail on the side of the head nearest the track center. The line from which measurements of gage are made.

Gage of Track
Distance between gage lines of rails laid in track.

Gage Rod
A device for holding track to correct gage, generally consisting of 1-1/4" rod with a forged jaw on one end and a malleable jaw on the other end, adjustable through a locknut. Sometimes consists of a rod made in two parts with a solid jaw on each end, united by a turnbuckle.

Gaging of Track
Bringing the rail heads of a track into their correct distance apart.

Grade
Rate of rise or fall of the grade line, expressed as a percentage of the feet of rise or fall per 100' of length. A steady rise or fall of 1' per 100' is a 1% grade.

Grade Line
The line representing top-of-rail elevations and the profile of the track.

Grade Rail
The rail first surfaced to track elevation; the line rail on tangents, the inner or low rail on curves.

Guard Rail - Frog
A rail section assembly used in a turnout with a railbound manganese (RBM) frog, spring rail frog, or in track crossings. The guard rail is designed to guide the wheel set through the proper flangeway of the frog. The guard rail prevents the wheel flange from wearing, striking or picking the frog point.

Guard Rail – Inner Track
An additional rail or rails laid parallel to and between the running rails of bridges, bridge approaches, and at other critical locations to prevent derailed equipment from striking a bridge or other structure and to keep the derailed wheels on the ties of the bridge.

Guard Rail – Outer Track
Additional timber laid parallel to the running rails of long-span viaducts.

- H -

Head Block - Switch
Ties used to support the switch-point operating mechanism (powered or unpowered) and the switch stand.

Head or No. 1 Rod
The switch rod nearest the point of a switch, usually placed between the two head block ties.

Heel Block - Fixed
A rigid heel block assembly at the switch heel to maintain the proper horizontal heel spread between the switch rail and stock rail. The heel block limits the amounts of longitudinal movement between the switch point and stock rail. The heel block is bolted to the switch rail and stock rail.

Heel Block - Floating
An assembly at the switch heel to maintain the proper horizontal heel spread between the switch rail and stock rail. If the assembly is bolted to the switch rail only, the switch heel "floats" and is called a floating heel block.

Heel Length - Frog
Distance between the heel end and half-inch point of a frog measured along gage lines.

Heel of Frog
The end of a frog farthest from the switch point.

Heel of Switch
The end of the switch where the switch point connects to the closure rails (see Heel Block – Fixed and Floating). The heel of the switch can be either fixed to the stock rail or allowed to float freely.

Heel Spread - Frog
Distance between gage lines at the heel end of a frog.

Heel Spread - Switch
The distance between the gage lines of the stock rail and switch rail at the heel of the switch.

Highway-Crossing Warning Devices (Active)
An arrangement of one or more highway-crossing signals, with or without gates at a highway grade crossing.

- I -

Impedance Bond
An electrical apparatus at code change points in electric traction areas to separate signal and traction current.

Interlockings
An arrangement of signals, switch locks, and signal appliances so interconnected that their movements succeed each other in a predetermined order. It may be operated manually or automatically.

- J -

Joint Bar
A steel angle bar or other shape used to fasten together the ends of rails in a track. They are used in pairs and are designed to fit the space between head and base of rail (fishing space) closely. They are held in place by track bolts. Also called angle bar, rail joint bar and splice bar.

Joint Bar – Compromise
A special rail joint, sometimes called a step joint, for joining rails of different sections. The joint is made so that it brings gage faces and rail heads into line so that a continuous smooth surface is present for the treads and flanges of passing wheels. The hand of a compromise joint is designated by standing in the gage of track at the small rail section looking or facing towards the heavier rail section to be joined or compromised. In this location in track, the right hand compromise joint is on the right and left hand is on the left. A compromise joint is described by indicating the heavier rail section and then the light rail section to be compromised (i.e., 136/115).

Joint – Frozen
A joint so tight that the rails cannot move within the joint bar as temperature varies.

Joint – Insulated
A rail joint designed to prevent the flow of electric current from rail to rail by means of insulation so placed as to separate the rail ends and other connecting metal parts at the joint.

Joints – Supported and Suspended
A supported rail joint has a tie directly under the rail ends. A suspended joint is one in which ends of the rail joint are not resting on a tie.

Joint Tie
A cross tie used under a rail joint.

- K -

Knuckle Rail
A bent rail, or equivalent structure, forming the obtuse point against which the moveable center points, of a moveable point crossing or slip switch, rests when set for traffic.

- L -

Latch - Switch Stand
A device for catching and holding the lever of switch stand in position, also called a switch keeper. Two latches are used at each switch stand.

Lateral Acceleration
The horizontal acceleration experienced by a rail vehicle that is perpendicular to the direction of travel. Lateral acceleration is a measure of ride quality and measured in units of ft./sec^2(g).

Lateral Resistance
The ability of the track structure to remain in position under the influence of in-service forces that are generated in a plane perpendicular to the line of the rail. Lateral resistance is a product of interaction of the ballast with the sides, bottom and end face of the tie.

Lead (Conventional)
The length between the actual point of switch and the 1/2" point of frog, measured on the line of the straight track.

Lead – Theoretical (Tangential)
The length between the actual point of switch and the theoretical point of a moveable point frog, measured on the line of the straight track.

Level Board
A tool used to determine the cross-level <u>or</u> super elevation of a track.

Lift Rail
The portion of a miter rail assembly that is attached to the moveable span of a moveable bridge. Sometimes called the bridge rail or moveable rail.

Line
The condition of a track in regard to uniformity in direction over short distances on tangents or uniformity in variation in direction over short distances on curves.

Line Rail
The rail on which alignment is based; the east rail of tangent track running north and south, the north rail of tangent track running east and west, the outer rail on curves, or the outside rails in multiple track territory.

Lining Track
Shifting the track laterally to conform to an established alignment. Maintenance lining is ordinarily done during repairs. Lining is done to make the track conform to predetermined alignment.

Longitudinal Resistance
The ability of the track structure to remain in position under the influence of train and temperature forces that run parallel with the rail. Longitudinal resistance is a product of the interaction of the ballast, the tie, rail anchors, rail clips and other elastic fasteners.

L/V Ratio
The relationship of lateral force on the rail to the vertical force on the rail, which is produced by the wheel of railroad rolling stock, locomotives, work equipment and other equipment moving along the track.

- M -

Maximum Authorized Speed (MAS)
That maximum speed for a portion of track as specified in the current Employee's Timetable.

Mechanical Stabilization
A procedure used to restore lateral and longitudinal stability of disturbed track following maintenance operations. This procedure may incorporate dynamic track stabilizers which are units of work equipment that are used as a substitute for the action provided by the passage of tonnage trains.

Middle Ordinate
The distance measured from gage line of rail to the middle of a string drawn taut and held to contact with the gage line of rail at its end. The middle ordinate provides a means of measuring curvature. Can also be used in bending rails to a desired curvature.

Miter Rail
A rail assembly on a moveable bridge that spans the gap between the moveable span and the adjacent stationary portion of the bridge. The miter rail typically consists of two pieces. One rail is stationary or fixed and attached to the non-moving portion of the bridge and the second rail is attached to and moves with the moving portion of the bridge.

The term miter is used because typically the abutting ends of the two portions of the miter rail assembly, rather than being cut square as in a conventional rail joint, are cut at an acute angle or "mitered" relative to each other. The miter can provide the wheels with continuous support over the rail gap.

Because one rail must be able to move relative to the other when the bridge is being opened, the abutting ends of the miter rail assembly are not bolted to each other as in a conventional rail joint, but rather sit in bed plates that align one end of the miter rail relative to the other.

Moveable Bridge
Any bridge span over a navigable waterway that can be moved to accommodate the passage of vessels taller than the normal underclearance of the bridge.

Moveable Center Point
One of the moveable switch points of a moveable point crossing or slip switch.

- N -

Neutral Temperature
The temperature at which rail is secured in a stress-free condition.

Neutral Temperature Management (See Appendix A)
Maintaining the condition of the track structure so that the neutral temperature of the rail remains within the acceptable neutral temperature range.

Number - Turnout
The number corresponding to the number of the frog used in a turnout.

- O -

Out-of-Face Surfacing or Lining (See Appendix A)
The continuous surfacing and/or lining of a piece of track greater than 200' in length.

Out-of-Face Tie Renewal (See Appendix A)
Tie replacement at the rate of more than six (6) ties per 39' of rail.

Out-of-Face Undercutting (See Appendix A)
Undercutting of more than two (2) consecutive ties or more than six (6) ties in 39' of track.

- P -

Post – Bumping
A device at the end of stub track to prevent rolling stock from going off the ends of the rails.

Profile
A longitudinal section through a track that shows elevation of the grade rails. The profile is usually obtained from levels taken on top of the rail.

- R -

Rail - High
The outer or elevated rail of a curved track, which is maintained as the line rail.

Rail - Low
The inner rail of a curve which is maintained as the grade rail.

Rail – Nervous Track
CWR which exhibits minute alignment irregularities which indicate that the rail is in a considerable amount of compression.

Rail - Scrap
Rails of standard section not fit for use as relayer rail.

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

Rail Bender
A tool for bending stock rails.

Rail Bond
A device used to transfer an electric circuit across rail ends at a rail joint or discontinuity in the rail.

Rail Brace
A device used at switches, moveable-point frogs, guardrails, etc., in combination with switch, tie or gage plates, for holding rail in place in the plate and preventing lateral displacement.

Rail Brand
An identification mark, including manufacturer’s name or initials, month and year the rail was rolled, manufacturer’s identification label, weight per lineal yard, initials of section, number of the heat, portion of the ingot and process of manufacture.

Rail Fastening System
The hold-down appliances that provide the required combination of horizontal, lateral and vertical restraint to permit the safe operation of rail vehicles. Examples of conventional systems found on MNR include the cut spike and rail anchor. Examples of elastic fastening systems include the Pandrol “e” clip, fast clip with a pin (lock spike) or lag screw.

Rail Joint - Pumping
A poorly supported rail joint that has excessive up and down movement under the passage of trains.

Rail Section
The pattern of dimensional details of rail, such as width of base, height of rail, thickness of web, width and thickness of head, angle of head and angle of base. Each particular pattern is identified by a brand name or symbol, in addition to its weight per yard.

Rail Stretcher Expander
A rail puller/expander operated by hand or by machine that is used to increase or decrease the gap between adjoining rail ends.

Rail Temperature
The temperature of the rail, measured with a rail thermometer on the shaded side of the web.

Rail Weight
The weight of a three (3) foot-long section of rail expressed in pounds per yard.

Remedial Actions
Those actions which track owners are required to take as a result of requirements of this part to address a non-compliant condition.

Roadbed
The finished sub-grade surface upon which the track and ballast rest.

Rod - Operating
A rod attached to a switch, derail, or other device, for moving it from one position to another. The operating or throw rod can be reset to adjust the amount of throw occurring at the switch or frog point.

Running Rail
The rail or surface on which the wheel bears.

Runoff - Curve
The change in superelevation in the spiral/easement from the full body of a curve to tangent or between compound curves.

Runoff - Surface
An area of grade change in track where the raised portion of a track is connected with the existing grade. The runoff between the two elevations is made along the two rails at a designated rate of change per 31' station for comfort and safety.

- S -

Scrap
Rail, ties or other track materials (OTM) that are not suitable for reuse.

Screw - Lag
A cylindrical threaded steel spike with a square head designed to be turned with a special appliance into holes bored into ties.

Shim - Track
A bearing piece, usually wood or metal of various thickness, at least equal to the width and length of the tie plate, for temporary use between the tie plate and ties to raise (surface) the rail to a desired relative elevation. Usually used to spot surface a track when the roadbed is frozen and the ties cannot be tamped and surfaced.

Side Planing - Undercutting
Cuts made on sides of the head of the switch rail to form a taper from the full width of the head to the switch point. Also used in a stock rail to match undercut switch points. This process is also used in a moveable point frog.

Slip Switch – Double
A combination of a crossing with two right-hand and two left-hand switches connecting the two intersecting tracks on both sides of the crossing without the use of separate turnout frogs.

Slip Switch – Single
A combination of a crossing with one right-hand and one left-hand switch and curve between them within the limits of the crossing and connecting the two intersecting tracks without the use of separate turnout frogs.

Smoothing
Surfacing a piece of track up to and including 10' in length.

Spot Surfacing (See Appendix A)
Surfacing a piece of track up to 200' in length.

Spot Tie Renewal (See Appendix A)
Replacing up to four ties in 39' of track where there are at least four adjacent ties on each side of the tie to be placed, no protection is required.

Stock Rail
The two running rails that support the operation of the switch points. The straight stock rail is on the straight side of a lateral turnout. The bent stock rail or curved rail is on the diverging side of the turnout. The switch points fit securely against or are undercut into the stock rail to permit the transfer of wheel load from the stock rail to the switch point. An equilateral turnout has two straight stock rails.

Stock Rail Bend
The bend or set that must be given the stock rail to allow the switch point to follow the gage line through the turnout. Usually, the stock rail on the diverging side of a turnout is bent. The opposite stock rail is straight.

Stringlining
A method for determining the alignment of a curve, by measuring mid-ordinates to the outer rail with string and paddles.

Sub-ballast
Any approved granular material which is placed between the ballast and finished sub-grade of the roadbed, to provide distribution of the load to the roadbed, better drainage, and prevent upheaval of the sub-grade by frost.

Sub-grade
The top of natural materials, gravel or crushed rock, usually inferior to ballast or sub-ballast, placed in fills or at the bottom of cuts that lie directly below the sub-ballast and ballast.

Superelevation – Equilibrium
The elevation of the outer rail which balances the centrifugal forces while negotiating a curve at a given design speed.

Superelevation
The height at which the outer rail is raised above the inner or grade rail on curves to resist the centrifugal force of moving trains.

Swing Bridge
A moveable bridge that pivots around a pier in the center of the span.

Switch
A connection between two lines of track to permit flange wheeled rail vehicles to pass from one track to another.

Switch – Insulated
A switch in which the fixtures, principally the gage plates and the switch rods connecting one rail to the other, are provided with insulation so that electric currents will not be shunted.

Switch – Spiked/Clamped
A switch point that is secured in one position through the use of spikes, blocks and clamps.

Switch – Throw of
The distance measured between the switch point and stock rail at the point of switch.

Switch Heater
A device for melting snow with heat generated by an electric current, gas or propane. This device enables a switch which is so equipped to be thrown in inclement weather when there are accumulations of sleet, ice or snow.

Switch Lock
A fastener, usually a spring padlock used to secure the switch or derail stand in place.

Switch Machine
The signal appliance that powers and provides for the positive movement and locking of the switch points and/or moveable point frog to permit the safe, uninterrupted movement of rail vehicles through a turnout.

Switch Machine Rod Basket
The appliance that connects the operating rod to the No. 1 tie rod in the switch or to the frog point lug of a moveable point frog

Switch Obstruction Test
This test is used as part of the criteria to determine if the switch points in signal territory are properly fitting up against the straight and bent stock rails or if the moveable point of a moveable point frog fits against the moveable point frog housing. This test ensures that the proper signal indication is being conveyed as the points move and are seated.

Switch Plate
A special metal tie plate for use on switch ties, each plate being long enough to extend not only under the stock rail and its supporting braces, but also under the switch point in the open position. Switch plates are furnished in sets to correspond with switch length. There are two plates to each tie. However, at the point of switch and at helper locations, the two plates may be replaced by a gage plate(s) that carries both switch points. A type of high-profile switch plate used in some turnouts which contain two elastic clips to secure the stock rail to the switch plate.

Switch Point
The moveable rail of a switch which determines the direction of train movement.

Switch Point – Asymmetrical
A switch point manufactured from a rail section that in cross section does not have the same shape or form about the center line through the end of the rail.

Switch Point – Housed
The design makes use of a recessed vertical matting surface between the switch point and stock rail. The switch point is recessed behind the gage line of the rail. The “housing” of the switch point is achieved by vertical milling on the gage face of the stock rail.

Switch Point – Undercut
A switch point that is planed on the field side to fit securely against an undercut stock rail.

Switch Point Guard
A structure made of rail or manganese steel secured to the field side of the running rail at the point of switch, with suitable flares to engage the tread rims of wheels and guide the wheel past the switch point. This appliance is intended to reduce or eliminate switch point contact and wear. This appliance is to be used where operating speeds are 15 mph and less.

Switch Point Lug (Clips)
The lug attached to a switch point, to which the front rod is connected.

Switch Point with Graduated Risers
A switch in which the switch points are gradually elevated by means of graduated riser plates, until they reach the required height above a stock rail and sloping back to zero at the fixed heel block.

Switch Point with Uniform Risers
A switch in which the switch points have a uniform elevation on riser plates for the entire length of the switch, and therefore do not have a heel slope. The switch point rail rise is run off in back of the floating heel block.

Switch Rod
The rods that connect the left hand and right hand switch point to ensure proper gage, alignment and adjustment throughout the switch.

Switch Stand
A manually operated device by which a switch is thrown, locked, and its position indicated. It consists essentially of a base, spindle, lever, connecting rod and target.

Switch Target
A signal placed adjacent to or fixed on the spindle of a switch stand with reflective materials indicating the position of the switch.

- T -

Tension
An axial force caused by equal and opposite forces pulling at the ends of the rail.

Thermal Loading
The compressive forces generated in the rail due to its temperature being increased above its neutral temperature.

Thimble (Insulated Joints)
The cylindrical pieces of an insulating joint that surround portions of the bolts.

Throat of Frog
The point at which the converging wing rails of a frog are close together just ahead of frog point.

Tie
A transverse support to which rails are fastened to keep them in line, gage and grade. Usually wooden or concrete.

Tie - Centerbound
Ballast condition where an unusually large percentage of the wheel load is carried at the center of the tie. This is an undesirable situation as compacted ballast under the rail seats should carry the load.

Tie Plate
A metal plate at least 6" wide and long enough to provide a safe bearing area on the tie, with a shoulder to restrain lateral movements of the rail.

Tie Plate - Twin
A tie plate in two parts that mate to form a combined width equal to that of the stand tie plate, for use back of the heel of switch to the point where standard tie plates may be applied.

Tie Plug
A wooden plug driven in to fill an unused spike hole or lag hole in a tie, to exclude moisture, prevent decay, and provide solid wood for re-driving of the spike. Usually supplied in the form of sticks containing several plugs.

Tie Spacing
The distances between tie centers in track or turnouts.

Tie Splice - Flexible
The mechanical connection to splice switch ties together in a crossover. This device maintains the gage of the rails in the diverging side of the crossover where long and short switch ties meet but are not continuous. This device can be used to join concrete to concrete switch ties.

Tight/Kinky Rail
CWR which exhibits minute alignment irregularities which indicate that the rail is in a considerable amount of compression.

Toe End of Frog
The end of a frog nearest the switch.

Toe Spread
The distance between gage lines at the toe end of the frog.

Tourist, Scenic, Historic, or Excursion Operations
Railroad operations that carry passengers with the conveyance of the passengers to a particular destination not being the principal purpose.

Track
The rail, ties, rail fastenings, hardware and roadbed between points not less than 4' outside of each rail.

Track Breathing
The changing of the neutral temperature of CWR as a result of the natural cycle of seasonal temperature and the effect of the dynamic loading due to train operations.

Track Buckling
The sudden formation of large lateral misalignments caused by high compressive forces, in the presence of some other influencing factors.

Track Lateral Resistance
The resistance provided to the rail/crosstie structure against lateral displacement.

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

Track - Skeletonized
Track with ballast removed from the cribs between ties.

Track Spike (Cut Spike)
A rectangular metal fastener with an elliptical head designed to secure tie plates and/or rail to wood ties and timber.

Track - Surface
The condition of the track structure as to vertical evenness or smoothness.

Tractive Force
The longitudinal force induced into the rail as a result of the tractive effort exerted by the powered axles of rail vehicles.

Trailing Point
A trailing point move would pass over the frog and then the switch points.

Train-induced Forces
The vertical, longitudinal and lateral dynamic forces which are generated during train movement.

Transition Rail
A rail that joins two rails of different sections. It consists of two different rails flash butt welded to a middle forged section of rail. This rail is used in place of compromise bars.

Transition Spiral
An easement curve from the tangent to the curve.

Transpose Rail
Changing rail from one side to the other on curves because of headwear.

Turnout (TO)
An arrangement of a switch and a frog with closure rails, by which rolling stock can be diverted from one track to another.

Turnout (Premium Design)
A turnout that contains tangential design with asymmetrical switch points and a moveable point frog or a conventional rail switch point with a new generation spring frog.

Turnout – Conventional
A turnout whose transition from tangent to curve is abrupt because of alignment changes between the switch point and frog. These turnouts are usually constructed on wood ties, but can also be constructed on concrete ties. These turnouts usually have a “tee” rail switch point section and a self-guarded manganese (SG) frog or railbound manganese (RBM) frog.

Turnout – Tangential
A turnout where the diverging route consists of a long smooth gradual curve between the point of switch and moveable point frog. In most cases, the tangential turnout has an asymmetric switch point. Lateral forces generated by vehicles in a tangential turnout are less than in a conventional turnout. The choice of tangential turnouts is driven by ride quality, increased maximum diverging speeds, increased safety factor and reduced maintenance.

- U -

Underbalance
The difference between the actual superelevation and the amount of superelevation calculated for equilibrium conditions. Design underbalance on MNR is 3".

Unscheduled Detour Operation
A short-term, unscheduled operation where a track owner has no more than 14 calendar days' notice that the operation is going to occur.

- V -

"Vee" Rail
The moveable point portion of a moveable point frog that lies between the wing rails. The "vee" rail is fixed on the heel end and it is free to move laterally at the point end. This rail permits the safe and continuous movement of wheels through a moveable point frog.

- W -

Washer – Spring (Lock)
A spring tensioned member designed to prevent movement of a nut and the loosening of a bolted member due to wear, stretch or other deterioration.

Weld – Flash Butt
A butt weld joining two abutting rails. This weld serves to join the rail ends using only parent materials. Electric flash butt rail welding is accomplished with a stationary or portable electrical plant.

Weld - Thermite
A weld joining two abutting rails. The weld serves to unite the abutting rails with the introduction of metal weldment into a preset gap. This is an alumnothermic process that is accomplished by using weld kits..

Wheel Tread
The flat or tapered surface of a railway wheel that contacts the top surface of the rail head.

Wing Rail
The left and right rails that are run from the toe to the flared end of a moveable point frog, railbound manganese frog (RBM) or spring frog.

Metro-North Railroad

APPENDIX G

TRACK DEPARTMENT SURFACING GUIDELINES

APPENDIX G

TRACK DEPARTMENT
SURFACING GUIDELINES

APPENDIX G

TRACK DEPARTMENT SURFACING GUIDELINES

1.0 General

(a) A general view of the track surfacing methods being applied on MNR are presented below. This Appendix does not address the skills required to operate each piece of equipment but provides guidelines and the technical requirements for surfacing and aligning track. The importance of computer methods and measurements are stressed and described in detail. Work methods and procedures are identified and explained and must be followed to ensure quality and consistency of track that is surfaced and aligned.

(b) Typical equipment contained in surfacing consists are a tamper, stabilizer and ballast regulator.

(1) Tampers: The tamper is used to surface and align the track. Most tampers are equipped with a micro-based computer, wireless communications and appropriate transponder hardware and software. Tampers have lasers and have computer-guided capabilities as well as manual modes of operation.

(2) Stabilizer: The stabilizer is used after surfacing and aligning to increase the longitudinal and lateral stability of the track. The stabilizers may measure and record track surface prior to stabilizing and after stabilizing. Stabilizers simulate the consolidating effects of a train by inducing constant vertical pressure simultaneously with horizontal vibration. The rate of vibration may be modulated by the operator as conditions dictate.

(3) Ballast Regulator: The ballast regulator regulates and distributes ballast as required both ahead of and behind the tamper. All controls are within the cab to ensure a safe, clean operator environment. The regulator, if so equipped, may be loaded with ballast prior to entering a work zone.

(4) All the surfacing and aligning equipment has been designed to be used in an efficient and safe manner. Headlights are on the front and rear of each piece of equipment. Lights are strategically placed for nighttime work. Jump seats are installed for crew members to sit during transit and movement of equipment. Cabs and controls are ergonomically designed. Each piece of equipment is equipped with a radio.

(5) Metro-North Railroad's investment in the surfacing equipment is substantial. It must be **protected and respected** to ensure the railroad's maximum return on investment. **When present on the machines or owning a job on a machine, it is your responsibility to keep it safe, secure, clean and in well-working order! Properly**

maintained equipment contributes to a safe work environment.

(6) To ensure the integrity of on-board systems (computers, circuit boards and other equipment), machine inspections will be periodically conducted by the Supervisor of Track Surfacing.

(7) Quality trackwork can only be achieved with a well maintained, properly operating machine.

2.0 Clearances

(a) When surfacing and aligning track on Metro-North Railroad you must be aware of and concerned about clearances. Track centers, bridge girders, viaduct columns, overpasses and stations all require extra caution when aligning and surfacing track.

(b) At the present time manual methods and safeguards will be employed when surfacing and aligning track. In the future, computer techniques will be developed as a tool for the Surfacing Foreman to monitor and set clearances.

(c) Overhead Clearance Verification:

(1) All clearances will be checked in accordance with the Metro-North Standard Plan 70051 Minimum Roadway Clearances (see Part II, Track Maintenance)(M).

(2) Measuring the vertical clearance will be accomplished using a measure pole. This instrument is assigned to each surfacing consist. The Surfacing Foreman of the consist will be responsible for the safety and operation of the pole. The pole is supplied with a case and has a 26-foot measuring limit. Readings are given in feet and inches.

3.0 Curve Tags

(a) Because of the computerized methods used when surfacing and aligning track, curves are built (lined and surfaced) with consistent accuracy and repeatable results.

(b) Proper marking of the curves are required for identification of the transition points throughout the curve. Curve tags are used to mark transition points.

(1) Curve tags are placed at each transition point along the curve and are sufficient to properly identify any curve. The curve transition points are: tangent to spiral (TS) and spiral to tangent (ST).

(2) The curve tags are small metal plates, which are stamped with the super elevation, or tangent to spiral (TS) and spiral to tangent (ST).

(3) The foreman of each surfacing consist is issued all the necessary equipment to produce curve tags (i.e., tags, hammer, nails, adhesive for concrete ties, numerical and alpha punches). It is the responsibility of the Surfacing Foreman to ensure that all curves are properly tagged.

(4) When placing the tags, keep in mind that they must be within the limits of the regulator “tunnels” so as not to be destroyed when regulating and dressing.

(b) Illustrated below are some examples of the information found on curve tags and their placement.

*Notes: Tags placed at full elevation are always placed parallel with the high rail.

(c) The required superelevation for the maximum authorized speed (MAS) on any track for 3" unbalanced elevation (E_u) is given in Appendix C, “Underbalance Tables Maximum Allowable Operating Speed On Curves.”

(d) The design rate of change in spirals for each 31' station is:

Maximum Authorized Speed (MAS)	**Design Rate of Change Per 31'**
Up to 60 MPH	1/2"
60 to 90 MPH	3/8"
Over 90 MPH	1/4"

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APPENDIX H

MASTER INDEX

APPENDIX H

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EXPLANATION OF THE MASTER INDEX

This Master Index is sorted by subject and references the appropriate paragraph number, part and page number for Parts I, II and III.

The following table shows the relationship of the part numbers and acronyms (Note A) used in Parts I, II and III and the Master Index.

	Inspection (Part I)	**Maintenance (Part II)**	**Construction (Part III)**
Track	Example: §213.53	§53.0(M)	§53.0(C)
Special Trackwork	Example: §213.53(ST)	§53.0(STM)	§53.0(STC)
Miter Rails	Example: §213.53(MR)	§53.0(MRM)	§53.0(MRC)

<u>Note A:</u>

The acronyms used in Parts I, II and III are as follows:

ST = Special Trackwork

MR = Miter Rails

M = Maintenance

STM = Special Trackwork Maintenance

MRM = Miter Rail Maintenance

C = Construction

STC = Special Trackwork Construction

MRC = Miter Rail Construction

MASTER INDEX
PARTS I, II AND III

Paragraph #	Subject (Paragraph Name)	Part and Page #
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§57.0(M)	Curves: Elevation and Speed Limitations	II-18
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§213.113	Defective Rails	I-16
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§213.143	Frog Guard Rails and Guard Faces; Gage	I-49
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§53.0(MRM)	Gage	II-108
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MASTER INDEX FOR
APPENDICES A THROUGH H

This Master Index is sorted alphabetically by Appendix letter.