TRACK STANDARDS

RC-0506-02TRK

May 2018

METROLINX

GO TRANSIT TRACK STANDARDS

RC-0506-02TRK

Publication Date: June 2016
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PREFACE

This is revision 1 of the GO Transit Track Standards RC-0506-02TRK May 2018. It is adapted from CN Engineering Track Standards as per the agreement between Metrolinx and CN on March 28, 2013. In accordance with the agreement, Metrolinx is authorized to affix the name of Metrolinx/GO Transit to the CN Standards, shall remove all references to CN and update/ modify the standards to Metrolinx/GO Transit Standards.

The purpose of the GO Transit Track Standards is to ensure that Metrolinx and GO Transit owned and operated track is constructed and maintained utilising safe, cost effective and efficient methods to meet project delivery timelines, and meet on-time operational performance goals. Furthermore, a consistent approach in the application of GO Transit owned track standards shall reduce disputes during the design and construction phases of a project, enhance the long term safety, reliability and extend the useful service life of the track infrastructure.

The technical content within the GO Transit Track Standards RC-0506-02TRK was modified/developed by the Metrolinx / GO Transit Track Standards Committee which includes specialized subject matter experts.

Note

The GO Transit Track Standards RC-0506-02TRK documents' most current version is intended for use by suitably qualified professionals. It is not a substitute for coordination and compliance with all applicable local codes, standards, manuals, and approvals for fire protection, life safety, and security measures that are part of the planning, design and implementation of a railway.

Suggestions for revisions and improvement

Suggestions for revision or improvement can be sent to the Metrolinx / GO Transit Track Standards Committee, Attention: Corridor Maintenance (CM) Senior Manager of Track and Structures who shall introduce the proposed changes to the

Metrolinx Track Standards Committee. The CM Senior Manager of Track and Structures ultimately has the deciding vote. Be sure to include a description of the proposed change, background of the application and any other useful rationale or justification. Be sure to include your name, company affiliation (if applicable), e-mail address, and phone number.

GENERAL REQUIREMENTS

1. The maintenance and construction standards and practices contained herein shall apply to all track and rights-of-way owned or operated by GO Transit ("the Railway"), and UP Express, which are divisions of Metrolinx, and are intended as the requirements but not intended to replace or supersede the Transport Canada Rules Respecting Track Safety.
2. Changes in railway standards or practices that do not conflict with TC standards may be implemented on a phased schedule or program, at the Corridor Maintenance (CM), Senior Manager of Track and Structures discretion.
3. All new or modified materials or equipment shall be subjected to a service test, unless otherwise directed by the CM Senior Manager of Track and Structures.
4. Under the requirements of these Standards, and where appropriate, the CM Senior Manager of Track and Structures may delegate their authority to a designated individual.
5. Designated Authority, as described above, shall be summarized at the end of this document.
6. The most current version of the GO Transit Track Standards and all applicable bulletins shall be located on the Metrolinx internal MYLINX intranet website at: mylinx/sites/RailServ/en/Pages/Track-Standards.aspx, under title "GO Transit Track Standards".

These standards are effective as of May 14th, 2018

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Section 1 Requirements

1.1. General

1. The Standards, practices, and procedures contained herein MUST be followed to ensure the safety of the Railway and/or to comply with regulation, or action MUST be taken to protect the condition, as in Section 1.2 below.

1.2. Track Standards

1. The black text within this document is the requirement for constructing, inspecting, and maintaining track owned and operated by GO Transit ("The Railway"), and UP Express, which are divisions of Metrolinx. Conditions on track must meet or exceed the minimum requirements laid out in this document. Where conditions on track do not comply with these requirements, immediate action must be taken to:
    a. Bring the track back into compliance as per the standards (e.g. protect, repair, slow order, etc.); or,
    b. Remove track from service until the minimum required repairs can be completed.
    c. In addition to the above requirements, the CM Manager of Track shall be notified immediately.
2. All employees responsible for the maintenance and/or inspection of track owned and maintained by GO Transit, must be trained and pass a qualifying test in these Track Standards at least every 3 years.
3. A qualified and certified track inspector must have a minimum of 2 years railway experience as determined by the CM Senior Manager of Track and Structures.
4. All employees responsible for the inspection, installation, adjustment, or maintenance of CWR track must be trained and pass a qualifying test on CWR Procedures.

5. The testing standard as per the requirements in clause 2, 3, and 4 as noted above, will come into effect within three years from the issuance of this document. Until such date, the Canadian National Railways Track Inspection Guidelines, and Continuous Welded Rail qualifications are acceptable.

6. Safety is the most important aspect of any job. Understanding and following safety rules and safe work practices is a condition to work on GO Transit and Metrolinx property. When in doubt, employees must take the safest course of action.

1.3. Recommended Methods

1. The blue text within this document contains the Recommended Methods, which shall be used as a guideline for performing the work described.

2. All employees responsible for the maintenance and/or inspection of track owned and/or maintained by GO Transit, must be familiar with the Recommended Methods contained herein.

1.4. Miscellaneous

1. For all new track construction and track rehabilitation projects, the horizontal and vertical deviation, and geometry tolerances shall meet or exceed those found in Appendix O – Minimum Construction Standards.

2. For all existing track, all track geometry maintenance parameters shall meet or exceed the requirements of Track Standard Section 16 Track Geometry.

3. Track and signals maintenance personnel require access to the track, signals, and wayside infrastructure with road vehicles. Emergency vehicles also require access to the rail corridors at times. Where practical, provision shall be made for roadway access in the layout of track, utilities and railway related infrastructure, within the rail corridors.

4. Tracks designated for maintenance use only (MOW) should be considered in the design of track. A pocket

track of 1,200 ft. (365.8 m) in length is recommended to be installed on a case by case basis per each project and subdivision.

a. These MOW tracks and locations must have adequate access by vehicles;

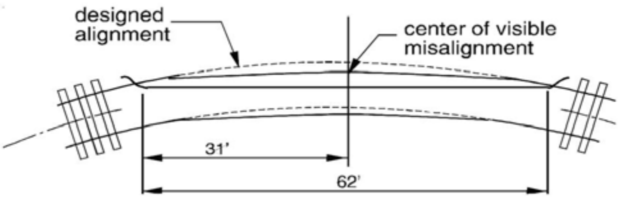
b. Locations must be reviewed by the CM, Manager of Track.

5. Prevention of fires on railway property and structures must be considered at the beginning of each task when working on the right-of-way. See Track Standards Section 24 .

Section 2 Definitions

1. Adjustment Length - The amount that rail is to be adjusted based on the length of rail removed.

2. Alignment – The measurement used to describe the line uniformity (straightness) of the rails in a horizontal plane. The measurement for alignment shall be the maximum mid ordinate, (positive or negative), in inches, of a 62 ft. (18.9 m) or 31 ft. (9.5 m) chord measured at the gauge point. On a curved track the high (outside) rail is used as the line rail.



3. Andian Vehicle – A type of Light Geometry Inspection Vehicle, used regularly on GO Transit owned corridors.

4. Battered End - A flattening down and widening of the rail head at the end of a rail.

5. Bolt Hole Break - a crack across the web, originating from a bolt hole, and progressing on a path either inclined upward towards the rail head or downward towards the base

6. Broken Base - any break in the base of a rail

7. Bumping Post - A device at the end of a stub track to prevent rolling stock from going off the ends of the rails.

8. Categories of Yard Track

   a. For the purposes of these Track Standards, all Yard tracks shall be maintained to Class 1 maintenance standards.

9. Class of Track – The allowable train speed on a subdivision, or portion thereof, shall be used to determine the class of track per the table in Track Standard Appendix A – Class of Track

10. Clearance Point - The location between two adjacent tracks beyond the frog of a turnout at which a specified clearance is provided between the tracks.

11. Compromise Bars - Rail joint bars connecting rails of different heights and sections.

12. Continuous Welded Rail (CWR) - Rail that is welded into lengths of 400 ft. (122 m) or greater, including fixed points between such lengths.

13. Cross Level - The measurement for cross-level shall be the difference in elevation, in mm or inches, between the grade rail and the other rail, measured with a level board.

14. Crossover – A track or two turnouts connecting two generally parallel adjacent tracks, which allow rail vehicles to cross from one track to another.

15. Crushed Head / Flattened Rail - a short length of rail, not at a joint, which has flattened out across the width of the rail head. 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

16. Damaged by Defective Rolling Stock - Rail that has been nicked on the head, base or web by flat wheels, broken wheels, or dragging equipment. Rail defects caused by damaged rolling stock will have defect codes which reflect the type of defect the damaged rolling stock created.

17. Damage by Derailment - Rail that has been broken, bent, nicked or otherwise damaged by derailment of equipment. Rail defects caused by derailments will have defect codes which reflect the type of defect the derailment created.

18. Damaged Rail - Any rail broken or damaged by wrecks, broken, flat, or unbalanced wheels, slipping, or similar causes, as well as by track units or off-track equipment.

19. Defective CAD Weld - The detail fracture from a welded bond connection is a progressive transverse defect that develops and expands from the point on the rail head where a head bond is attached.

20. Defective Gas Weld - A progressive crosswise fracture starting from a nucleus in the vertical centre of the weld where the two rail ends meet during the welding process.

21. Defective Weld - a field (DWF) or plant (DWP) weld containing any discontinuities or pockets, exceeding 5 percent of the rail head area or 10 percent in the aggregate, oriented in or near the transverse plane, due to incomplete penetration of the weld metal between the rail ends, lack of fusion between weld and rail end metal, entrainment of slag or sand, under-bead or other shrinkage cracking or fatigue cracking.

22. Destressing Rail - The operation of removing or adding steel in continuous welded rail, to make the longitudinal thermal stress equal (within specified limits) to what it would be if laid stress free at the preferred rail laying temperature.

23. Diamond - An intersection of two tracks at grade with no connecting route between the two tracks.

24. Direct Fixation Track – (DFT) An “open” track-form with nearly all of the major components easily visible and accessible for inspection and maintenance. As compared to traditional ballasted track, DFT is fixed directly to a concrete slab eliminating the requirement for ballast and ties.

25. Double Slip Switch - A combination of a movable-point crossing and two turnouts interconnected into one assembly. The turnout switches are located between the end frogs of the crossing.

26. Engine Burn - Damage to the running surface of the rail caused by a slipping wheel.

27. Fire Watch – A person assigned to observe a location during and after hot work.

28. Flange Wear (Gauge Wear) – Is the reduction in head width of the rail on one side compared to the nominal rail

section. It is measured 5/8 in. (16 mm) below the top of the rail head.

29. Flash Butt Weld –A process of fusing rail ends together using electric current. Flash butt welds provide a weld superior to thermite welds and are always to be preferred over thermite welds where practical.

30. Frequency of Inspection

   a. Twice Weekly - a minimum of two inspections each week (Sunday to Saturday), with no more than 3 days between inspections

   b. Weekly – A minimum of one inspection per week, with no more than 10 days between inspections

   c. Twice Monthly – A minimum of two inspections each month (1st of the month to the last day) and with no more than 20 days between inspections

   d. Monthly – A minimum of one inspection per month with no more than 40 days between inspections

   e. Quarterly – A minimum of one inspection each quarter (Jan 1 - Mar 31, Apr 1 – June 30, Jul 1 – Sept 30, Oct 1 – Dec 31), with no less than 60 days between inspections, and no more than 100 days between inspections

   f. Three times annually – a minimum of one inspection each 4 months (Jan 1 – Apr 30, May 1 – Aug 31, Sept 1 – Dec 31) with no less than 90 days between inspections, no more than 180 days between inspections

   g. Twice Annually – a minimum of one inspection every 6 months (Jan 1 – Jun 30, Jul 1 – Dec 31), with no less than 120 days between inspection and no more than 225 days between inspections

   h. Annually – one inspection per year (Jan 1 – Dec 31), with no less than 180 days between inspections and no more than 400 days between inspections

31. Frog - A track structure in a turnout or track crossing used at the intersection of two running rails to provide support for wheels and passageways for their flanges, thus permitting wheels on either rail to cross the other.

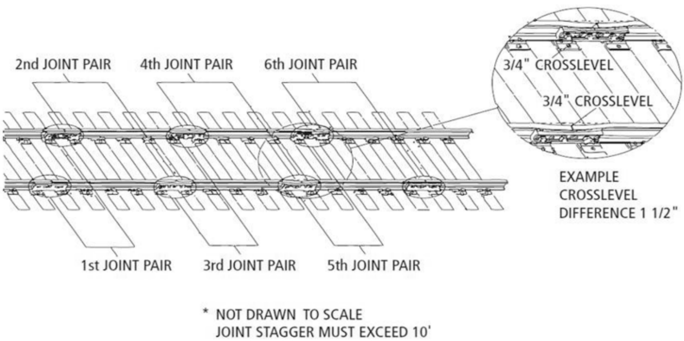
32. Gauge – The perpendicular measurement between the gauge faces (inner sides) of the two running rails taken at 5/8 in. (16 mm) below the centre of top of rail head. Standard gauge is 56½ in. (1,435 mm) on tangents and curves up to 14°. Refer to Track Standard Section 4.5 standard gauge of curves over 14°.

33. Grade Crossing - is an intersection where a road, path, or railway crosses railway tracks at the same level. Grade crossings are also known as level crossings, railway crossings or train crossings.

34. Grade Crossing Standards - Road/Railway Grade Crossings: Technical Standards and Inspections, Testing and Maintenance Requirements, established by the Department of Transport (Transport Canada), as amended from time to time.

35. Guard Rail – (GTS-1108) Rail installed on bridges, high embankments and other designated locations as a safety appliance. They are intended to contain and guide a derailed truck, keeping the vehicle upright on the track structure. Guard rails are also installed on turnouts to protect the frog.

36. Harmonics (Rock and Roll) – The motion on rolling stock created through a series of low staggered joints.



37. Head-Web Separation - A progressive fracture longitudinally separating the head and web of the rail at the fillet under the head.

38. Head Wear (Vertical Wear) – Also known as loss of vertical height, is the reduction in the total height of the rail compared to the nominal rail section, measured in the centre of the head of the rail.

39. Horizontal Split Head - A horizontal progressive defect originating inside of the rail head, usually one quarter inch or more below the running surface and progressing horizontally in all directions, and generally accompanied by a flat spot on the running surface. The defect appears as a crack lengthwise of the rail when it reaches the side of the rail head.

40. Hot Work - Any activity which involves cutting, grinding, welding, or open flames.

41. Impedance Bond – An electrical apparatus at code change points in electric traction areas to separate signal and traction current.

42. In Service Rail Failure - An occurrence of any type of rail break or rail weld failure in normal service.

43. Insulated Joint - A rail joint in which electrical insulation is provided to stop electrical current from flowing from one rail to another, separating sections of track into distinct circuits for signal shunting and operation of signal system and crossing protection.

44. Interlocking – An arrangement of interconnected signals and signal appliances for which interlocking rules and special instructions are in effect.

45. IRIS – Integrated Rail Inspection System – A GO Transit heavy truck outfitted with equipment having the capability to test track geometry under loaded conditions, rail wear, and rail flaw testing.

46. Joint - Locations where two rail ends meet and are connected with a joint bar, or by other means. Jointed rail shall be laid with staggered joints.

    a. Permanent Joint – are fully drilled and bolted. For all joints in CWR, every tie is box anchored for a minimum of 200 ft. (61 m) in each direction and spiked to pattern D for 19 ft. 6 in. (5.9 m) on both sides of joint.

b. Temporary Joints – are joints which are expected to be removed from track, or are intended to be welded. In CWR, all holes are drilled except those nearest the rail ends.

c. Supported Joint – are joints (not including insulated joints) that have the centre of the joint located over a tie plate. Supported joints cannot be welded without moving the tie.

d. Suspended joint – have the centre of the joint located between ties.

47. Localised Surface Collapse - A flattening down and widening of the rail head other than at the end of a rail, not associated with any internal defect in the rail.

48. Match Marks - Marks placed on the base and tie plate, used when destressing rail to ensure that rail has moved the required amount.

49. MGT (Million Gross Tons) – The total weight that travels over a section of track.

50. Mill Defect - Deformations, cavities, laps, seams, scabs, burnt steel, or foreign material found in any portion of the rail.

51. Ordinary Break - a partial or complete break in which there is no sign of a fissure, and in which none of the other defects described in this paragraph are found.

52. Overhead Contact System (OCS) – The part of the electric traction system comprising the overhead conductor(s), aerial feeders, support structures, and other assemblies, which delivers electrical power to the train engine.

53. No Test Rail (NTR) is rail that the rail flaw detector car is unable to test.

54. New Rail – is rail that has never been in service

55. Partial Worn rail (PW) – (occasionally known as second hand rail - SH) is rail that has been in service and removed for any cause

56. Piped Rail - a vertical split in a rail, usually in the web due to failure of the shrinkage cavity in the ingot to unite in rolling.

57. Preferred Rail Laying Temperature (PRLT) – The target installation temperature of welded rail in a particular area.

58. Preferred Rail Laying Temperature Range (PRLTR) – The tolerance or range for the PRLT.

59. Rail – a long rolled steel section used as a running surface for equipment and track units.

    a. Compromise Forged Rail – A special rail rolled to different rail sections at each end for joining two rails of different size.

    b. Transition Rail – A special rail which has its rail head reduced through grinding or other means in order to provide an adequate transition between new and worn rail. This is occasionally referenced as a shaved rail.

60. Rail Laying Temperature (RLT) – The actual rail temperature at which the CWR is installed.

61. Rail Neutral Temperature (RNT) – The actual rail temperature at which the rail is neither in tension or compression.

62. Railway – GO Transit. A company (CN, CP and TTR) that operates and/or dispatches trains within their corresponding right-of-way.

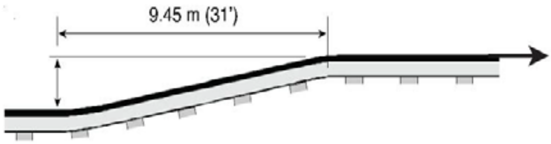
63. Reference Marks - a pair of vertical lines located on the field side web of the rail, each placed to a minimum of 5 ft. (1,524 mm) away from a joint or planned rail cut, at opposite ends of a rail repair, used to check whether rail was added or removed from track.

64. Restraining Rail – rail installed on the gauge side of the low rail through a high degree curve to improve vehicle curving performance. Their primary function is to prevent wheel climb and reduce accelerated rail wear on the high rail by restraining the lateral movement of the wheels from riding up the high rail.

65. Restricted Crossing - Is any crossing that is not included in the definition of an Unrestricted Crossing.

66. Running Rail – Rail carrying all vertical loads of railway vehicles and equipment.

67. Runoff – When surfacing track, or when surfacing to a fixed structure, Runoff is the elevation difference in the track structure over a 31 ft. (9.5 m) section.



68. Shelly Rail – A progressive horizontal separation that may crack out at any level on the gauge side, generally at the upper gauge corner. It extends longitudinally not as a true horizontal or vertical crack, but at an angle related to the amount of rail wear.

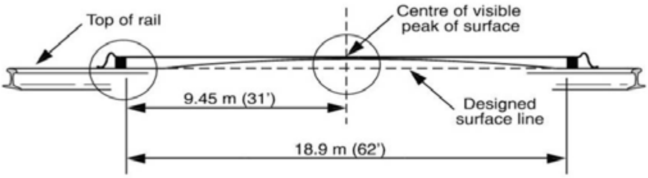
69. Special Track Work - A general term used to describe all track hardware that is not standard tie-and-ballast track. Special Track-work includes, turnouts of all sizes, single and double slip switches, expansion joints (sliding rail joints), and crossings (diamonds).

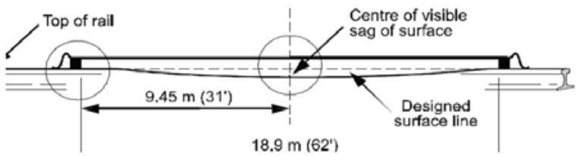
70. Split Web – a lengthwise crack along the side of the web and extending into or through it

71. Spot Tie Replacement – A maximum of 5 ties replaced in a 39 ft. (11.9 m) track section with no more than 3 consecutive ties.

72. Superelevation – The amount by which the outer rail of a curve is banked above the inner rail.

73. Surface – The vertical alignment or the surface uniformity in the vertical plane. The measurement for surface shall be the maximum positive or negative mid-ordinate, in inches (mm), of a 62 ft. (18.9 m) chord measured along the top surface of the rail.





74. Surfacing:

a. Spot Surfacing – Restoring of the track surface, cross-level and alignment through short stretches of track, not more than 19 ft. 6in (5.9 m) in length, when a continuous raise is not necessary

b. Out-of-face Surfacing – The continuous raising of track to restore track surface, cross-level, and alignment.

75. Temperature

a. Ambient Temperature – the air temperature as measured by a thermometer, not including humidity or wind chill.

b. Rail Temperature – The temperature of the rail. Rail temperature in cold weather is typically equal to the ambient temperature. As a guideline, in hot weather, the rail temperature is equivalent to the ambient temperature plus 30ºF (16ºC).

i. Note: Rail temperature must be physically measured periodically throughout the day with an approved accurate thermometer, according to the manufacturer's specifications. Measurements shall be taken away from all sources of natural and artificial heat and cold including but not limited to the sun, wind, rain, etc. Measurements are typically taken from on the web near the base of the rail.

76. Thermite Weld - A process of welding the ends of two rails together by pouring molten steel between the rail ends causing fusion.

77. Track Buckling – The lateral misalignment of the track structure due to excessive compressive forces in the rail.

78. Transverse Defect - Any progressive fracture occurring in the head of the rail and has a transverse separation.

79. Turnout - A track structure by means of which vehicles are diverted from one track to another.

80. Turnout Inspections

    a. Routine Inspection – A visual inspection to assess the general turnout condition and to identify any defects. This inspection is done each time the turnout is traversed.

    b. Walking Inspection – An inspection performed on foot to assess the general condition of a Turnout or other special track work. This condition is checked against a set checklist (Recommended Method 3500-1: Turnout Inspection), approved by the Railway, and includes gauge and clearances between switch point and stock rails, and the recording of exceptions and remedial actions taken

    c. Detailed Inspection – A thorough and detailed inspection performed on foot to assess the condition of all components in each turnout or other special track work. Hand operated switches are to be operated to all positions during this inspection. This type of inspection is further defined in Track Standard Section 17.6 Detailed Turnout Inspection

81. Ultrasonic Rail Flaw Testing – Is a non-destructive method of testing the internal structure of rail through the use of high-frequency sound waves.

82. Unrestricted Crossing - A public grade crossing or a grade crossing whose road is one of the following:

a. A recreation road or trail or a pedestrian or bicycle path maintained by a club, association or other organization, including a snowmobile or hiking trail;

b. A road or a pedestrian or bicycle path of a commercial or industrial establishment, including a business operated from a residential or farm property, that is used in connection with the establishment by persons other than employees of the establishment;

c. A road that serves three or more principal residences;

d. A road that serves three or more seasonal residences access to which is not controlled by a gate equipped with a lock;

e. A road that connects two public roads; or

f. A road maintained by a resource company, such as a company involved in forestry or mining activities;

83. Vertical Split Head - 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 split off the side of the head.

84. V_{max} – the maximum speed permitted based on the degree of curve, superelevation, and imbalance.

85. Weld Repair Bars – Temporary use bars, with slotted bolt boles and relief to accommodate welds, for the purpose of aligning rail ends at field welds to allow the passage of trains. Often known as banana bars.

Section 3 Electrified Territory

3.1. General

1. The requirements in this section apply in electrified territory, or in territory being under construction for future electrification.

3.2. Tools and Equipment

1. All tools used in electrified territory must have insulated handles.
2. Equip cranes and booms with protective measures such as insulated shields. All equipment used in electrified territory must be bonded and grounded.
3. Specify the size of maintenance of way equipment based upon updated OCS clearances as defined in from Chapter 2 of Performance Specifications for Structures Passing over Electrified Corridors and GO Electrification Enabling Works ET Standards

3.3. Impedance Bonds

1. Impedance bonds shall be specified according to the voltage and current carried by the traction return circuit. Properly sized dc bonds may be used within territory that carries both ac and dc currents; ac bonds should not be used in dc territory.
2. Impedance bond arrangement shall be established with input from signal and traction return designers.

3.4. Rail Return Bonds

1. Rail bond conductance and size should be in accordance with the OCS conductance and size. For example, for 350 MCM contact wire and 500 MCM messenger wire (850 MCM total for OCS), 2x250 MCM

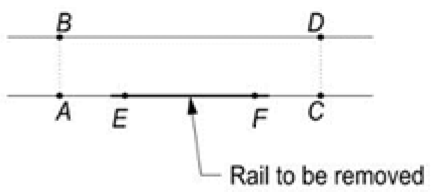
rail bonds per rail (1,000 MCM total return) should suffice.

3.5. Insulated Joints

1. Insulated joint material specifications are not substantially different for signalized or electrified track apart from the installation of impedance bonds as discussed above.
2. Pre-service testing of insulated joints should be conducted per AREMA 3.8.7.3.2 Megohmmeter Test.

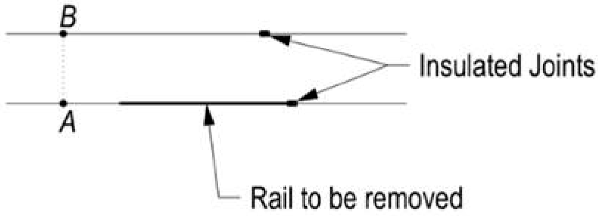
3.6. Track Work

1. In electrified territory, prior to removing joint bars, cutting rail, or repairing a discontinuity in the rail, a temporary return path for electric traction current must be created. Before the rail is disconnected, a temporary bond across the track each side of the section of rail to be removed must be installed either through the installation of a temporary rail jumper or cross bonding. A minimum 4/0 AWG cable should be used for jumpers along with an approved rail clamp. Ensure that no insulating rail joints interfere with the cross bonding circuit."



Make jumper connections AB and CD before rail or rail bonds are removed from track. Alternatively, where possible a jumper connection from A to C may be made. When new rail is properly installed, remove temporary jumper connection and make jumper connection AE and FC until permanent rail bonding is applied.

Figure 1. Method of applying temporary rail jumper in electrified territory



Make jumper connections AB before the rail connected to the impedance bond is removed. Jumper AB may be removed once new rail is installed and impedance bond is reconnected.

Figure 2. Method of applying a temporary rail jumper in electrified territory when removing rail with a connection to an impedance bond.

3.7. Vegetation

1. Vegetation in electrified territory must be regularly trimmed to meet electrical clearance requirements and to maintain visibility of signage and access to rail equipment and facilities at all times.

Section 4 Rail

4.1. Rail Identification

1. Rail branding is the raised letters and numbers along the web of the rail. Rail stamping is on the opposite side of the web and has indented letters and numbers.

2. Branding identifies the rail weight or section, manufacturer, manufacturing method, year and month rolled.

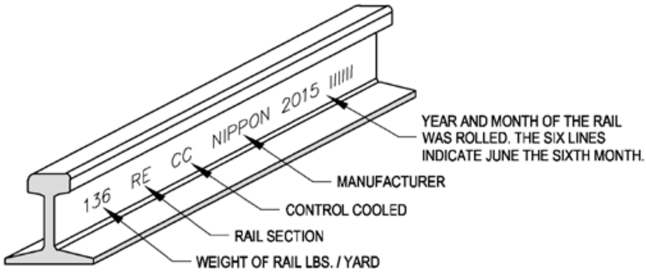


Figure 3. Branding descriptions

3. Stamping identifies heat, ingot, and rail sequence in the manufacturing process.

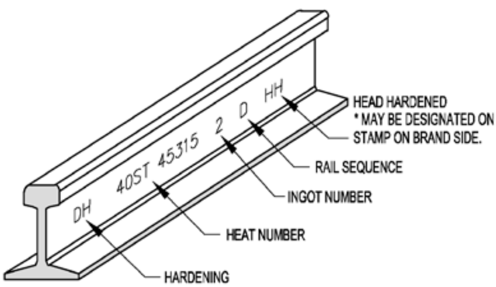


Figure 4. Stamping description

4. The branding code in Table 1 identifies the manufacturing process of rail.

Table 1 Branding Codes

Branding	Manufacturing Process
MACKIE, MRC, RC	Control Cooled
CC	Control Cooled
CH	Control Cooled and End Hardened
BC	Control Cooled Blooms
VT	Vacuum Treated – Control Cooled
OP	Other Practices
OH	Open Hearth

5. Rail identified as alloy rail, with stamping as in Table 2, **MUST NOT** be put back into track.

Table 2 Alloy Rail Information

Manufacturer	Stamping	Chemistry
ALGOMA	Cr	Chrome
	CrV	Chrome / Vanadium
	CrVMo	Chrome / Vanadium / Molybdenum
Colorado Fuel and Iron Company (CF&I)	CROMO	Chrome / Molybdenum
	HI SI	High Silicon
Hayange (HAY)	SACILOR – CrSiV	Chrome / Silicon / Vanadium
Klockner - AL	Blank	Chrome / Vanadium
Krupp – AL	Blank	Chrome / Vanadium
Sydney (pre 1976)	HS	High Silicon
Sydney (post 1976)	CS	High Silicon
Sydney	SYSCO – CrCb	Chrome / Niobium
	SYSCO – CrMo	Chrome / Molybdenum
	SYSCO – CrSiV	Chrome / Silicon / Vanadium
Thyssen – AL	Blank	Chrome / Vanadium
Wheeling Pitt	WR	Chrome / Silicon

6. Rail Manufacturers and brands of non-alloy rails shown below in Table 3, can be reused in track.

Table 3 Rail Manufacturer Information

Manufacturer	Stamping	Type
MT (ARCELORMITTAL USA)	STN	SS / HH
SDI (Steel Dynamics)	SDI	SS / HH
RMSM, ERMS, EVRAZ	DH 390	HH
	SS	SS
	ISHH	IHHS
	HCP	HH
	OCP	HH
	Blank	SS
Algoma	ALGOMA	SS
Bethlehem Steel	FT	FHT
	HH	HH
	MH	SS
British Steel	FT	HH
Colorado Fuel and Iron Company (CF&I)	IS	HH
	HH	HH
	DH 390	HH
	SS	SS
Colorado	Blank	SS
Dominion	Blank	SS
Dosco	Blank	SS
HAY (Hayange)	Blank	HH
ILLINOIS	Blank	SS
INLAND	Blank	SS

Manufacturer	Stamping	Type
Nippon Steel & Sumitomo Metal Corporation	DH 340	IH
	DH 370	HH
	HE 370	HH
	HE 400	HH
	HEX	HH
TZ (Czech / Moravia)	TZ	SS
International Steel Group (ISG)	Blank	SS
	Blank	HH
KLOCKNER	Blank	SS
KRUPP	Blank	SS
Lackawanna	Blank	SS
	Blank	SS
NKK	NHH	HH
	SP	HH
PST (Penn Steel)	PST	SS
PST (HH)	PST	HH
SYDNEY	Blank	SS
TATA	Blank	SS
TENNESSEE	Blank	SS
THYSSEN	HH	HH
	Blank	SS
Vilru	Blank	SS
WP (Wheeling Pitt)	MH	SS

7. Rail Hardness is identified by branding or stenciling as shown in Table 4.

Table 4 – Rail Hardness Branding Information

Branding	Rail Hardening	Branding	Rail Hardening
Blank	Standard Strength (310BHN)	IHHS	Int. Hardness High Strength (350BHN)
SS	Standard Strength (310BHN)	HH	Head Hardened (370BHN)
3HB	Standard Strength (310BHN)	FHH	Fully Head Hardened (370BHN)
IH	Intermediate Strength (350BHN)	DHH	Deep Head Hardened (370BHN)

8. Recommended Method 1303-0 – Classification of Rail covers the criteria used in the classification and usage of rail that will be either welded into CWR or remain as jointed rail. This can be found at the end of this section.

4.2. General Requirements

1. See Track Standards Section 3 for further requirements within electrified territory.
2. Rails used for spot renewals should be selected to have the same average wear and metallurgy as the rail in track.
3. Scrap rails must be clearly marked with an X of red paint at regular intervals to differentiate them from reusable rails.
4. Scrap rail less than 4 ft. (1,219 mm) in length must be immediately removed from the railway Right-of-Way.
5. Rails used in main track tangents must not be less than 15 ft. (4.6 m) long. Rails used in main track curves must not be less than 19 ft. 6 in (5.9 m).
6. When cutting rail the saw cut must be made:
    a. With a saw properly secured to the rail.
    b. Square and perpendicular to the rail axis with a variation not to exceed 1/8 in. (3 mm) and all burrs removed
    c. Centred in the crib, if possible, at least 4 in (102 mm) from the side of the tie.
    d. No closer than 3 ft. (914 mm) to a plant or field flash butt weld, except as identified in Track Standards Section 8.1.5.
    e. No closer than 6 ft. (1,829 mm) to a thermite weld, except as identified in Track Standards Section 8.1.5.
    f. No closer than 4 in. (102 mm) from any torch mark or bond / bolt hole in the rail except as identified in Track Standards Section 8.1.9.

g. If a field or flash butt weld is being cut out, make the cut at least 3 inches (76 mm) away from the weld to remove the heat affected zone.

7. All PW rail that is saw cut will have the exposed ends tested for longitudinal defects with dye penetrant (DP) this includes rail currently in track.

8. Rail having cuts or holes made with an oxy-acetylene torch, an electric arc, or thermal methods must not be used in track unless being cropped for use per Track Standard Section 8.1.9.

9. Rail must not be struck with a spike maul, steel hammer or similar tool.

10. All holes newly drilled in rail must be deburred as per Recommended Method 3700-0 – Drilling Holes in Rail.

11. Rail for replacements and relay programs will be in accordance with Appendix P – Rail Usage Guidelines.

4.3. Plug Rail

1. Rail will be graded to determine the suitability for future use. Rail removed which is planned for local reuse will be graded by the Track Supervisors for use in specific tracks.

2. The Track Supervisor shall save select rail from rail relays for suitable plug rails. Rails kept for spot renewals shall:

   a. Have the last UTT date and estimate tonnage since the test, if known, written on the web of the rail.

   b. Have the vertical and gauge wear values written on the top of the head of the rail.

   c. Be neatly stacked by rail section and metallurgy. In material storage yards, clearly identify each rail stand with signs for each. For rail stands along the right of way, ensure the area allows accessibility year round but doesn’t interfere with operations.

   d. Rail which has not been UTT tested must be segregated from rail which has been tested or is planned to be scrapped. If required, space rail adequately to allow for UTT testing as per Track Standard Section 18.4. Rail that has been UTT tested must be clearly marked.

3. Rail used for replacement or plugs in main track and controlled sidings will:

   a. Have gauge face and vertical head wear mismatch within maximum allowable limits identified in Track Standard section 4.6 and Appendix G – Rail Wear Limits.

4. When removing rail defects by replacing with a plug rail, the following conditions must be adhered to on main tracks containing CWR:

   a. The plug rail must be Rail Flaw tested and marked per Track Standard Section 18.4.

      i. If not, a class 2 speed restriction must be placed until it has been tested.

      ii. All PW rail that is saw cut will have the exposed ends tested for longitudinal defects with dye penetrant (DP).

   b. Gauge face and head wear must be within the limits prescribed in the Transport Canada Rules Respecting Track Safety and Appendix G – Rail Wear Limits Table A and Table B whichever is more restrictive.

   c. Must have gauge face and vertical head wear mismatch within maximum allowable limits identified in Track Standard section 4.6 and Appendix G – Rail Wear Limits.

   d. Must be a grade equal to, or better than, the parent rail (e.g. if the replacement is in a curve and the parent rail is head-hardened rail, then the plug rail must also be head-hardened)

      i. The following rail chemistries must not be reinstalled on any main track or controlled siding unless authorized by the CM Senior Manager of Track and Structures.

- British, Workington, Vilru, or Bethlehem FT.
- Any of the alloy rails listed in Table 2
- “A” rails (rails with the letter “A” in the heat number
- “OH” rails (Open-Hearth)

e. Types of rail are:

i. Standard carbon (referred to as 3HB or 310 Brinell Hardness).

ii. Intermediate hardness. (350 Brinell Hardness)

iii. Head-hardened. (370 Brinell Hardness)

iv. Note: Type of rail does not apply to insulated glued joints.

f. If the correct type of rail is unavailable, item c of the above standards shall be modified as follows:

i. A plug rail of a different type may be installed on a temporary basis. This temporary plug rail must not be welded into track.

ii. The temporary plug rail must be removed within 180 days (6 months) of installation and replaced with a plug rail meeting the condition criteria of a, b and c above.

4.4. Handling and Unloading Rail

1. Only approved grapples can be used for loading, unloading, and distributing rail.

a. Refer to Appendix Y – Grapple Ability by Make and Model for details on approved grapples.

2. Dragging rail along the track is prohibited unless ALL of the following conditions are met and permission is

obtained from the CM Senior Manager of Track and Structures:

a. A thorough job briefing and field level assessment is conducted;

b. Have readily available a list of phone number for fire-fighting agencies;

c. Any open deck bridges will be wetted down prior to making the move;

d. At least two employees will remain on site to monitor the site until they are certain there is no fire risk*;

e. The employees are equipped with water and fire extinguisher foam;

f. The employees have a means of radio or cell phone communication;

g. The rail is not dragged faster than 3mph; and

h. Steel on steel contact shall be avoided while dragging.

i. Inspect for damage to spikes, anchors or clips behind the movement, especially in curves locations.

j. Rail shall not be dragged through turnouts without protection of turnout components.

k. Note: it is permissible to place rail on an open deck bridge for the purposes of installation provided the above is adhered to.

** In areas where the rail is to be dragged over more than one bridge and the bridges are in close proximity, the two employees can be used to patrol the area.*

3. Dragging rail greater in length than 80 ft. (24.4 m) shall be done only with appropriate rail dragging devices.

4. When using rail tongs to drag rail under 80 ft. (24.4 m) in length, the rail tongs shall be 8 tonne or greater.

5. When dragging rail over crossings or other similar locations, rollers shall be used.

6. Rail loaded in gondolas with tongs for reuse should be:

a. Loaded with the rail standing upright and orderly

b. Loaded to the capacity of the equipment or less. The 70 ton gondola capacity, by rail section, is as per Table 5

Table 5 - Rail Capacity of 70 Ton Gondolas

136RE	132RE	115RE
3,154 lin. ft. (961.3 lin. m)	3,250 lin. ft. (990.6 lin. m)	3,680 lin. ft. (1,121 lin. m)

7. Where unloaded rail presents a walking hazard it shall be covered by a General Bulletin Order (GBO).

8. Recommended Method 3700-3 - Unloading Rail covers the procedures to be followed when unloading CWR from a rail train. Metrolinx and GO Transit requires a written procedure for unloading CWR from a rail train prior to commencement of work.

9. The owner of the equipment and the operator are responsible for ensuring that all rail unloading equipment and hardware is in good working condition.

10. Rail should be unloaded by use of a crane with magnets, approved rail grapples or tongs, skids or threader and must not be dropped.

11. Rail must be centre marked to balance the lift. Tag lines will be used when lifting rail with tongs.

4.5. Laying Rail

1. Rail of different metallurgies shall not be mixed in any given stretch of track

2. The gauge of track after laying must be uniform. Rail must be laid to the gauge shown in Track Standard section Table 6.

3. The Rail Laying Temperature (RLT) shall be written on the web of the rail, and shall not be removed until destressing is completed.

4. Any curve to be designed or constructed greater than 8 degrees must be approved in writing by the CM Senior Manager of Track and Structures.

   a. The Senior Manager will also review that the proposed curve design can be safely negotiated by the fleet of rail equipment.

Table 6 – Gauge for High Degree Curves

Degree of Curve	Gauge in inches	Gauge in mm
Up to 14°00’	56-1/2	1435
14°01’ to 16°00’*	56-5/8	1438
16°01’ to 18°00”*	56-3/4	1441
18°01’ to 20°00’*†	56-7/8	1445
20°01’ to 22°00’ *†	57	1448
22°01’ to 24°00’ *†‡	57-1/8	1451
24°01’ and over *†‡	57-1/4	1454

* Metrolinx regulatory inspection vehicles (IRIS) cannot traverse curves greater than 14 degrees.

† All curves over 18 degrees also require review by external stakeholders that have running rights on GO Transit / Metrolinx territory and must be approved in writing by the CM Senior Manager of Track and Structures.

‡ GO Transit bi-level coaches specify a min. horizontal radius of 250 ft. (76.2 m) equivalent to a 23° curve.

5. Any curve approved to be constructed greater than 8 degrees must:

   a. Identify train handling requirements;

   b. Reduce train operating speed as required;

   c. Use forged plates (eg. MSR);

   d. Be fully spiked and lagged;

e. Use concrete ties, steel ties. or 9 ft. (2.74 m) Grade #1 creosote treated hardwood ties that are 100% end plated. Hardwood and Steel ties shall be spaced at 18 in. (457 mm) on centre. Concrete ties shall be spaced at 20 in. (508 mm) on centre.

6. In order to maintain correct gauge, at least every fourth tie must be gauged on tangents and every third in curves greater than 2º. Where poor tie conditions exist, additional gauging may be required.

7. On completion of the rail laying, cribs must be filled and the track must be surfaced and lined, within forty eight hours.

8. Jointed rail shall be laid with staggered joints. See section 5.2.10

9. The rail temperature shall be measured periodically throughout the day with an approved accurate thermometer and recorded.

10. Joint bars shall be applied, lubricated, and bolts tightened before the rail is spiked. See Track Standards Section 5.2

11. Where different sections of rail are being joined, one of the following methods must be used:

    a. The appropriately sized compromise rails.

    b. Compromise welds only where applicable. See Approved Track Welding Manual for further instructions.

    c. Compromise joints only where applicable. See Track Standards Section 5.4

12. When newly laid rail joins rail previously in track, the old rail should be built up by welding at the joint, if necessary, to protect the end of the newly laid rail.

13. Where rail end mismatch exceeds 1/8” (3 mm) on the top or the gauge side of a rail joint, it shall be repaired promptly by grinding, welding or replacement of the rail. Until such time as these repairs are made, movements over the mismatch shall not exceed the speed for the appropriate class of track, as prescribed by Table 7.

Table 7 - Rail End Mismatch

Class of Track	Maximum Mismatch On top of Rail	Maximum Mismatch on Gauge Side of Rail
1	1⁄4” (6 mm)	1⁄4” (6 mm)
2 and 3	3/16” (4.5 mm)	3/16” (4.5 mm)
4 and 5	1/8” (3 mm)	1/8” (3 mm)

14. Rail ends with excessive flow will be repaired by slotting. Crushed or battered rail ends will be repaired by welding.

4.6. Rail Wear

1. When rail wear reaches the increased monitoring limits as defined in Appendix G – Rail Wear Limits, the rail must be monitored and measured quarterly and noted on inspection documents.
    a. Measure at least 3 locations throughout the curve
    b. The locations should be roughly 400 ft. (122 m) – 600 ft. (183 m) apart (shorter spacing for short curves)
    c. Mark the rail at the measurement points to ensure repeatability.
2. Rail on curves at approximately 95% of their rail wear limits must be inspected via a walking inspection on a weekly basis.
3. Rail shall not be transposed in main track. In no case will the low rail be transposed to the high side.
4. If rail is continued in service beyond the vertical wear limits in Table 8, high clearance joint bars must be used on the gauge side of rail for new construction, repairs and spot replacements.

Table 8 – Rail Wear for High Clearance Joint Bar Requirement

Rail Size	141 lb.	136 lb.	132 lb.	115 lb.	100 lb.	100 HF	85 lb.
Rail Wear	17 mm 11/16” (0.6875)	14 mm 9/16” (0.5625)	10 mm 3/8” (0.375)	8 mm 5/16” (0.3125)	7 mm 1/4” (0.25)	6 mm 1⁄4 (0.25)	5mm 3/16” (0.1875)

5. Appendix G – Rail Wear Limits Table A and Table B identifies the wear limits when rail should be removed from the track. If rail is worn to or beyond the urgent limits in this table and must be left in the track, the CM Senior Manager of Track and Structures or their designate must be notified. A speed restriction may be placed and additional inspection frequency specified at the discretion of the CM Senior Manager of Track and Structures. Condition of rail (e.g., shells, spalls, corrugation) must also be taken into consideration.
6. If the worn rail is on a bridge, overpass or tunnel, the wear limits are only 75% of the wear limits shown in Appendix G – Rail Wear Limits Table B
7. The underside of the rail head must be physically inspected when either one of the following conditions exists:
   a. Rail wear is at the increased monitoring limits or greater of the urgent limit; or
   b. Rail head shelling, spalling, or corrugation is present.
8. Should the CM Senior Manager of Track and Structures decide to leave the worn rail in the track, the speed restriction to be applied shall be as near as possible to the equilibrium speed, not exceeding the maximum allowable speed for that class of track, until the rail can be changed out. If rail change-out cannot happen within 30 days (or 60 days on class 2 track), then a further speed restriction of 10mph must be applied.

9. Where rail wear has resulted in joint bars being impacted by wheel flanges, until the rail can be replaced, the joint must be welded or a high clearance bar or compatible worn bar must be applied. Train speed must be restricted to the equilibrium speed.

4.7. Continuous Welded Rail

1. All track forces must properly protect and promptly report any unusual and/or unsafe conditions observed developing in CWR to the CM Manager of Track.
2. All supervisory personnel, including the Track Foreman and Track Inspectors on whose territory CWR is laid, must be familiar with the causes, high risk conditions, work and inspection procedures, and speed restriction requirements to avoid track buckling.
3. All employees responsible for the installation, maintenance and inspection of CWR must be trained and qualified in the maintenance of CWR.
4. The Current PRLT (Preferred Rail Laying Temperature) is outlined in Table 9.
    a. The PRLTR (Preferred Rail Laying Temperature Range) is outlined in Table 9.

Table 9 - Preferred Rail Laying Temperature and Range

PRLT	PRLTR
100 ºF (37.7 ºC)	**90 - 115 ºF** (32.2 – 46.1 ºC)

5. CWR will be installed and anchored within the PRLTR without further adjustment. CWR installed outside the PRLTR must be destressed as soon as possible after laying.
    a. A speed restriction will apply if destressing cannot be completed before the rail temperature

increase is greater than 40 ºF (22 ºC) above the RLT. See Track Standard Section 4.9.22.

6. CWR must be destressed using proper procedures. Heaters and/or expanders must be used to bring the rail to the correct length. The CWR Thermal Expansion Chart is contained in Appendix L – Continuous Welded Rail Thermal Expansion Chart.
7. Newly installed track-work in CWR territory **MUST** be destressed within the timelines prescribed in Track Standards Section 4.9.24.
8. CWR will not end on open deck bridges or closer than 200 ft. (61 m) from the back-wall of the bridge.
9. A list of the rail temperatures marked on each string, the string numbers, alloy (if any) mileage and date of laying or adjusting shall be compiled and kept up to date by the Track Supervisor with copies to the GO Transit CM Manager of Track. The actual rail laying temperature will be marked at the end of each string of CWR installed.
10. Use six-hole joint bars with four bolts installed on standard joints that are planned to be eliminated through field welding. To facilitate welding, the hole nearest the end of the two abutting rails must not be drilled. A joint gap not exceeding 3/8 in. (9.5 mm) is to be left. All temporary joints must be welded prior to the onset of winter as defined by the CM Senior Manager of Track and Structures. Any temporary joints that are unable to be welded prior to winter shall be fully drilled, bolted and every tie will be fully box anchored for 200 ft. (61 m) in both directions and spiked to pattern D for 19 ft. 6 in. (5.9 m) on both sides of joint.
11. On completion of the day’s work, all rail laid, or ties inserted, must be spiked with a minimum of two rail holding spikes per plate in a cross pattern (on curves greater than 2 degrees, three rail holding spikes are required at a minimum), bolted and anchored per standard. The gang must then return to spike the ties to the applicable spiking pattern in Appendix R – Spiking Patterns.

12. The CM Manager of Track or his designate will make a decision on whether or not to adze ties and will record this information in the resulting contract.

13. CWR strings may be left between the rails until the next shift (overnight) provided that:

    a. The CWR string height does not exceed 1 in. (25 mm) above the top of the running rail

    b. Deflectors are placed at each end of rail

    c. The CWR rail ends are bypassed and secured at the ends with spikes.

4.8. Maintenance of Thermal Stress in Rail

1. Detailed guidelines on destressing CWR are contained in Recommended Method 3205-0: Destressing CWR, Recommended Method 3205-2A: Destressing at Turnouts, and Recommended Method 3205-2B: Destressing at Roadway Crossings. Guidelines on handling rail failures in CWR are contained in Track Standard Section 4.10.

2. Precautions must be taken to monitor the length of rail installed during rail changes and repairs. Whenever practicable, rail will not be added to CWR track.

3. See Track Standards section 4.10.9.c. for information on reference marks.

4. When a rail is to be changed, reference marks will be made on the web of the rail prior to cutting the CWR. They will be on each side of the location where the cut is to be made and where the mark will not be covered by joint bars or removed by changing the rail.

    a. All previously made reference marks shall be painted over.

5. The reference marks and the measured distance between them will be written with paint stick or other permanent marker.

6. When addressing a failure in CWR:

    a. If the rail ends have pulled apart, the distance of separation of the two rail ends will be noted. The distance recorded on the rail shall then be the measured distance between the reference marks minus the separation of the rail ends.

b. If the rail ends bypass each other, the distance recorded on the rail shall be the measured distance between the reference marks plus the amount the rail ends bypass.

c. After the rail has been changed, measure the distance between the reference marks. If the distance changes over the original measured distance, the amount of rail added or removed will be marked on the rail and the information will be forwarded to the Track Supervisor, who shall inform the CM Manager of Track.

7. The Track Supervisor will be responsible for the locations and amounts of rail that is added or removed.

8. Continuous welded rail must be maintained so that it is in a state of zero thermal stress in between the PRLTR.

a. Continuous welded rail may drift into tension or compression, so that it is stress free at some temperature outside the preferred rail laying temperature range, as a result of such activities as track surfacing, tie renewals, ballast cleaning, track lining, and curve rail renewal. Even if the track is not worked on, the rail can shift and go out of destress as a result of rail breaks, emergency brake applications, worn or defective anchors, poor quality or insufficient ballast, Permanent Slow Order locations, or soft subgrade. On vertical curves and gradients, rail is generally seen to move slowly downhill, resulting in an excessively low stress-free temperature at the bottom and an excessively high stress-free temperature at the top.

9. Any locations where rail is added below the PRLTR, the rail shall be destressed prior to a rail temperature increase greater than 40 ºF or 22 ºC above the RLT.

a. When ambient temperatures exceed this range, and 1 inch (25 mm) or more rail within 1,000 feet (304.8 m) has been added, and adjustments have not been made, then a speed restriction shall apply as per Track Standard Section 4.9.22.

10. Except in the case of emergencies, no surfacing and lining, rail replacement or tie renewal will be performed if the rail temperature is above the PRLTR unless approved by the CM Senior Manager of Track and Structures or designate.

11. Track Maintenance activities that disturbs track and could potentially cause a track buckle must be protected by the appropriate speed restriction. The tables in Appendix J – Speed Restrictions for Track Work contain the speed restriction and the appropriate timeframe for removing them on CWR track.

12. Refer to Track Standard section14.16 and 14.17 for hot weather related inspections and speed restrictions.

13. See Track Standards section 4.14.10 for information on direct fixed track.

4.9. Destressing Rail

1. Rail must be laid and anchored within the PRLTR. If this cannot be achieved, the rail must be destressed.

2. When destressing, the adjusting temperature is to be marked on the rail and all previous temperature markings shall be painted over.

3. When it is evident that the stress free temperature of a section of rail has decreased to a level that a track buckle may occur, the stress-free temperature should be adjusted back to the Preferred Rail Laying Temperature. The method of destressing involves removing rail anchors, cutting the rail and removing rail to achieve the correct rail laying temperature.

4. Prior to cutting the rail the following MUST be completed:

    a. Rail anchors may have to be tightened for at least 200 feet (61 m) on each side of where the rail is to be cut.

b. All ties must be fully box anchored at least 200 feet (61 m) beyond the rail being destressed prior to making the cut.

c. In concrete tie territory chording clips and risers must be distributed, tie pads and insulators if required.

d. Reference marks must be made with a paint stick on the field side web of the rail at a minimum of 5 ft. (1,524 mm) away from both sides of the joint or planned rail cut.

e. Starting at the reference marks, match marks MUST be made with a paint stick on the gauge side base of the rail extending onto the tie plates or concrete ties on unanchored ties intervals throughout the length to be destressed about every 100 ft. (30 m).

5. The rail shall be cut and may need to be trimmed or placed in a position that will permit the rail ends to bypass each other.

6. The rail anchors/rail clips shall be removed for the length of rail being destressed to allow for the free movement of rail.

7. The rail must be raised from the tie plates or tie pads on all tie types and placed on risers or elevating rollers.

a. For rail replacements, the use of power vibrators shall be permitted when used in conjunction with heaters.

8. Unless authorized by the CM Senior Manager of Track and Structures, on all tie types, risers must be placed every 12 to 15 ties to ensure base of rail is free.

9. In concrete and steel tie areas all rail clips and insulators must be removed and chording clips must be installed approximately every 20 ties on curves up to 4 degrees and every 15 ties on curves 4 degrees and over.

10. Following the completion of items 4 through 10, the rail now in the raised position on risers, or fully power vibrated, is stress free at the current rail temperature as it is totally unrestricted.

a. When the rail is stress free (rail has been allowed to freely move), the Rail Laying Temperature at this location must be clearly marked on the web of the rail along with the date and the gang ID.

11. Knowing the length of rail being destressed, the PRLT and the present rail temperature, the calculations can now be made as to the adjustment requirement.

12. Prior to making the adjustment, check the anchors on the 200 feet of rail that was fully box anchored beyond the rail that was being destressed for movement.

    a. If this rail is the last 200 feet of CWR before jointed rail, it must also be destressed.

13. Make the adjustment and check the match marks to ensure that proper movement has been achieved.

14. Remove risers. Tap down the raised spikes and apply rail anchors/rail clips. In concrete and steel tie areas, apply insulators and clips. The chording clips are not removed until they are encountered when the clip installation reaches their location.

15. Paint adjacent to the rail laying temperatures that had previously been painted on web of rail, the "destressed" temperature (rail anchoring temperature), which should be within the PRLTR.

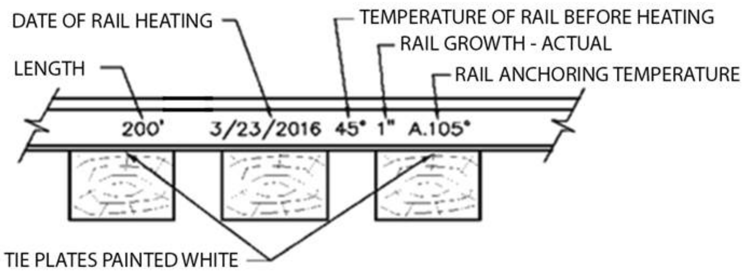


Figure 5. Rail markings for destressing

16. Destressing reports must be created and forwarded to the CM Manager of Track and to the Track Supervisor on the prescribed [GO Transit Destressing Form.]

17. The total length of tangent rail that may be destressed at any one time shall be 3,000 ft. (914 m). Under this scenario, the cut is made at 1,500 ft. (457 m) and the two ends pulled together.

    a. During the winter months as defined by the CM Sr. Manager of Track and Structures, the maximum length of tangent rail that may be destressed at any one time shall be 1,600 ft. (487m). Under this scenario, the cut is made at 800 ft. (244 m) and the two ends pulled together.

    b. For destressing curve rail, the maximum length of rail that may be destressed at any one time shall be determined by the CM Sr. Manager of Track and Structures.

18. For destressing of road crossings, refer to Track Standards section 14.5.

19. For destressing of turnouts and other special track work, refer to Track Standards section 13.3.

20. Destressing should be scheduled and completed when the rail temperature is at or below the preferred rail laying temperature.

21. When the rail temperature is above the PRLT and there are signs of a potential track buckle, the rail must be cut. Record temperature of rail, limits of rail movement, amount of rail cut out, and width of joint gap when bolts and bars applied. Report this information to the CM Manager of Track and the Track Supervisor for further instructions.

22. If rail cannot be destressed prior to a rail temperature increase greater than 40 ºF or 22 ºC above the RLT, then a speed restriction must be applied until such time as the rail is destressed. The speed restriction shall be 30 MPH. See Appendix J – Speed Restrictions for Track Work.

23. In order to accurately maintain a record of the Neutral Rail Temperature at any given time, the Rail Laying Forms MUST be submitted to CM Manager of Track within 24 hours of rail installation.

    a. The RLT shall be written on the web as per Track Standard section 4.5.3 and 4.9.10.a.

24. Newly installed track-work in CWR territory **MUST** be destressed within 48 hours from the date the track is placed in revenue service, unless otherwise approved in writing by the CM Senior Manager of Track and Structures. Speed restrictions shall apply as per Track Standard Section 4.9.22.

25. The CM Senior Manager of Track and Structures may apply a speed restriction if required in locations where destressing information is unavailable, deficiencies may exist, or in areas of known conditions.

    a. Should a speed restriction be placed through this item on an existing contract where the track is disturbed, cut, installed, or in any way affected the qualified track contractor responsible for that Contract will correct this deficiency within 48 hours.

Recommended Method 3205-0: Destressing CWR

1. Destressing may be done by means such as:
   a. heaters
   b. hydraulic rail pullers
2. Before destressing any location, the following information must be known:
   a. the PRLT
   b. the length of CWR to be destressed
   c. the present rail temperature
3. In most instances the following tools, equipment, and material will be required to carry out a destressing program:
   a. At least two rail thermometers or pyrometers
   b. chording clips
   c. paint stick
   d. 120 ton hydraulic rail puller or rail heater
   e. rail saw
   f. rail drill
   g. non-conducting fibreglass or collapsible wood measuring tape at least 50 feet in length, or rolling measuring wheel
   h. Thermite welding equipment, with proper kits for rail weights
   i. additional bolts, spikes, anchors, tie plugs, Pandrol clips, pads, insulators
   j. a vibrator or a dead-blow hammer
   k. risers (spike, long bolt, pipe, special design tool)
   l. claw bars
   m. spike mauls
   n. sledge hammers
   o. track jack

p. track wrenches and torque wrench

q. anchor applicator wrench if required

r. rail slotter if welders not available

s. one or two pieces of rail of the same weight, section, metallurgy, and degree of wear as the rail in track, 15 feet (4.5 m) long or longer (19 ft-6 in. or 5.95 m on curves)

t. rail tongs

u. rail positioner / rail seater

v. clip applicator

4. Two examples are provided below:

Example 1:

Rail anchored hot; rail ends pull apart		
Length of CWR being destressed	3000ft	
PRLT	100°F	
Current rail temperature Degrees	65°F	(100-65°F)
temperature below PRLT	35°F	
Gap required as calculated	8.4 in.	(3000*35*.00008)
Gap required per tables	8¼ in.	Multiply the gap for 1000 ft. by 3

NOTE: If the rail separates away from each other upon cutting more than 8.4 in. the rail was at a stress free state at a temperature higher than the PRLT.

Adjustment required:		8¼ in
Actual Gap measured in the field:		9 in.
Difference:	(8¼"-9")	¾ in. less rail than required
One standard weld		will add 1 in. steel material
Length of rail to be added	(¾"-1")	-¼ in.

When the ¼ inch of rail is removed and the 1" of weld material added, the rail would be stress free when the rail temperature is at 100°F.

GO TRANSIT RECOMMENDED METHODS

The Approved Track Welder Manual should be consulted for the proper procedures.

Example 2:

Rail anchored cold; rail ends bypass

Length of CWR being destressed	3,000 ft.	
PRLT	100°F	
Present rail temperature Degrees	65°F	(100-65°F)
temperature below PRLT	35°F	
Rail ends bypass 3 in.		
Gap required by calculation	8.4 in.	(3000*35*.00008)
Gap required by tables	8¼ in.	Multiply the gap for 1000 ft. by 3

NOTE: If the rails bypass each other when the rail is cut or the gap is less than 8.4 in. the rail was in a stress free state at a temperature lower than 65°F as identified in this example.

Adjustment required:		8¼ inches
Actual Bypass:		3 inches
Difference:	(8¼"+3")	11¼ inches more rail than required
One standard weld		will add 1 inch steel material
Length of rail to be cut off	(11¼"+1")	12¼ inches

12¼ inches of rail will be cut off leaving a 9¼ inch gap. The rail is then to be pulled back 8¼ inches and welded. (Note 1" gap is left for the weld)

This rail would now be stress free when the rail temperature is 100°F. (PRLT)

4.10. Failures in CWR

1. Service failures of CWR include broken rails, pull-aparts, buckles or other rail damage. Any service failure and the associated remedial action must be reported promptly to the CM Manager of Track or designate.

2. In electrified territory, prior to approaching a broken rail or any rail discontinuity as well as prior to conducting any repairs, install jumpers or cross-bonds around failures.

3. Joints in CWR will be treated as follows:

    a. Temporary joints in CWR that cannot be immediately welded will be drilled and joint bars applied to allow for future thermite welding, leaving a joint gap not exceeding 3/8 in. (9.5 mm). Only the outer four holes are to be drilled and used. All temporary joints should be welded prior to the onset of winter as defined by the CM Sr. Manager of Track and Structures. Any temporary joints that are unable to be welded prior to winter shall be fully drilled, bolted and every tie will be full box anchored.

    b. Permanent joints in CWR which are not intended to be welded will be fully drilled and bolted, joint bars applied, and the rail fully box anchored 200 feet (61 m) each side of the joint on every tie, and spiked to pattern D for 19 ft. 6 in. (5.9 m) on both sides of joint.

4. Where CWR has pulled-apart, broken, or is cut for removal of defect or track panel installation, a record of pre-cut / break neutral temperature will be made when it can be determined. This must be submitted to the CM Manager of Track within 24 hours. The information required is:

    a. Subdivision, track number, mileage, GPS coordinates, tangent or curved track, rail side of break (which rail), and remedial action

b. Rail and ambient Temperature at the time of break, pull-apart, or cut

c. Gap size, Offset

d. Defect type (if identifiable)

e. Rail weight, manufacturer, rolling year, vertical and horizontal wear measurements.

f. If a weld, the date of the weld, weld number, and welder identification, as well as the rail wear measurements on both sides of the weld.

g. Anchor or clip pattern and type.

h. Fastener pattern and type

i. Proximity to fixed locations and/or previous cuts

j. Tie type

k. Ballast condition

5. For rail breaks, a clear photo of the broken rail ends, both side views and bottom, will be taken and submitted to the CM Manager of Track, including 6 in. (152 mm) of the physical broken rail ends.

a. Rail ends will be sprayed with penetrating lubricant or equivalent to prevent oxidation.

b. For longitudinal failures, longer pieces may be required

c. Have the subdivision, milepost, rail side, date and direction written in paint marker on all pieces. See Figure 6.

d. Where rail breaks into multiple pieces, attempt to reassemble the rail, then place match markings from the pieces to the surrounding rail. Include all pieces with the shipment.

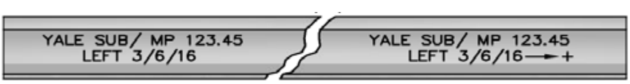


Figure 6. Marking a Broken Rail

6. Broken rail ends will be retained for 2 weeks in case it is determined to send them off-site for further examination.

7. Four types of failures can be detected in CWR:

   a. Visually detected failures

   b. Ultrasonically detected failures

   c. Signal detected failures

   d. Magnetic particle detected failures.

8. Immediate repairs are required for the following:

   a. Certain rail defects, weld defects, and breaks as per Appendix I – Remedial Action for Rail Defects

   b. Pull-aparts

   c. Track buckles

   d. It is essential that any type of failure receives prompt attention and action to maintain safe movement of traffic.

9. Prior to cutting rail, reference marks MUST be made on the web of the rail. The marks should be on either side of the proposed cut and should be of sufficient distance apart so as not to be obscured by joint bars. The distance between the marks shall be measured and noted on the rail prior to the cut being made. This will create a reference to confirm whether any rail was added or removed during the repair. The use of reference marks includes:

   a. Install jumpers or cross-bonds around any discontinuity, pull-apart, rail flaw defect, etc.

   b. Marking the location where rail is to be cut. Centre this mark in a crib

   c. Place reference marks no less than 5 ft. (1524 mm) outside the intended saw cut locations on the field side web of the rail.

   d. Write the following information on the parent rail immediately beyond the reference marks. Do NOT write within the 5 ft. (1,524 mm) on either side of the cut location. This area is reserved for the welder's information. See Figure 7.

i. The actual distance between the reference marks minus any gap. If the rail grows and must be trimmed, then measure the growth and add to the reference mark distance.

ii. Gap distance

iii. Rail temperature at the time of the rail cut, pull-apart, or rail break

iv. Length of the rail added or removed

v. Foreman’s initials

vi. Date

10. Dye penetrant testing shall be performed on rail ends:

a. in the event of an in-service rail failure;

b. when a defect is visually detected; or

c. when one of the following defects was not immediately removed from track after detection by an ultrasonic test car:

i. Vertical Split Head

ii. Horizontal Split Head

iii. Head Web Separation

iv. Split Web

v. Piped Rail

d. Mark the rail “DP” when rail is tested with dye penetrant.

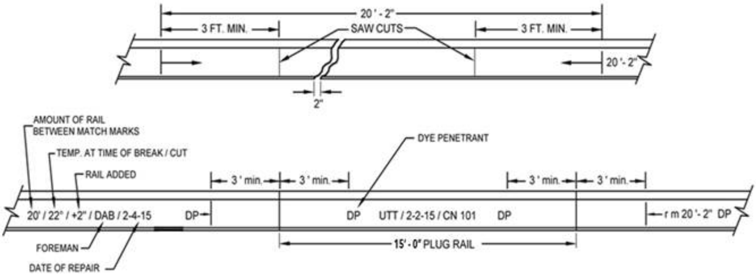


Figure 7. Rail Markings for Repairs

11. Note that it is possible for vertical split heads to carry through plant and field welds.

12. See Track Standard Section 4.15 for further details on defective rails.

4.11. Repairing Pull-Aparts

1. In electrified territory, install jumpers or cross-bonds around failures prior to approaching and/or repairing broken rail or any rail discontinuity.

2. When a pull-apart occurs corrective action must be taken by either applying heat or expanders to bring the rail ends together or by installing a temporary closure rail.

3. Do NOT use rail heating rope for heating rail on open deck bridges.

4. Make the repair with the use of a rail puller, or heat the rail to close the gap.

5. Install new bolts to proper torque. See Track Standard Section 5.2.

6. If possible, adjust the anchors for at least two hundred feet. See Track Standards section 4.10.3 for further instructions on joints in CWR for failures.

7. When the rail temperature is at or near the preferred rail-laying temperature, the location must be checked to see if destressing is required. This will be determined as per Recommended Method 3205-0: Destressing CWR.

8. Ensure proper joint maintenance is performed and anchor condition and pattern conforms to this Track Standard.

9. If the pull-apart is greater than 3 in. (76mm), a temporary repair should be made by cutting out sufficient rail to allow a length of rail as specified in Track Standard section 4.2.5 , to be installed.

10. Arrangements should be made to have the closure rail welded in before the rail ends batter. Depending on traffic levels, excessive batter may occur in as little as two weeks.

11. A minimum of one inch (25 mm) must be removed from the closure rail for each thermite weld at the time of welding.

    a. Rail shall be destressed as per Track Standards section 4.9.

12. **Always record the amount of steel if added.** This information is necessary for making a permanent repair, which should be completed as soon as possible, but not longer than specified by the requirements in Track Standards section 4.9.

13. The cause of the pull-apart must be determined, and forwarded to the CM Manager of Track. Possible causes include:

    a. Insufficient crib and shoulder ballast

    b. Insufficient, improperly adjusted or defective rail anchors

    c. Rail anchored above the preferred rail laying temperature range and not destressed

    d. Unstable road bed

    e. Maintenance work performed with the rail temperature above the PRLTR

    f. Excessive tension due to extreme cold or a sudden drop in temperature

    g. Shearing the joint bolts (i.e. by dragging equipment)

    h. Ballast surfacing work being performed when the rail temperature is high causing such things as curves to be lined outward

    i. Emergency application of train brakes

4.12. Repairing a Track Buckle

1. Whenever ambient temperature exceeds 30ºC (86ºF) or during periods of significant seasonal increase in temperature (i.e. Spring), hot weather track patrols are required. Refer to Track Standard Section Hot Weather Inspections 15.19.

2. When a track buckle occurs one of the following corrective actions must be taken:

    a. Make cuts in the CWR near the buckle, remove rail anchors 225 ft. (69 m) on either side of the buckle allowing rail to run, line the track and make a closure.

    b. Place the track in the best possible alignment where it will remain without further movement and where it will provide proper clearance.

3. While under temporary repair, trains are to be operated at a speed specified by the foreman in charge but not exceeding 10 mph.

4. Permanent repairs may include applying new anchors, adding ballast to shoulders and cribs, replacing defective ties, tamp, line, surface track, and stabilize, cut out rail, destress, and weld.

5. After the track is fully repaired, it will be treated as disturbed track and protected by the appropriate speed restriction indicated in the tables in Appendix J – Speed Restrictions for Track Work, depending upon the rail temperature.

6. In the event that a track buckle was repaired by lining without cutting the rail, and the track was lined exceeding one inch for one third of the length of the curve or more, a temporary speed restriction must be placed as per Appendix J – Speed Restrictions for Track Work Table 56. The track must be destressed when the permanent repairs are made.

7. Promptly notify the Track Supervisor and CM Manager of Track of the temperature of the rail at the time of the buckle.

4.13. Track Buckling Causes and Prevention

1. Track Buckling is a constant threat during times of high or rapidly rising temperatures. It is a particular concern on CWR territory in the spring and summer months, generally between the hours of 11:00 and 20:00.

2. Sufficient patrols will be arranged in order to cover the track during these times.

3. Immediate remedial action will be taken by either placing a speed restriction or adjusting the rail when any of the following are apparent:

   a. Rail running either through rail anchors or with the anchors;

   b. Rail lifting up under the spike heads (rail base lifted out of seat);

   c. Rail pushing against both shoulders of the tie plates;

   d. Canting rail on curves;

   e. Short flat misalignments in curves;

   f. Gaps or voids at the ends of the ties indicating lateral movement of the track;

   g. Track having a wavy or non-uniform alignment;

   h. Tie movement;

   i. Churning of ballast caused by tie movement or bunching ties resulting in gauge and line kinks. ; or

   j. Longitudinal movement of switch point in relation to the stock rail.

4. When surfacing near high risk locations Track Standard Section 12.2 must be followed.

5. High risk locations include but are not limited to:

   a. Curves;

   b. Bridge approaches;

   c. Grade crossings;

   d. Crossings with other railways (diamonds);

   e. Bottom of a heavy grade, or bottom of a sag;

   f. Sink holes;

   g. Rock cuts where rail temperatures may be extremely high;

   h. Areas having a history of lateral instability;

i. Recently disturbed track (e.g. tie replacements, surfacing, etc.);

j. Locations where track work was undertaken in cold weather and rail has not been destressed, rail anchors not applied, or ballast not restored;

k. Locations where rail was recently welded;

l. Previous track buckle not permanently repaired;

m. Track where pull-aparts or broken rails have occurred during cold weather and it was necessary to add rail to close the gap; and/or

n. Fixed locations such as turnouts, crossings, and bridges, transition from wood to concrete ties. In particular, pay special attention to locations where rail has been observed to be moving through a rail anchor towards a fixed location.

6. Before surfacing and lining a curve on main tracks, the curve must be staked if the degree of curvatures is greater than 3° and the rail temperature is greater than 50°F or 28°C below the Preferred Rail Laying Temperature, or large temperature variations are expected within the next 24 hours.

7. To stake a curve prior to surfacing and lining, place at least 3 reference stakes uniformly spaced around the curve with the middle stake located near the middle of the curve. Additional stakes may be used due to the overall length of the curve.

8. Inspect for curve movement periodically after the work, especially during periods of large temperature fluctuations. If the curve is found to have shifted inward more than 1 in. (25 mm), it must be lined out or destressed prior to ambient temperature reaching 70°F (21°C). If the curve is not lined out or destressed, then a speed restriction must be placed per Track Standard Section 4.9.22. The effective rail length added to a curve as a result of chording inwards is calculated in Appendix B.

4.14. Remedial Action for Broken Rail or Defect

1. The track or signal maintainer that arrives to the location of a broken rail first, must inspect the track for 300 ft. (91 m) in both directions from the break. Each maintainer should be looking for pieces of equipment and for damage to the rail or track structure (e.g. wheel marks).
2. The location of the rail break and findings from the above inspection must be communicated to the CM Manager of Track and Track Evaluation Officer. A report must be submitted to the CM Senior Manager of Track and Structures.
3. Each defective rail must be marked with a highly visible yellow paint marking on both sides of the web and base when possible.
4. When removing rail defects from track, careful examination of the adjacent rail ends of the parent rail must be performed to ensure that the defect has been completely removed.
5. Minimum two 6 inch (152 mm) sections, each including the broken portion shall be submitted to the CM Manager of Track within 48 hours of the incident for metallurgical testing. The ends of the rails with the broken portion must be wiped with penetrating lubricant to prevent corrosion.
6. The remedial action to be taken is dependent on the rail temperature at the time of the repair.
7. When the rail temperature is at or near the PRLT:
    a. If adjustment to rail is required and thermite welds can be made at the time of repair, cut out the rail including the defect (centred) within at least the minimum length specified in Track Standards section 4.2.5. Install a permanent closure rail two inches shorter than the rail cut out to account for the two welds required. All permanent closure rails are required to be the same metallurgy and approximate wear as the rail removed.

b. If welds cannot be made at the time of repair, install a closure rail with temporary joints, leaving no gap. Arrangements should be made to have the closure rail welded in before the rail ends batter. Depending on traffic levels, excessive batter may occur in as little as two weeks. One inch of rail, for each thermite weld, must be removed from the closure rail at the time of welding. When a temporary closure rail is to be welded, the reference marks and original measurements noted on the rail should be consulted to ensure the appropriate rail length is being maintained.

c. **Always record the amount of steel added.** This information is necessary for making the permanent repair, which should be completed as soon as possible.

8. When the rail temperature is below the PRLT:

a. If welding is possible at the time of the repair cut out the rail including the defect (centred) within at least the minimum length specified in Track Standards section 4.2.5. Install a permanent closure rail two inches shorter than the rail cut out to account for the two welds required. Bring together rail ends using hydraulic rail pullers or by heating so as to leave a 1” gap for each weld. All permanent closures are required to be the same metallurgy and approximate wear as the rail removed.

b. If welds cannot be made at the time of repair, install a closure rail with temporary joints.

c. The closure rail is to be the same length as the rail cut out to allow for future welding.

d. The rail ends must be brought together with a hydraulic rail puller or by heating so as to leave no joint gap.

e. Arrangements should be made to have the closure rail welded in before the rail ends batter. Depending on traffic levels, excessive batter may occur in as little as two weeks.

f. One inch of rail, for each thermite weld, must be removed from the closure rail at the time of welding.

g. When a temporary closure rail is to be welded, the reference marks and original measurements noted on the rail should be consulted to ensure the appropriate rail length is being maintained.

h. If it is expected that the joint will be under significant tension (such as prolonged winter exposure or an expected drop in temperature) or if the joint is in a location with a history of pull-aparts, the joint should be installed with all six bolts and every tie will be fully box anchored for 200 ft. (61 m) in either direction.

i. If the rail ends separate more than three inches, a temporary repair should be made by installing a closure rail of a length equal to the opening leaving a gap at each joint no greater than 3/8 in. (9.5 mm).

j. **Always record the amount of steel if added.** This information is necessary for making the permanent repair, which should be completed as soon as possible

9. When the rail temperature is above the PRLTR

a. Box anchor every tie in both directions for 200 feet (61 m) start at a point 8 feet (2.4 m) on either side of the defect and.

b. Refer to Track Standards section 8.1.9 for details on torch cutting rail.

c. Temporary repair will be made by cutting out the defect and any torched rail, and installing a plug rail.

d. Drill the four outer holes and install joint bars and bolts leaving no joint gap.

e. Record the amount of steel removed. This information is necessary for making the permanent repair.

10. Extra care must be taken on Direct Fixation Track on structures when a broken rail is found. Destressing **MUST** occur immediately.

4.15. Defective Rails

1. When a rail in track contains a defect the following procedure should be followed:
    a. Identify the rail surface condition. Detailed descriptions of rail surface irregularities can be found in Appendix H – Rail Defect Descriptions
    b. Check surface of rail and the underside of the rail head with straightedge for indication of surface collapse or crushed head. The remedial action for these defects can be found in Track Standard Section 4.16 and Appendix I – Remedial Action for Rail Defects.
    c. If spalling is present, measure depth of spall.
    d. Visually check underside of rail head for indication of crack-out in the upper fillet area.
    e. Apply remedial action from Appendix I – Remedial Action for Rail Defects and notify the CM Manager of Track of the defect condition. This remedial action does not apply to incidents of spalls on switch points, frog points, or in rail joint areas. Spalls at these locations are to be welded in accordance with existing approved procedures.
2. Note that whenever the ballast section is frozen, or when the track structure is otherwise stiff, such as on bridge structures or where concrete ties are installed, the development of rail surface irregularities will escalate rapidly.
3. When a rail in track contains any of the defects listed in Appendix H – Rail Defect Descriptions, operation over the defective rail is not permitted until:
    a. The rail is replaced; or
    b. The remedial action prescribed in the applicable table is initiated.

4. On Class 1, 2, and class 3 track with less than 20 MGT annually, where no passenger trains operate, all defects must be removed as soon as conditions permit but in no case longer than the next ultrasonic test car run

5. Defective rails and rail breaks must be reported to the Track Evaluation Officer and the CM Manager of Track.

6. When a defect is found on a Class 1, 2, or Class 3 track carrying less than 20 MGT annually, refer to and apply the appropriate remedial action codes A through I of Table 52 in Appendix I – Remedial Action for Rail Defects.

    a. Any Class 3 track carrying passenger trains or hazardous materials, regardless of annual tonnage, refer to and apply the appropriate remedial action codes 1 to 13 of Table 53 in Appendix I – Remedial Action for Rail Defects.

7. Refer to and apply the appropriate remedial action codes 1 to 13 of Table 53 in Appendix I – Remedial Action for Rail Defects, when a defect is found in:

    a. Class 3 track carrying more than 20 MGT annually, hazardous materials, or passenger service; or,

    b. Class 4 and 5 track.

8. Damaged rail and ordinary breaks will be handled according to appropriate remedial action table.

4.16. Crushed Heads or Localized Surface Collapse and Rail End Batter

1. The criteria in Table 50 of Appendix I – Remedial Action for Rail Defects shall be used in restricting the operating speed over crushed heads, surface collapse and rail end batter until such time as they can be corrected.

2. During the winter months (as determined by the Manager of Track and/or designate), Table 51 of Appendix I – Remedial Action for Rail Defects applies to in-track rail joints in Class 3 track and greater with an annual MGT of 10 or greater.

3. When rail end joint batter is over 1/8 in (3 mm) cross-level measurements must be taken to ensure a profile or warp situation is not evident. If a profile or warp condition is found to be close to urgent conditions, the condition must be protected as per the track standards.

4. Depth of crushed heads, localized surface collapse and rail end batter shall be determined using a straight edge and a 3/8 in. (10 mm) wide taper gauge as per the following diagrams:

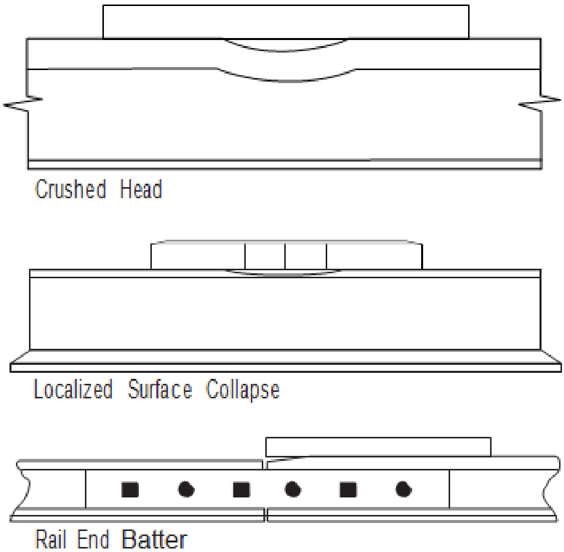


Figure 8. Examples of how to measure depth of crushed heads, surface collapse, and batter

4.17. Authorizing Movements over Rail Breaks and In-Service Rail Failures

1. This section expands upon practices outlined in Track Standard Section 4.10 through 4.16 and has been developed to provide specific criteria for a qualified employee to authorize a train or engine to proceed safely over rail breaks.

a. For the purpose of this section, a rail break shall be considered a complete break of the rail.

b. Thermite weld run-throughs produce conditions similar to rail breaks. As such, the practice contained herein for movements over rail breaks may be equally applied provided approved weld repair bars are applied.

c. A qualified employee for authorizing movements over rail breaks must be trained in movements over rail breaks as defined by Transport Canada.

2. In electrified territory, prior to approaching a broken rail or any rail discontinuity as well as prior to conducting any repairs, install jumpers or cross-bonds around failures.

3. A train or engine must not be permitted to operate over a rail break when any of the following conditions exist:

   a. The rail break is in a tunnel or on an open deck bridge;

   b. For supervised moves, the rail break is within 100 feet (30.5 m) of an unanchored open deck bridge;

   c. For unsupervised moves, the rail break is within 500 feet (152.4 m) of an unanchored open deck bridge;

   d. The ties on either side of the break are defective, crushed, or split in the tie plate area;

   e. Cracks are observed radiating from the broken rail ends;

   f. The rail break occurs in an area of unstable grade;

   g. The offset (overhang) is greater than 2 inches (51 mm);

   h. The gap is greater than 3½ inches (89 mm);

   i. In the case of a joint area, the break extends beyond the limits of the joint bar; or

j. The break occurs in an area in which the CM Senior Manager of Track and Structures has specified that movements over rail breaks are not permitted.

4. Where none of the above conditions exist and joint bars are installed with at least one bolt through the centre of the break trains or engines are allowed to operate over the break at a speed not exceeding 10 miles per hour.

5. When none of the conditions outlined in item 2 exist, the break is not on a ballast deck bridge and the gap size is too small to allow for the installation of joint bars with one bolt through the centre of the break (less 1 1/8" or 29 mm) trains may be permitted to operate over the broken rail at a speed not exceeding 5 mph.

6. If the break is at a weld location and bolt holes exist, joint bars, or weld repair bars should be installed whenever possible, with at least one bolt in each rail end.

7. The condition of rail breaks, joint bars, weld repair bars and supporting track ties must be observed as movements operate over the break.

8. The requirement in Item 7 may be waived if the rail break is a significant distance from a location where the employees' vehicle can be cleared. For example, where there is no other track, grade crossing or road nearby, or where access by foot is impeded by adverse weather conditions provided the following regulatory requirements are met:

   a. The rail break is either:

      i. An ordinary break;

      ii. A complete break in which there is a sign of a transverse fissure or compound fissure; or

      iii. A complete break at a defective weld

   b. The condition of the rail break, joint bars and supporting track ties must be inspected prior to each movement over the break

c. Not more than 24 hours has elapsed since the initial inspection of the defect, and

d. All unsupervised movements are recorded when reporting the break to the Manager of Track.

9. Speed restrictions must be applied in accordance with the applicable operating rules:

a. The Rail Traffic Controller, RTC, must be notified, as to how the restriction is to be applied. One of the following methods must be used:

i. Flags placed in accordance with CROR Rule 843;

ii. By the use of an approved rail break sign; or

iii. When flags or an approved rail break sign are not available, restrictions must be applied between two identifiable locations.

10. If the condition of the rail break, joint bars, and supporting track ties, can be visually observed as the train or engine operates over the break, use the flow chart in Figure 38 in Appendix K – Authorizing Movements over Rail Breaks to determine the appropriate action.

4.18. Defects at CAD Welds and Pin Brazing

1. CAD welds may be used on GO Transit Territory, however cannot be placed on the head of the rail.

2. Pin brazing may be used on GO Transit Territory but cannot be placed on the head of the rail, except on insulated glued joints.

3. Where defective CAD weld or pin brazed bonds have been detected on the rail head between 0 and 20 per cent, the following repair procedure applies:

a. Grind the field side of the rail head, containing the defect (crack), carefully so as to ensure no overheating of the rail head will occur. Overheating and rapid cooling of the rail may cause the formation of martensite, which is a very hard brittle microstructure easily susceptible to cracking.

b. If more than 1/4 inch (6 mm) needs to be ground, the rail must be removed.

c. The grinding must be tapered over a distance of at least 12 inches (305 mm) on each side of the defect so as to not cause an abrupt change in the rail head section.

d. The defect shall only be considered as removed if ascertained through a follow-up ultrasonic test.

e. If the defect is detected a second time by ultrasonic means, then the defect must be protected as per Appendix I – Remedial Action for Rail Defects and removed from track.

Recommended Method 1303-0 – Classification of Rail

1. When producing and using used rail drilled at one end only, i.e. drilled at the left end, for butt welding, determination of the left end or right end will be made while facing the gauge side of the rail
2. All used rail received at a designated rail storage yard must be classified by a qualified rail inspector.
3. Rail may be classified either on line or at designated rail storage yards. Rail classified at rail storage yards must be ultrasonically tested. All other used rail must be ultrasonically tested as per the GO Transit Ultrasonic Inspection Policy contained in Track Standard Section 18.4
4. The Track Supervisor or equivalent as designated by the CM Senior Manager of Track and Structures will be responsible for field classification of rail.
5. When rail is classified, it must be marked with white paint on the web of the rail not more than 3 ft. (914 mm) from the end and clear of the joint bars. The marking must be in accordance with the requirements for various classes shown in this Recommended Method and must be placed on the side of the rail that will be the gauge side when rail is laid in track.
6. When rail is reclassified, all previous classification marks must be obliterated.
7. Rails, which when placed on a flat surface having their ends higher than the centre (vertical bend), are acceptable provided they contain a uniform sweep, the middle ordinate of which does not exceed the following:

5” (127 mm)	for	78’ (23774 mm) rail
4-1/4” (108 mm)	for	72’ (21946 mm) rail
3 1/2” (89 mm)	for	66’ (20117 mm) rail
3” (76 mm)	for	60’ (18289 mm) rail
1-1/4” (33 mm)	for	39’ (11887 mm) rail

1-1/16” (27 mm)	for	36’ (10973 mm) rail
7/8” (22 mm)	for	33’ (10058 mm) rail
3/4” (19 mm)	for	30’ (9144 mm) rail
5/8” (16 mm)	for	27’(8230 mm) rail
1/4” (6 mm)	for	18’ (5486 mm) rail

8. GO Transit standard rail sections only permit the use of One Spot (Class 1) used rail on any GO Transit owned track. Used rail shall be classified and marked according to the following standards:

   a. One Spot (Class 1), marked: ‘ • ‘

      i. In addition to meeting the above requirements, rails must be free of all physical defects. There must be no sharp kinks in either line or surface and the rail must be within the limits of length and wear shown in Tables 1A and 1B of this recommended method. Use of this rail in any track is not limited.

   b. Two Spot (Class 2), marked: ‘ •• ‘

      i. Rails must conform to the requirements of One Spot (Class 1) rail for physical condition. Rail must be within the limits of length and wear shown in Tables 1A and 1B of this recommended method. Use of this rail in any track is not limited.

   c. Three Spot (Class 3), marked: ‘ ••• ‘

      i. Rails may have minor imperfections of line and/or surface, or minor physical defects that will not interfere with the safe use of the rail under traffic. Rails must be within the limits of wear and length shown in Tables 1A and 1B of this recommended method. Use of this rail will be generally limited to main lines with less than 15 MGT annually on curves less than 2º, sidings and all other tracks.

      ii. Note: Rails that are shipped to the field in jointed strings where loss of vertical height exceeds the values shown in Track Standard Section 4.6, modified joint bars as shown in Standard Plan TS-1209A/B must be installed to prevent wheel flanges from striking joint bars.

d. Four Spot (Class 4), marked: ' •••• '

i. Rails may have minor imperfections in line and/or surface, or minor physical defects that will not interfere with the safe use of the rail in yard tracks, industrial tracks and light density spurs. Rails must be within the limits of wear and length shown in Tables 1A and 1B of this recommended method.

ii. Note: Rails that are shipped to the field in jointed strings where loss of vertical height exceeds the values shown in Track Standard Section 4.6, modified joint bars as shown in Standard Plan TS-1209A/B must be installed to prevent wheel flanges from striking joint bars.

e. Scrap, marked: ' X '

i. Rails that do not satisfy the above requirements of the classifications must be scrapped.

ii. All rails having horizontal split heads, vertical split heads, pipes, cracked webs or broken bases due to longitudinal seams or splits, or surface defects that might cause damage to wheels or rolling stock must be scrapped.

iii. Rail arriving at the rail storage yard painted red or marked as scrap shall be immediately scrapped.

f. Rails to be sawn, marked: ' S '

i. Rails must conform to the requirement of either One, Two, Three or Four Spot in that portion of the rail that would remain after sawing.

ii. When rail is sawn in the rail yard for classification purposes, the cut must be made a minimum of 4" (100 mm) from any torch cut and a minimum of 6 inches either side of a thermite weld. If bolt holes, batter, or other defects exist, sufficient rail must be cut off to remove the defect.

iii. End cuts must be true and square, a variation of not more than 1/32” being allowed. Rail which has been snapped using a rail shearing head and is intended for reuse, must be sawn.

- End must be sawn at a minimum of 6 ft. (1.83 m) from the shear snapped end.

Table 1A – Classification Wear Limits Applicable on GO Transit

Rail Section	Class	Min length (ft.)	Loss of Vertical Height (in)	Flange Wear (in)		Total Wear (Sum of both sides plus vertical wear) (in)	End Batter (in)
				One side	Other side		
141RE	•	27	¼	¼	0	3/8	1/16
136RE	•	27	3/16	¼	0	3/8	1/16
132RE	•	27	3/16	¼	0	3/8	1/16
115RE	•	27	1/8	3/16	0	¼	1/16
100RA	•	27	1/16	1/8	0	1/8	1/16
85	•	27	1/16	1/16	0	1/16	1/16

Table 1B – Metric Classification of Wear Limits on GO Transit

Rail Section	Class	Min length (m)	Loss of Vertical Height (mm)	Flange Wear (mm)		Total Wear (Sum of both sides plus vertical wear) (mm)	End Batter (mm)
				One side	Other side		
141RE	•	27	¼	¼	0	3/8	1/16
136RE	•	27	3/16	¼	0	3/8	1/16
132RE	•	27	3/16	¼	0	3/8	1/16
115RE	•	27	1/8	3/16	0	¼	1/16
100RA	•	27	1/16	1/8	0	1/8	1/16
85	•	27	1/16	1/16	0	1/16	1/16

Recommended Method 3700-3 - Unloading Rail

CWR is transported and unloaded by specially designed rail trains. Preparation is critical in unloading rail efficiently. Unloading strings as close as possible to their final position in the track reduces the amount of rail handling necessary.

The procedures described in this Recommended Method outline the rail renewal process and the actions that must be undertaken with the utmost regard for safety.

There are five major steps in the CWR delivery and unloading process

1. Planning for Rail Renewal
    a. Pre-project planning (conducted months prior to the job) Includes emergencies, work environment, materials required, project impediments, work site access, etc.
    b. Pre-project planning (conducted weeks before the job) Includes track protection requirements and work blocks
    c. Pre-block planning (conducted prior to the work) Includes material and equipment readiness, job briefing, field level risk assessment.
2. Preparation
    a. Overhead contact systems shall be de-energised and grounded on each side of the working limits prior to commencing the loading or unloading of any rail.
    b. Preparation is key to safely and efficiently unloading rail. In addition, to all the planning and recognized "Best Practices" involved, the following essential preparation will help maintain a safe and productive work environment. Unloading CWR has many inherent risks associated with it. It is therefore essential that a proper and thorough job briefing be performed. The job briefing(s) and Field Level Risk Assessment will include the entire unloading gang, AND the work train crew. It is of utmost importance

that all employees engaged in the unloading of CWR have a clear understanding of:

i. The type of track protection and work limits provided

ii. The work to be performed

iii. The roles and responsibilities of all employees involved

iv. The identification of all immediate or potential hazards and identifies controls to minimize the risk associated with the identified hazards.

v. A communication plan must be established for all personnel involved in the unloading process. An understanding of this plan must be confirmed with all employees

vi. Utilization of the proper tools for the job

vii. The proper procedures for unloading CWR as outlined in this recommended method.

c. Ensure all hardware is present and inspected prior to use

d. Ensure unloading area has been visited prior to arrival of the rail train to evaluate any safety of other site limitations

e. Rail Unloading Hardware

Figure 9. Rail shoe used to pull rail trough the threader box

Figure 10. Rail grip used to anchor rail to track structure

Figure 11. End of one rail connected to the beginning of another being unloaded

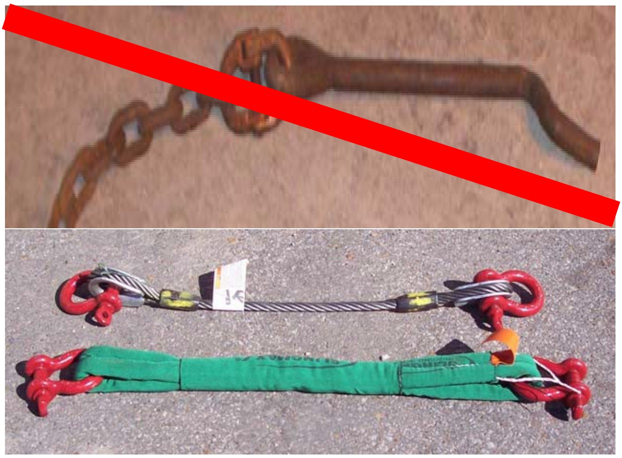


Figure 12. DO NOT USE CHAINS OR PIGTAILS for rail unloading; use nylon slings or steel cables.

f. The equipment owner and operator is responsible for ensuring that all rail unloading equipment and hardware is in good working condition

g. Winch cables, clevises, turnbuckles, nylon slings, rail grips, head pullers, and steel cables should be present and in good working condition. Verify that the electric impact wrench and generator are operational on the anchor car. Also ensure that the generator has fuel and that there is an extension cord in place.

h. Ensure all location details are known, including:

   i. List of unloading locations (should be previously marked in field).

   ii. Obstructions at unloading area (crossings, bridges, turnouts, steep embankments, high-degree curves, etc.). These items are to be noted on the Field Level Risk Assessment

   iii. Exact length(s) of rail required at each location and side of track on which it is to be unloaded.

   iv. Identify prior to the work block which rails require holes to be cut into the ends to facilitate rail shoes or clevis, this may have to be done at both ends of the rail where multiple strings will be unloaded in succession.

   v. Single, double or multi-track territory

i. Welding Certification Requirements for Manufacturing of Rail Unloading Hardware shall be from the Canadian Welding Board Certification (all positions)

3. Set up ramp and threader cars

a. In order to place the CWR beside the track, two specialized cars are utilized to guide the rail into position.

   i. Ramp Car: Contains adjustable height rollers (movable tables) to match the height of the tier from which rail is being unloaded. This allows the proper angle to be maintained for rail fed through the threader car. This prevents the rail from binding or kinking.

ii. Threader Car: Used to guide rail off the rail train to its final position on the shoulder of the track. It does so by threading it through adjustable roller "threader boxes" mounted on the sides of the car.

iii. Anchor Car: The anchor car secures the rail in place during transit. This car is located near the mid-point of the train. The rail is held place on the anchor car by a plate that is secured with bolts. The electric impact wrench supplied in the tool box on the anchor car can be used to remove the bolts.

b. The following procedure is followed to thread rail through the ramp and threader cars, prior to the actual unloading of rail:

i. Step 1: Spot end of threader car at beginning of desired rail-unloading location.

ii. Step 2: Attach rail shoe to leading end of the rail to be unloaded.

iii. Step 3: Guide winch cable(s) through threader box, through threader cone, over moveable tables, and connect to rail shoe (which is already attached to rail to be unloaded).

iv. Step 4: Remove bolts and plates (located at anchor car) from leg of rail to be unloaded.

v. Step 5: Winch rail over adjustable tables, and through threader cone. Ensure rollers are adjusted for the size of the rail section.

vi. Step 6: Attach head-puller assembly onto rail and winch through final threader box. Head puller assembly may have to be reset to complete this task.

c. In order to reduce the risk of personal injury, unloading personnel must not be allowed on the unloading cars or in the vicinity of the winch cables while rail is being threaded. The only exceptions to this are the winch operator, and the employee controlling the height of the adjustable tables.

4. Unloading Rail

a. The following procedure is applicable once the rail has been threaded through the threader boxes (as described in Part 3 above). If rail is being unloaded on both sides, perform the following procedure for each rail and unload rails simultaneously:

i. Step 1: Ensure end of threader car is located at beginning of desired final rail location.

ii. Step 2: Attach rail grip to the rail base between the ties of the “in-track” rail.

iii. Step 3: Attach cable and turnbuckle between rail grip and rail being unloaded. Ensure turnbuckle is adjusted to shortest position so that any tension from the unloading process can be released by lengthening it.

iv. Step 5: Slowly move train in the direction that will pull the rail off the train. Unload slowly as to not overheat rollers or cause unnecessary wear. **DO NOT EXCEED 10 MPH WHILE UNLOADING RAIL**. Considerations to height of embankment, track curvature, etc. must be considered when deciding upon an appropriate unloading speed.

v. Step 6: Stop the train when the end of the threader car reaches the end of the desired unloading location.

Table 10 - Rail Unloading Scenarios

If...	Then...
The end of the leg being unloaded is near (i.e. only a short piece is left on the train)	Unload the entire leg, OTHERWISE cut the rail with an oxy-acetylene torch to the required length.
Next unloading area is close **(No greater than 1 mile away)**	Travel at slow speed with rail in threader box, to next location. **Threader box must be tight against the threader car, and rail secured if possible.**
Next unloading area is <u>not</u> close	Cut hole in rail, install clevis to secure rail to side of threader car before moving to next unloading area or if possible re- install the anchors in the centre of the train.

vi. Step 7: When rail unloading is finished at a particular location, the rail grip will be retrieved by the employees who installed it. This is accomplished by lengthening the turnbuckle to remove any tension, then removing the rail grip from the in-track rail.

b. If unloading more than one string of rail at a particular location, insert this step between steps 5 & 6 of the instructions for unloading a single string of rail (listed above).

i. Stop the train; do not try to connect the second string until the movement has come to a complete stop. An additional string can be connected to the trailing end of a string being unloaded. This connection is depicted in Figure 11 of this document.

ii. The speed of the movement while threading the second or trailing rail must be slow and controlled **(not to exceed 5 mph)**.

iii. The rail shoe must fit entirely over the face of the trailing rail. The length of cable or nylon sling between two rails connected to be unloaded must not exceed **three feet**. The operator of the ramp car must ensure that the rail being pulled from the rail train is properly supported as it approaches the threader car.

c. In some cases a complete string of rail is not required at the location. This will require that the rail will need to be cut in place utilizing an oxy-acetylene torch. Should this be required follow these recommendations:

i. Only qualified employees are to utilize oxy-acetylene torches

ii. Perform supplemental Job Briefing and Field Level Risk Assessment (conditions changed)

iii. Identify personnel required to be in the vicinity and ensure all other employees are clear of the area.

iv. Identify the “line of fire” of the suspended rail, looking ahead to the point at which the cut is complete, where will the rail fall, where will the rail swing.

v. Designate and equip employees to watch for sparks and extinguish embers, hot slag or fires that may ignite.

5. Moving to the Next Unloading Location

a. The initial process of threading rail through the ramp and threader cars is time consuming in comparison to the time it takes to unload one string (generally in the vicinity of 40 minutes to thread and 20 minutes to unload per string). Therefore, it is advantageous to keep rail threaded through the unloading cars as often as possible. In some cases this may be done while in a siding, waiting for track time. Proper track protection must be in place.

b. Limiting the amount of travel between unloading points, i.e. unloading rail at locations that are in close proximity to one another, can greatly reduce the amount of set up time required. However, DO NOT leave rail in the threader boxes unless moves are short. When traveling with rail in the threader boxes, restrict speeds to a **maximum of 15 mph if train is making a reverse movement and 25 mph**

if train is making a forward movement. Please ensure that the locomotive engineer is aware that **no sudden stops are to be made at any time**. All movements must come to a controlled stop. If rail is fully on the racks (not in the threader box) and anchors and plates applied, the train may travel at track speed.

Section 5 Joints

5.1. General Information

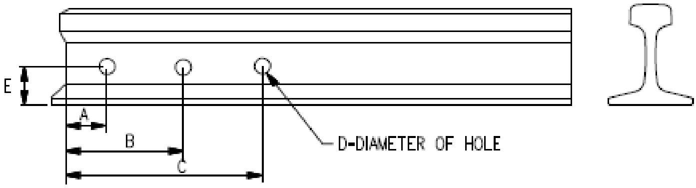
1. In conventional jointed track, each rail shall be bolted with at least two bolts at each joint in Classes 2 through 5 tracks and with at least one bolt in Class 1 track.
2. In the case of Continuous Welded Rail (CWR) track, each rail shall be bolted with at least two bolts at each joint.

5.2. Conventional Joints

1. Proper drilling techniques must be exercised to protect against the harmful effects created by unsuitable drilling practices. Proper drilling techniques will also increase the useful life of drill bits. See Track Standards Section 4.2.10 and refer to Recommended Method 3700-0 – Drilling Holes in Rail for details.
2. Rail bolt holes will be located using the correct indexing bar. The indexing bar will be placed so that the edge of the indexing bar matches the end of the rail.
3. The diameter of the hole drilled shall be of the appropriate size for the rail section. See Table 11 for details.
4. Only joint bars of the correct design for the rail section, drilling pattern, and bolt type will be used.
5. All joints in CWR territory must be inspected at a minimum frequency of that shown in Appendix B – Track Inspection Frequencies on Table 45.
6. In Class 3 track and above, joint bars that are broken, cracked or allow vertical movement of either rail when all bolts are tight shall be replaced immediately.

Table 11 Drilling Data for Rails

Rail Size	A	B	C	D	E	Spacing
100ARA	2 11/16 (68.25)	8 3/16 (8.25)	13 11/16 (347.75)	1 3/16 (30.25)	2 ¾ (70)	2 11/16 : 5 ½ : 5 ½ (68.25 : 140 : 140)
115RE	3 ½ (89)	9 ½ (241)	15 ½ (394)	1 3/16 (30.25)	2 7/8 (73)	3 ½ : 6 : 6 (89 : 152 : 152)
132RE 136RE	3 ½ (89)	9 ½ (241)	15 ½ (394)	1 5/16 (33.25)	3 3/32 (78.5)	3 ½ : 6 : 6 (89 : 152 : 152)



All units in inches, (mm)
When drilling for temporary joints, omit dimension for "A" hole

7. Joint bars that are cracked or broken between the middle two bolt holes regardless of the class of track must be replaced immediately.

8. Rail joints should be slotted to prevent flowed rail and chipped joints.

9. Where 33 ft. (10 m) to 39 ft. (11.9 m) panels are installed and three or more consecutive square joints exist, speed will be limited to that of class 3 track.

10. When jointed rail is installed, the joint stagger shall be 12 ft. (3.7 m) with a tolerance of + 2 ft. (609 mm). See Section 16.2.9.

11. Expansion space between rail ends, when laying bolted rail or track panels, must be provided. Expansion space of the proper dimension between rail ends can be obtained through the use of shims of the correct thickness as per Table 12 below. A lubricant shall be applied on the rail within the area of the permanent joint bar at time of installation. Temporary joints that are planned to be welded are NOT to be lubricated. Expansion shims must not be removed until the rail is properly spiked, the bolts tightened, and rail anchors applied.

Table 12 - Expansion Gap Required for Rail Temperature

Expansion Gap	33 ft. (10.1 m) Rail Temp.	
	(ºF)	**(ºC)**
5/16” (8mm)	Below 10	Below -12
1⁄4” (6.5mm)	10 to 14	-12 to -10
3/16” (4.8mm)	15 to 34	-10 to 1
1/8” (3.2mm)	35 to 59	1 to 15
1/16” (1.6mm)	60 to 85	15 to 30
0	Above 85	Above 30

Expansion Gap	39 ft. (11.9 m) Rail Temp.	
	(ºF)	**(ºC)**
5/16” (8mm)	Below 6	Below -14
1⁄4” (6.5mm)	6 to 25	-14 to -4
3/16” (4.8mm)	26 to 45	-4 to 7
1/8” (3.2mm)	46 to 65	7 to 18
1/16” (1.6mm)	65 to 85	18 to 30
0	Above 85	Above 30

Expansion Gap	78 ft. (23.8 m) Rail Temp.	
	(ºF)	**(ºC)**
5/16” (8mm)	Below 35	Below 1
1⁄4” (6.5mm)	35 to 47	1 to 8
3/16” (4.8mm)	48 to 60	8 to 15
1/8” (3.2mm)	61 to 73	15 to 23
1/16” (1.6mm)	74 to 85	23 to 29
0	Above 85	Above 30

12. Rail joints will not be installed closer than:

a. 20 ft. (6.1 m) from the edge of road crossings. Short welded rails (SWR) should be used wherever possible

b. 20 ft. (6.1 m) to the face of the back-wall of an open deck bridge on the approach side, nor less than 4 ft. (1.22 m) from the face of the back-wall on the bridge side.

13. Joint bars must be applied and the bolts tightened before the rail is spiked. Bolts in rail joints shall be tightened in the following sequence:

    a. The centre two bolts

    b. The second bolt from the centre

    c. The third bolt from the centre, where applicable

14. Tighten track bolts with track wrenches or power wrenches set to the proper torque settings as per Table 13 below. Care must be exercised when tightening bolts to avoid stripping threads.

Table 13 - Torque to be Applied to Rail Joint Track Bolts

Size of Bolt	7/8	1	1-1/8
Torque ft-lb	375	490	705
Torque N-m	508	664	955

15. At the end of each shift, all of the rail laid must be bolted and anchored per standard and each plate must be spiked as per Track Standard Section 4.7.11.

16. Rail joints should be slotted to prevent flowed rail and chipped joints.

17. When secured to wood ties with spikes, have spikes driven so spike heads hold the toe of the joint bar.

18. Both sides of the joint shall be supported by the same composition of tie (hardwood, concrete, or steel as required) and shall be separated from a different tie composition by at least four ties.

5.3. Insulated Joints

1. Continuous insulated joints are fully bonded.
2. Continuous (glued) insulated joints are to be used in CWR.
3. Non-continuous insulated joints are not bonded. This includes encapsulated insulated joints.
4. Encapsulated (coated) insulated joints are to be used in jointed rail sections. Mitred glued joints shall not be installed on main track.
5. Defective insulated joints must be repaired or replaced immediately.
6. Continuous insulated joints must be tested by qualified signals employees prior to installation.
7. Signal forces must report defective insulated joints to track forces promptly.
8. Signal forces AND Electric Traction forces must advise the track forces of the location of insulated joints for proper signal operation. The location must not be changed without the approval of the CM Manager of Signals AND the CM Manager responsible for Electric Traction.
9. Fibre bars may be used in light rail sections of 100ARA or less. Fibre insulated joint bars are NOT permitted in main track.
10. Plates must be used with all insulated joints on wood track ties. As shown on Standard Plan GTS-1206, insulated tie plates will be used on ties within 2” of the end post of an insulated joint.
11. Proper insulated joint clip fully driven in place must be used when Pandrol tie plates or concrete ties are used.
12. Insulated joints should be suspended (the end post should not be over a tie).
13. Rail ends where insulated joints are to be installed must conform to the following:

a. The end face shall be saw cut and bolt holes drilled to the proper size and location for the rail section.

b. All rough edges and burrs shall be removed from the end face and the bolt holes.

c. Batter shall not exceed 1/32 inch (0.75 mm).

d. The heights of the adjacent rails shall not differ by more than 1/16 inch (1.6 mm).

14. All rust, scale, dirt or other foreign matter must be removed from the rail joint area and from the joint bars before the joint is installed.

15. If the end post projects above the top of rail, it must be trimmed so that the top is below the top of rail, but not exceeding 1/8 inch (3.2 mm) below.

16. Both sides of the insulated glued joints shall be supported by the same composition of tie (hardwood, concrete, or steel) and shall be separated from a different tie composition by at least four ties.

17. Track near insulated joints shall be adequately anchored.

    a. Non-continuous insulated joints will be considered as joints and will be fully box anchored at every tie for 200 ft. (60.9 m) in both directions.

18. Rail anchors must not be applied on the sides of ties adjacent to bootlegs. Anchors removed from these locations shall be relocated to the next available tie so as to maintain total anchorage requirements.

19. Rail end overflow must be removed at insulated joints by slotting in accordance with Standard Plan GTS-1113. The gap should be filled with silicone sealer to prevent the influx of dirt and grinding material.

20. After welding, insulation must not be replaced until the rails have cooled.

21. Insulated joints that are no longer required, must be removed from track within 72 hours.

22. At insulated joints tie spacing shall not be less than 19½ in. (495 mm) for non-continuous insulated joints, and 18 in. (457 mm) for continuous insulated joints.

23. A series of eight 9 ft. (2.74 m) ties shall be used between each pair of insulated joints.

    a. This shall not be required within turnouts.

24. Insulated joints shall be staggered at a maximum of 4 ft.-3 in. (1.3 m) for non-continuous insulated joints, and a maximum 4 ft.-6 in. (1.37 m) for continuous insulated joints. Final location of insulated joints shall be confirmed with qualified signals personnel prior to installation.

    a. In electrified territory or in territory where stray current is likely to be prevalent, insulated joints shall be staggered a minimum of two (2) tie cribs apart. A stagger of 39 in. (990 mm) is recommended for continuously insulated joints and 36 in. (914 mm) for non-continuously insulated joints.

5.4. Compromise Rails and Joints

1. To determine the hand of the joint, face the joint from the centre of the track. When the larger rail section is on the left side of the joint, it is a left hand joint. When the rail of larger section is on the right, it is a right hand joint.

2. A compromise joint consists of one gauge side and one field side bar per set. The rail sections that the compromise bar will fit are indicated at each end of the bar.

3. Compromise joint bars must not be modified from their initial design to fit a different rail section.

4. Compromise joints bars (except 132/136 RE) must not be installed in, on, or within 20 ft. (6.1 m) of a turnout, an open deck bridge, highway crossing, or railroad crossing.

5. Compromise joint bars should be painted a colour designated by the Senior Manager of Track and Structures.

6. Compromise joint bars are ONLY permitted in non-main tracks unless otherwise authorised by the CM Senior Manager of Track and Structures.

   a. Existing 132/136 compromise joint bars shall be scheduled for replacement where possible.

7. Compromise rails consist of a single piece of rail, with a forged transition from one rail section to another. Compromise rails may be universal or "handed", depending on the rail sections, and are identified just as a joint would be.

8. Compromise rails will be fully supported and tamped with the correct size tie plates under the corresponding rail section.

   a. The centre of a compromise rail or joint shall be centred in a tie crib.

5.5. Weld Repair Bars

1. Weld repair bars are only to be used to temporarily bolt around a broken rail, a failed weld, or a suspected weld. See Section 4.17

Recommended Method 3700-0 – Drilling Holes in Rail

Rail Drills:

The various models of rail drills or approved equivalent are recommended to be used on GO Transit territory may be classified into two categories, as outlined below;

1. Gas Powered Drills (Supplied by Modern Track Machinery)
    a. Model PR8 c/w speed bit advance
        i. engine speed – 3600 rpm
        ii. spindle feed rate – 130 rpm
        iii. feed rate:
            - low: 0.002” (0.04mm)/rev
            - medium: 0.0049” (0.125mm) /rev
            - high: 0.0098” (0.25mm) / rev
    b. Model PR3AA-2S High precision automatic advance/stop
        i. engine speed – 3600 rpm
        ii. spindle feed rate – 130 rpm for standard rail and 80 rpm for hardened rail
        iii. feed rate: 0.0051” (0.130mm) / rev
        iv. drilling time will vary:
            - Standard Carbon Rail (275-320 BHN) 60-90 seconds
            - Premium rail (321-360 BHN) 90-120 seconds
        v. Note: this model is equipped with a manual “over-ride” which, when activated allows the operator to manually feed the drill bit to the rail. Manual operation is not recommended except in the case of a mechanical problem.
2. Hydraulic Drills (Supplied by Stanley Tool Company)
    a. Model RD11 Stanley Rail Drill – used with flat drill bit

i. set relief valve at power source to 2350 psi
ii. hydraulic working full load pressure: 2000 psi
iii. Max. back pressure: 250 psi
iv. oil flow: 5gpm or 10gpm (both acceptable)
v. spindle feed rate: 90 - 180 rpm
vi. drill time: 90 - 120 seconds

b. Model RD12 Stanley Rail Drill – used with carbide tipped bits attached to a bit holder

i. set relief valve at power source to 2350 psi
ii. hydraulic working full load pressure: 2000 psi
iii. maximum back pressure: 250 psi
iv. oil flow: 10 GPM (critical)
v. spindle feed rate: 900 RPM
vi. drill time: 40 sec. (approx.)

Drill Bits:

GO Transit uses Carbide tipped coring drill bits as in Figure 13

Note: There are two carbide-titanium coated tipped bits on each bit “holder”. Each carbide tip is designed with four cutting faces. When a cutting edge is dull, (approximately 35 holes), the cutting tip can be rotated 90 degrees to the next face, etc. Both cutting tips should be rotated at the same time. The total number of holes per set of cutting tips should be 140-200 holes. The tool bit holder is estimated to last upwards of 2000 hole-drillings with proper drilling techniques.

Figure 13. – Carbide Tipped Coring Bit

Lubrication:

When all other requirements for speed, feed and drilling times are met, the expected life of a drill bit could be reduced by one half, if proper lubrication is not provided. Lubrication must be applied to the tip of the bit while drilling.

The following practices apply to lubrication while drilling:

1. A continuous flow of lubricant must be directed at the drilling bit tip to be effective. Approved oil such as "Castrol" or cutting machine oil should be used. Water soluble coolant (can be diluted with water) is the next preferred lubricant. Approved oil will outperform water, and water will outperform dry drilling. Antifreeze works well in cold weather.
2. When using an antifreeze mixture, remember to be environmentally friendly and use a biodegradable brand wherever possible.
3. Carbide tipped coring bits (RD12 drills) require lubrication at all times and must not be permitted to drill dry. It is recommended that a continuous flow of

lubricant to the drill bit is ensured. The use of an appropriate lubricant is recommended.

4. Intermittent cooling/lubrication using snow or water is not permitted as it can be more damaging than dry drilling. The whole area may become superheated and quenched, increasing the hardness of the hole so much that the drill bit will no longer cut properly.

5. Never throw snow or water onto drill bits. This will introduce further problems associated with production of brittle un-tempered martensite in the rail and drill bit.

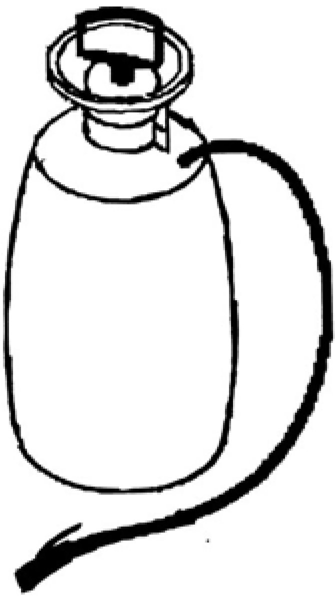


Figure 14. – Typical Garden Weed Sprayer

Drilling with Carbide Tipped Coring Bits:

The model RD 12 hydraulic rail drill (see Figure 15) is used with carbide tipped coring bits. The following practices shall be observed:

1. Wipe all hose connections with a clean lint-free cloth before making connections.
2. Connect the hoses from the hydraulic power source to the hose couplers at the tool. It is a good practice to connect the return hose first and disconnect it last to minimize or avoid trapped pressure within the drill.
3. Observe flow indicators stamped on hose couplers to be sure that oil flow is in the proper direction. The female coupler is the inlet coupler.
4. The RD12 rail drill is equipped with a separate coolant assembly that is used to deliver coolant to the drill bit. Ensure this is operating properly before drilling.
5. Connect the coolant assembly to the rail drill using the supplied quick- disconnect coupler.
6. Make sure the carbide inserts on the drill bit have good cutting edges. If the surfaces are worn or chipped, unscrew the retaining screw and rotate the insert to a good cutting surface.
7. Install the drill bit into the piston assembly then turn clockwise.
8. RD12 Drills must be used with rail templates and hole guides.
9. The drilling machine must be properly aligned with the proper rail guide. Never use joint bars as a guide.
10. Ensure drill is level and very tight
11. When clamping the drill to the rail, double check to ensure clamping pressure. If loose, the drill will skid down the rail and bits will be destroyed.
12. Drilling speed shall be set at the requirements set out by the supplier. The spindle feed rate for the RD12 is 900 rpm @ 10 GPM.

13. Drilling speed and feed rates are very important. Drilling speeds out of adjustment will affect the feed rate and decrease the life of the carbide bit, increasing drilling problems. Ensure drills are checked regularly for recommended rpm's, oil flow and pressures.

14. Feed rates are pre-set by the drilling speed. If drilling speed is correct the feed rate will be correct as well.

15. Drilling must be closely timed using a stop watch or other reliable method.

16. Watch the feed screw while the machine is drilling. If it stops turning that means the drill bit is not cutting and the machine should be stopped.

17. Drilling a hole with the RD 12 drills with carbide tipped coring bits should take 40-60 seconds. Drilling times longer than 60 seconds are generally a result of a dull or chipped carbide bits and the bits should then be rotated.

18. Pay close attention to the drilling times previously mentioned. The extra friction and heat produced by exceeding the recommended drilling times can destroy the cutting edge of the bit and result in poor surface finishes and poor durability of the hole.

19. The tool bit holder must be inserted into the deepest position of the chuck, properly seated and secured.

20. Do not run out of coolant. If this occurs, the drill bits will only last approximately 10 seconds, the cutters will break and the tool bit holder will be ruined and difficult to remove.

21. Check cutters every 3 or 4 holes for condition. Cutters should get approximately 30 holes before requiring rotation.

22. Remove drill bit while in transit to avoid damage to the cutters.

23. Remove tool holder out of spindle and place a rag in the spindle for transit.

24. Use the correct template for the size of rail you are drilling.

25. A qualified mechanic must check the condition of your drilling machine at least once per year. Where a large

number of drills are in use, a routine maintenance program should be set up to allow for cycled maintenance of the drills, and to ensure that all drills are checked yearly.

26. Whenever cycled maintenance has been performed, drill should be tagged with last maintenance date and next due date.

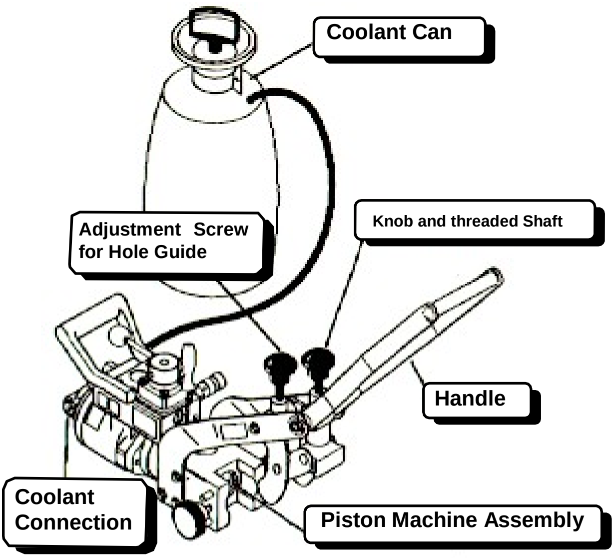


Figure 15. – RD12 Hydraulic Rail Drill

Safety Precautions:

1. Operators of drills must be familiar with prohibited work areas such as excessive slopes and dangerous terrain conditions.
2. Supervisors must ensure that proper training has been received to ensure safe operation of drills by their operators.

3. Always wear safety equipment such as goggles, ear and head protection, safety shoes and reflectorized apparel while operating a drill.
4. Do not overreach. Maintain proper footing and balance at all times.
5. Do not inspect, replace the drill bit or clean the tool while the power source is connected. Accidental engagement of the tool can cause serious injury.
6. Always connect hoses to the tool hose couplers before energizing the hydraulic power source. Be sure all connections are tight.
7. Never wear loose clothing that can get entangled in the working parts of the drill.
8. To avoid injury or equipment damage, all drill repairs, maintenance and service must be performed by authorized and properly trained personnel.
9. Always check bits for damage and chips out of the chisel edge points and roundness of the cutting edges before each use. Any damage to the bits will affect the ability of the bit to drill a hole. Damaged bits should be removed from further use.
10. Keep hands and fingers away from rotating parts.
11. Handle drill bits with care. They are a precise cutting tool. Avoid hitting of the drill bits against other surfaces.
12. If drilling time is beyond the 2.5 minute limit (or 1 min. for the carbide tipped coring bits) **STOP** the machine and change the drill bit or rotate cutters. Never let a dull bit heat up the rail.
13. Record the number of holes drilled with each bit as well as the drilling time. As time nears the maximum time period it is time to change the drill bit.
14. Discard old flat bits that will not be re-sharpened so they do not get used again. Coring bits can have the carbide tips rotated or replaced. Do not discard these bits
15. Consistent and good lubrication is necessary. Dry drilling is better than inconsistent lubrication in the case of PR8, PR3AA and RD11 drills.

16. RD12 Rail drills and bits must have good lubrication, dry drilling is not permitted.
17. Always ensure manufacturer's recommendations are followed.
18. Ensure any burrs, fins and sharp edges are removed after each drilling operation using an approved tool.

Quality Assurance:

If for any reason it is felt that a quality issue exists with new drill bits ensure the following:

1. Drill (machine) is functioning properly.
2. Proper procedures have been followed.
3. Good lubrication has been provided.
4. Drill bit has not been damaged through rough handling.
5. Ensure hydraulic pump drive belt is properly adjusted.

If the above has been followed and problems still exist contact your immediate supervisor.

Document all pertinent details and information for warranty or claim.

Section 6 Rail Grinding and Milling

6.1. Rail Grinding with Self Propelled Grinding Machines

1. Where practical, crossing surfaces adjacent to the rails should be removed. This will permit grinding and milling across the entire rail head and applies to both the large out-of-face grinders and milling machines and the switch and crossing grinders and milling machines.
2. Rail segments through hot box detectors, wheel impact detectors etc. shall not be ground or milled unless the Signals Department has arranged to protect such installations.
3. Wayside lubricator system actuators, ramps, wiping bars and other parts which might be damaged must be lowered or removed prior to rail grinding or rail milling operations but must be placed back in service immediately following grinding or milling.
4. Rail grinding and rail milling profiles and frequencies will be as specified by the CM Senior Manager of Track and Structures and found in Appendix Q – Standard Rail Head Profiles.
5. Rail that is scheduled for removal shall be classified, UTT tested, and ground prior to removal, to improve its condition for the next position, if it is:
    a. To be used for maintenance rail;
    b. To be used for direct field cascading
6. Corrective grinding or milling should be undertaken when:
    a. Corrugation exists to the extent that the average slope from peak to trough of the corrugation exceeds 0.002 inches per inch (0.002 mm per mm); or
    b. The running band requires correction

7. Before grinding commences, the following preparation work must be done:

   a. A complete survey of the rail condition shall be made;

   b. The track must be in good surface, gauge and line;

   c. To the extent possible, all replacement rail should be installed and field welds made;

   d. Engine burns, rail end batter, stock rail batter or any other discrete defects which would be deeper than 0.010” (0.25 mm) after the planned grinding, should be repaired or removed prior to grinding;

   e. Areas that cannot be repaired economically, or that habitually deteriorate at a rate greater than that of the adjacent rail, should be removed and replaced with permanent closures prior to grinding.

8. A Grinding or Milling Supervisor shall accompany the grinding or milling machine, and their responsibilities shall include:

   a. Performing pre-inspections of rail condition;

   b. Ensure that there is adequate communication between the control operators and the conductor;

   c. Ensure that the machine progress and performance is optimum;

   d. Ensure metal removal and levelling tests are performed on a regular basis;

   e. Coordinate fire patrols during the periods of the year when such patrols are necessary and communicate regularly with appropriate fire protection agencies;

   f. Keep a daily log of machine performance and ensure that the daily reports are correct; and

   g. Inspect around insulated joints, turnouts, and other locations where filings could disrupt the signal system.

h. Ensure, when practicable, on-track lubricators are applying grease to the gauge corner of the high rail and to the top of the low rail on newly ground curves prior to the passage of train traffic.

9. After grinding or milling is complete the rail head should be consistent with the designed and approved rail profiles. See Appendix Q – Standard Rail Head Profiles

10. See Track Standard Section 24 – Fire Prevention.

6.2. Frog and Switch Grinding and Milling

1. When grinding or milling turnouts with a frog and switch grinder or milling machine, the following procedures will apply:

   a. The frog shall not be ground or milled. The grinding or milling wheels should be raised at the last joint (or weld) before the frog and lowered at the first joint (or weld) after the frog. Pick up and set down points should be consistent within 12” (305 mm);

   b. Normally, point rails shall not be ground or milled between the point end and the end of the head side planning (except in the case of item c. below);

   c. When the difference between the vertical dimension of the running surface of the switch point and the stock rail, in the riser area, is reduced by wear to 3/16 in. (5 mm) , the stock rail and/or the switch point may be ground to restore the ¼ in. - 5/16 in. (6-8 mm) dimension (See Track Standard 17.5); and

   d. At switches and crossings, grinding and milling shall continue for 80 ft. (24.4 m) beyond the point of switch and heel of frog. This ensures a smooth transition zone.

2. If necessary, the switch and crossing grinder may be used to grind spots on tangents and curves that would be otherwise uneconomical to grind with a large grinder.

6.3. Rail Grinding and Milling near Bridges and Structures

1. Grinding is NOT to be performed within 50 feet (15.2 m) on either side of any structure that is not scheduled for grinding unless this area, including the first 200 feet (61 m) of the bridge deck, is wetted down with a fire retardant foam/water mixture. In this case, grinding can be performed to within 25 feet (7.6 m) on either side of the structure.
    a. This requirement is not applicable to steel and concrete bridges.
2. Milling will be permitted to be performed within 50 feet (15.2 m) of a bridge. During dry conditions and summer months, the first 200 ft. (61 m) of the bridge deck must be wetted down.
3. Whenever possible, rail grinding or milling on bridges should be scheduled during winter months or under wet weather conditions.
4. During the pre-grinding/milling survey inspections the Grinding Supervisor along with the Track Supervisor will establish and agree on a list of bridges to be ground and/or milled.
5. The Track Supervisor or CM Manager of Track will then contact the CM Manager of Bridges and Structures and notify them of the bridge(s) to be ground and/or milled.
6. The CM Manager of Bridges and Structures must then examine the structure(s) for fire hazards and provide an assessment of the risks that are present. This assessment will include:
    a. A mitigation plan for each structure, which will outline the precautions to be taken in terms of additional fire protection. This mitigation plan must also include the following:

i. Requirements for post grind patrols.

ii. List of local fire department contacts

iii. Any specific fire suppression requirements unique to a structure (i.e. Presence of local Fire Department required).

iv. Any special requirements for removal of fire susceptible material near and under the bridge.

7. Prior to grinding or milling, the Grinding/Milling Supervisor must ascertain from the Track Supervisor that:

   a. All bridges on the grinding and/or milling list have been inspected for fire hazards and assessed by the Manager of Bridges and Structures; and,

   b. All fire precautions and patrols are in place as outlined in the mitigation plan for the type of rail head profile optimization method to be employed.

   c. If all these conditions cannot be ascertained, then NO grinding and/or milling of the bridge(s) shall be done.

8. The grinding train must not leave the structure until either a patrol or the fire truck is physically in place. A thorough job briefing must be performed and such persons must understand their duties. They must have suitable fire-fighting equipment (at least 3 Wajax cans filled with water or preferably a water/foam retardant mixture) and know how to operate them. The foam mixture is much more effective than water alone.

9. The fire suppression systems on the grinding train must be equipped with a fire retardant foam/water mixture.

10. Any timber structure is to be ground or milled must be wetted down prior to grinding to reduce the risk of fire.

11. Grinding train ditch and tie sprays must be operated continuously during the entire bridge grinding operation.

12. A fire suppression system must accompany the milling equipment to mitigate fire risk.

13. On timber structures, once grinding is complete, run the grinding train with ditch and tie sprays operating over the entire bridge including 200 feet (61 m) on each side at least once to wet down any sparks that may have been left by the grinding operation. This train movement should be done at a constant speed without any sudden stops to avoid dislodging slag and swarf from the grinding train.

14. On timber structures, once the milling operation is complete, run the fire suppression with ditch and tie sprays operating over the entire length of the bridge including 100 ft. (30.5 m) on each side at least once.

15. When grinding and/or milling in the area of timber bridges and trestles, a fire inspection must be performed after passing over these structures. This inspection includes viewing the structure with thermal imaging devices.

16. See Track Standards Section 24 – Fire Prevention.

Section 7 Rail Lubrication

7.1. Wayside Lubricators

1. All new curves of 2º and greater in main line tracks shall be protected by a wayside lubrication system at the discretion of the CM Senior Manager of Track and Structures.
2. All new main line curves over 6º must be protected by a wayside lubrication system and be subjected to the criteria stated herein. The CM Sr. Manager of Track and Structures shall determine whether lubricators are required for non-main line track.
   a. All existing main line curves shall be upgraded to comply with this Standard.
3. Locations for wayside lubricators shall be determined through the following criteria:
   a. Maintenance road and power access to the location or as approved by the CM Senior Manager of Track and Structures.
   b. Wayside lubricators should be located away from water-courses, road crossings, turnouts, diamonds, open deck bridges, hot box detectors and Signal & Communications installations.
   c. Wayside lubricators shall be kept at least 100 ft. (30.5 m) from insulated joints.
   d. Wayside lubricators should be located away from stopping points, and normal points of sanding, sink holes, and frost heave areas.
   e. Wayside lubricators should where possible be installed no closer than ½ mile (800 m) from a public road crossing.
   f. Carrying properties of the grease;
   g. Grade of track; and
   h. The total central angle of curves

i. Each curve will have a Total Central Angle of Curvature calculated using the formula:

$$TAC = \frac{D_c \cdot \left(L_c \cdot {}^{1}\!/_{2} \cdot (L_{s1} + L_{s2})\right)}{100}$$

$D_c = degree\ of\ curve$

$L_c = Length\ of\ curve$

$L_{s1} = length\ of\ entry\ spiral$

$L_{s2} = length\ of\ exit\ spiral$

The coverage for a single wayside lubricator will be determined when the sum total of TAC values for successive curves reaches 600.

4. Track conditions at the location of the wayside lubricator shall be as follows:

   a. Rail wear should be such that the wiping bars are not damaged by passing wheels.

   b. Gauge at the lubricator must be maintained to 56½ in. (1,435 mm).

   c. Wayside lubricators must NOT be installed on concrete ties with worn insulators.

   d. On wood ties, ties will be fully spiked for 30 ft. (9.1 m) on either side of the lubricator.

   e. All track ties within the limits of the applicator bars must be sound and free of plate cutting.

   f. All other track material, such as tie plates, spikes, etc., must be in good condition.

   g. Wayside lubricators shall be installed in accordance with the manufacturer's instructions.

5. Track will be covered with woven geotechnical fabric designed for the specific application for a distance of 50 ft. (15.2 m) to either side of a wayside lubricator, and installed per the manufacturer's recommendations.

   a. Every spring remove the fabric from the track to inspect the track, noting ballast conditions, tie conditions, plate or spike movement, etc., and replace with new fabric.

6. The type of wayside lubricators to be installed and their locations shall be approved by the CM Senior Manager of Track and Structures.

7. Electric wayside lubricators (solar powered or 120 Volt AC) are recommended for all new installations.

8. The location of electric wayside lubricators should be selected in consultation with the S&C department, which will advise on electric power availability.

9. Electrical hook-ups to electric wayside lubricators must be made by qualified personnel. Ground Fault Circuit Interrupters must be used on all 120 Volt installations.

10. Solar panels for electric wayside lubricators must be located and mounted according to manufacturer's instructions, where the maximum amount of sunlight will be obtained. The use of a protective shield is recommended to prevent damage to the solar panels.

11. The batteries of electric wayside lubricators must be protected from freezing in the event of a total discharge.

12. The exact locations of installation shall be determined in the field.

13. Maintenance of the wayside lubricators shall include, but not be limited to:

    a. Wayside lubricators must be inspected on foot at least once per month.

        i. Any wayside lubricator found not working shall be documented and reported to the CM Manager of Track.

    b. In track circuit territory, including but limited to CTC territory or in a crossing approach, care must be taken to ensure that no part of the wayside lubrication system grounds or shorts out the rails. This includes checking that metal reinforced hoses do not contact the rails, and ensuring that the lubricator does not interfere with bond wires and temporary bond wires.

    c. The lids of wayside lubricators must be kept locked except when maintenance is being performed.

d. Hydraulic fluid levels in hydraulically activated wayside lubricators must be checked and filled according to manufacturer's instructions.

e. Mechanical pump drive connections must be inspected and lubricated on a regular basis.

f. All hold-down bolts, clamps, etc., kept tight.

14. Wayside lubricator actuators, ramps, wiping bars and other parts which might be damaged must be lowered or removed prior to rail grinding or milling operations but must be placed back in service immediately following grinding or milling.

15. As grease interferes with proper ultrasonic testing, all wayside lubricators must be shut off sufficiently in advance of any Ultrasonic Rail Testing to ensure no grease is present. Wayside lubricators must be reactivated immediately after testing.

16. The area immediately around wayside lubricators must be kept as clean as possible. Packaging materials and contaminated grease must be disposed of in an approved manner.

17. With the exception with the lubrication specified for rail grinding and milling, GO Transit does NOT permit any top of rail lubrication.

7.2. Lubricating Products

1. Only approved grease is to be used in wayside lubricators.

2. The grease must be puddled when the reservoir is being filled.

3. The grease reservoir must never be allowed to pump dry.

4. Summer and winter grade greases will be used during the appropriate seasons.

Section 8 Field Welding

8.1. General Information

1. All welding shall conform to the requirements specified in the Approved Track Welding Manual
2. In electrified territory, temporary rail jumpers or cross-bonds shall be installed prior to commencing joint removal.
3. Prior to welding, rail must be visually examined for physical defects, and must meet the criteria herein for alignment and wear.
4. Thermite or field flash butt welds shall be located as close as possible to the centre of tie cribs. In no case may a field weld be situated over a tie plate.
5. Field Welds will not be made:
   a. Within 6 ft. (1.8 m) of a thermite weld;
   b. Within 3 ft. (910 mm) of a flash butt weld; or
   c. Within 4 in. (102 mm) off the edge of a tie.
6. All rail ends must be saw cut. The cut must be square and perpendicular to the rail axis, with a variation not exceeding 1/8 in. (3 mm) and all burrs must be removed.
7. All PW rail that is saw cut will have the exposed ends tested for longitudinal defects with dye penetrant (DP).
8. Joints intended to be welded in signalled territory, must be supported with an approved signals work methodology plan.
9. *In case of emergency*: torch cutting of the rail is allowable provided that:
   a. A minimum of 4 in. (102 mm) of rail must be removed.
   b. Movements over the torch cut are limited to 10 mph and supervised by a qualified employee with established communication with the movement.

10. The distance from the end of rail to the nearest edge of any drilled hole in the rail shall not be less than 4 in. (102 mm).

11. The Month, Year, Welder ID, and weld number of each weld shall be identified with a tag or written with a paint marker on the gauge side of the web within 3 ft. (914 mm) of the weld.

12. For the welding of insulated joints, standard joint bars shall be applied on only one joint at a time. (Note that when the insulated joint is on the closure rail, the installation of standard joint bars may short the track circuit).

13. Rail pullers **MUST** be used on all closure welds if the rail temperature is at or below the PRLT.

    a. Rail pullers must not be removed until the weld has cooled below 700°F (372°C).

14. NO welding of switch points or stock rails on Class 3 track and above with the following exception:

    a. *In cases of emergency:* Welding will be allowed, following proper welding procedures and limiting the speed over the weld repair to Class 2 track until component is replaced.

        i. Switch point welding must be conducted by a qualified welding foreman as determined by the CM Senior Manager of Track and Structures.

        ii. In NO case shall switch points be welded if the defective area requires a repair to exceed 12 in. (305 mm).

        iii. Where welding is necessary and the weld repair is equal to or greater than 4 in. (102 mm) in length, the total number of times the switch point can be welded is once.

        iv. Where welding is necessary and the weld repair is less than 4 in. (102 mm), there is no restriction on the number of times a point can be welded.

15. Table 14 identifies the maximum allowable rail base vertical offset for welding joints.

Table 14 Maximum Allowable Vertical Rail Base Offsets for Welding Joints.

Rail Weights	100ARA	115RE	132RE / 136RE
Thermite Welds			
Standard weld kit or kit with equal wear	Up to 3 mm	Up to 3 mm	Up to 3 mm
Weld kit with sloped base plate	Not Allowed	3 - 5 mm	3 – 5 mm
Flash Butt Welds			
Standard FBW	3 mm	3 mm	3 mm
Grind ball to taper over 36 inches	Not Allowed	2 mm ball / 3 mm base	2 mm ball / 3 mm base

16. Each weld will be labelled, in white permanent paint marker, on the field side of the rail with the following:
    a. Identification of welder (Thermite welders initial or Welder number)
    b. Date of weld / consecutive weld number / rail added or removed
    c. Rail temperature when welded / dye penetrant (DP) if the rail was cut.

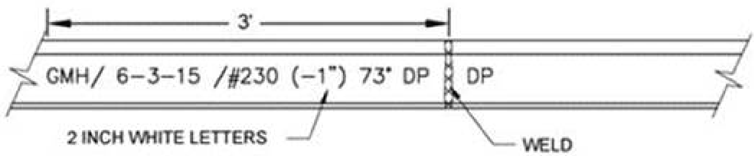


Figure 16. Weld Information Marking

17. All required weld information must be recorded on the Rail Welding report.

18. Upon completion of the weld:
    a. Ties under either side of the welded joint will be firmly tamped under the rail.
    b. Ties will have spike holes plugged and spikes driven to the applicable pattern

c. Anchors will be applied and tightened to the applicable pattern 200 ft. (61 m) in each direction.

   i. Ensure anchors are no closer than 2” to a weld.

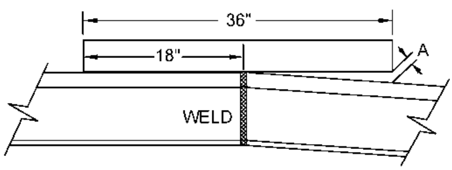
d. Cribs will be filled with ballast and dressed to standard

e. The area around the weld will be cleaned. This includes the removal of all bolts, bars, slag, molds, etc.

19. Welds will be ground to the tolerances in Table 15. Weld dimensions outside the tolerances will be reground to comply, or the weld will be removed.

Table 15 Weld Grinding Tolerances

Measurement	Dimension	Tolerance	
		Thermite (in.)	**FBW (in.)**
Crown: peak of rail at the weld	A	0.030 (0.76 mm)	0.060 (1.52 mm)
Vertical Offset: Addition of crown and vertical height difference	A + C	0	0.060 (1.52 mm)
Dip Camber		0	0
Horizontal Offset: head difference on side of rail	B	0.015 (0.38 mm)	0.040 (1.01 mm)
Indent –Kink to field side	D	0.030 (0.76 mm)	0.030 (0.76 mm)
Indent – Crown inward (peak) toward track center	D	0.030 (0.76 mm)	0.060 (1.52 mm)



CROWN TOLERANCE

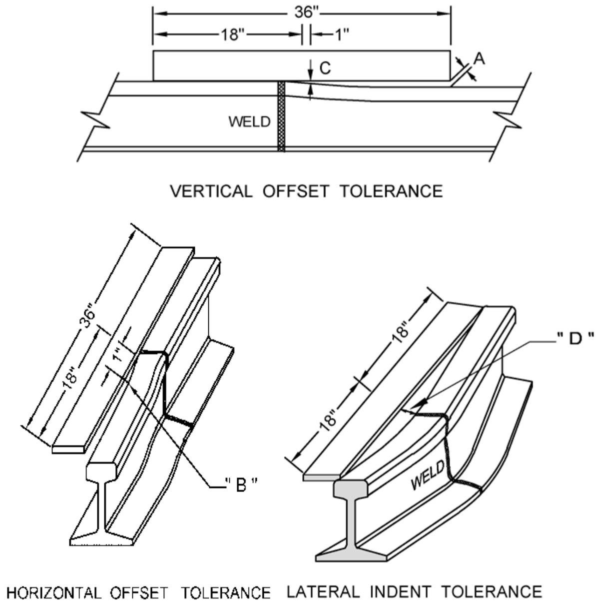


Figure 17. Weld Grinding Tolerance Diagrams

20. All track work nearby shall be stopped during the drop and for the first 5 minutes following.
    a. If the weld is near a crossing, road traffic should be stopped for the same timeline as above.
21. Only trained, qualified, and certified personnel will be allowed to weld.
22. Temporary bonds or rail bypass cables shall be applied around a cut within a crossing circuit, as per Track Standards section 22.3, to prevent the requirement for deactivation and/or nuisance ringing.

8.2. Thermite Welding

1. Welding kits must be compatible with the type of rail being welded.
2. Safety is everyone's number one priority whenever thermite welding. Extreme caution must be exercised to prevent injury and to assure weld quality.

3. Grinding of thermite welds will not extend into the parent rail. Grinding and removal of posts shall conform to the Approved Track Welding Manual.

    a. Base risers shall be removed and ground flush with the weld collar.

4. Thermite welding is not permitted within Road Crossings.

5. Welding debris must be removed from Metrolinx property within 48 hours of welding and NOT be buried in the ballast.

6. Thermite welds are recommended to be performed in dry weather conditions.

    a. Thermite welding in light moisture conditions is permitted, if and only if, the weld area, welding material, and the finishing of the weld can be protected from moisture.

7. When thermite welding in light moisture conditions, the thermite weld must be covered immediately after shearing until the weld cools below a temperature of 900°F (483°C).

8. Do not use thermite weld kits that have exceeded their 2 year maximum shelf-life. This includes the crucibles.

8.3. Flash Butt Welding

1. Following the flash butt welding procedure, the gauge and field sides of the weld shall be ground to match the rail profile.

2. The edges of the rail base **AND** the rail base shall be ground to assure that there are no stress risers at the edges and to allow rail to fit into the tie plates.

3. The web of the rail shall be ground to remove any shear marks and to allow for magnetic particle testing.

4. Flash butt welding is permitted in moderate moisture conditions such as rain, sleet, or blowing snow if the following conditions are met:

    a. The rail can and is kept dry with no weld head clamp slippage.

b. The welding equipment can be kept dry and functioning properly.

5. In wet weather conditions, all flash butt welds must be covered immediately after shearing until the weld has cooled below 900°F (483°C).

8.4. Arc Welding

1. During the arc welding process, stray electrical current can damage sensitive signal equipment. As such the following precautions are applicable:

   a. Avoid accidentally striking an arc while ground clamp is attached to the opposite rail;

   b. In locations of potential damage, notify the Signals and Communications employee well in advance in order that circuit fuses can be installed to protect the equipment;

   c. All electrical equipment must be grounded at the source; and

   d. No more than two single arc welding machines may be operated within the limits of any track circuit. This applies to territory having any number of tracks.

2. Following the arc welding procedure, the gauge and field sides of the weld shall be ground to match the rail profile.

8.5. Cold Weather Welding

1. Cold Weather is defined as:

   a. Windy or precipitation (snow or rain)

   b. Temperature below 60ºF (15ºC)

2. If the above applies, the rail must be warmed up with a turbo torch to 100ºF (37.7ºC) before or during the preheating procedure.

   a. The rail must be preheated before installing the mould.

3. A minimum of a 10 ft. (3.05 m) must be cleared of snow around the weld area.

   a. Where embankment constraints are present, clear snow to edge of ballast section, as well as a walkway to disposal area.

4. Rail pullers **MUST** be used during cold weather welding.

5. In NO case will thermite welding be allowed when the temperature is below 5°F (-15°C).

6. In NO case will electric flash butt welding be allowed when temperature is below -10ºF (-23ºC).

   a. Low consumption electric flash butt welding will be limited to between April 1 and November 30 provided the rail temperature is warmer than 32ºF (0ºC).

7. The length of rail to preheat varies according to the rail temperature. See Table 16:

Table 16 - Length of Rail to Preheat

Rail Temperature ºF (ºC)	Length of Rail to Warm inches (mm)
16 to 60 (-9 to15)	30 to 36 (760 to 910)
5 to 16 (-15 to -9)	36 to 48 (910 to 1220)

8. Immediately after shearing, cover the weld with an approved heat retarding blanket or a cooling box. Ensure that the area is completely protected from the weather for at least 10 minutes before grinding.

9. To prevent rapid cool down, an approved cooling blanket or cooling box MUST be used. The weld must be covered immediately following hot grinding and remain covered until the weld has cooled below 900°F (483°C) as shown in the Figure 18.

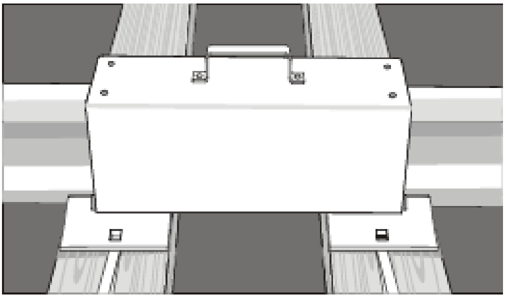


Figure 18. Diagram of a Cooling Box

8.6. Additional Safety Requirements

1. Hot thermite material has the potential to become explosive whenever it comes in contact with moisture. The source of moisture can be in the form of snow or frost on ballast, rain, sleet, and/or frost.
    a. A 10 ft. (3 m) radius must be cleared of snow around a weld. Where this is not practical due to embankment constraints, snow must be cleared to at least the edge of ballast. It may be necessary to heat the ballast with a torch to facilitate removal.
    b. It is recommended to install an approved drip pan with dry sand under the weld area to prevent any excess molten metal from contacting any moisture that may be present. It may be necessary to heat the ballast with a torch in order to facilitate the operation.
2. After igniting the charge, ensure that everyone is clear of the weld area, until one minute after the reaction and pour are complete. 40 ft. (12.2 m) is the required safe distance.
3. All preheat and teardown times must be strictly adhered to.

a. Note: 5 minutes is the minimum time required before the removal of slag pans, crucible and normal demolding begins.

4. Where rail pullers are used, they shall not be removed until the weld has cooled below 700°F (371°C).

5. A dry location must be secured to place waste material. It is recommended to use a steel drum or a rack on the back of a truck.

8.7. Welding on Bridges

1. Rail on a bridge requiring thermite welding or rail end build-up shall be welded off the bridge when possible, and then installed on the bridge after all work on the weld is finished. However, when there is no alternative to doing the welding on a bridge, follow the precautions below:

   a. Contact the CM Manager of Bridges and Structures and the CM Manager of Track to ensure they are aware and authorize the work required to be performed.

   b. Before any welding is undertaken, a site inspection must be made to identify any hazards, and in particular, anything that may catch fire. Any loose combustible material, dry vegetation, etc., must be removed. The entire structure must be examined. **DO NOT** assume that if no combustible is visible from above, the bridge is fire safe;

      i. A ballast deck timber trestle is as combustible as an open deck timber trestle and must be treated as such;

   c. A thorough job briefing must be conducted with all personnel involved, to determine what will be done in case of accident or fire. Where sufficient personnel and equipment are not available to take care of any accident or fire that may occur, welding must not be undertaken;

   d. The area around the weld must be wetted down to reduce the risk of fire;

e. Bridge ties must be spread at the joint to be welded

f. When thermite welding must be performed on open deck bridges, a ¼ inch (6 mm) thick steel sandbox partially filled with sand and placed between the ties is required in case of a run through. Bridge timbers will be spread by the Bridges and Structures forces so that the box may be installed. Welding shall not be undertaken without the use of the box;

g. The wood ties and bridge timbers, plus the area around the structure, must be wetted with a water and fire retarding foam additive to lessen the chance of fire from cutting, grinding or welding.

h. During any cutting, welding and grinding, a designated fire watch person(s) must be assigned. The fire watch must be adequately equipped to fight a fire, if it occurs.

i. Designated fire watch person(s) must be assigned. Such person(s) must understand their duties and ensure that suitable fire-fighting equipment is in position before the work commences. Where the fire watch person(s) are positioned under the bridge, fire-fighting equipment must also be available on the bridge deck; see Track Standards Section 24 for details.

j. The fire watch will remain on site inspecting for any smoldering fires, until the weld has cooled to ambient temperature.

k. Additional precautions may be required as per GO Transit Hot Work Requirements.

2. See Track Standards Section 24 – Fire Prevention.

Section 9 Ties

9.1. Timber Tie Installation and Maintenance

1. Timber ties shall be made from hardwood and:
   a. No. 1 Grade, 7 in x 9 in x 8 ft. 6 in (178 mm x 229 mm x 2591 mm) treated hardwood with 100% end plating on all main lines spaced at 20 3/8 in (517 mm) on center
   b. No. 2 Grade, 6 in x 8 in x 8 ft. 6 in (152 mm x 203 mm x 2591 mm) treated hardwood with 100% end plating for spurs, industry and yard tracks at a minimum and spaced at 21 ¼ in. (540 mm) on center.
   c. Installed perpendicular (square) with the rail and centered with the track, with the end of the tie approximately 18 ½ in (470 mm) from the field edge of the rail base.
2. Crossing ties in CWR territory replaced as part of crossing rehabilitation may all be changed in a single pass provided that the:
   a. Crossing surface is replaced immediately following tie renewal;
   b. Crossing approaches are restored and are of sound condition;
   c. The appropriate speed restriction is applied for out-of-face surfacing;
   d. Crossing ties should extend for 5 ties beyond the end of the crossing surface;
3. Crossing ties shall be composed of 9 ft. (2.7 m) long hardwood ties 100 % end plated unless otherwise approved by the CM Senior Manager of Track and Structures and shall be spaced at 18” (457 mm) throughout the crossing.

a. Crossing ties in concrete tie territory shall be composed of 10 ft. (3.1 m) long hardwood 100% end plated or composite ties.

b. Alternate tie types may be accepted upon approval of the CM Senior Manager of Track and Structures. See Recommended Method 1802-0: Covering the Acceptance of New Material and Conducting an In-Service Test of New Material.

4. Turnout ties installed will:

a. Be the correct length for the location to be installed in the turnout per the appropriate standard plan. Tie length required is to be marked in the field.

b. Not be cut in order to get shorter lengths

i. Turnout ties may be field cut as long as the cut ends are properly treated and end-plated.

c. Be installed so that lacing of standard cross ties does not occur at the end of the long tie

5. Turnout ties should be considered as replacement ties for special locations such as heavily travelled road crossings, hot box detectors, insulated joints, approach ties, transition ties, swamp ties, or on curves where nine-foot hardwood ties are used.

6. All timber ties shall be 100% end plated and composed of a hardwood material.

7. Treated ties must not be handled with any tool that has sharp points that will penetrate beyond the depth of the treatment.

8. Creosote is the only accepted preservative on GO Transit territory.

a. Other wood preservatives for ties may be used only upon receipt of written direction from the CM Senior Manager of Track and Structures.

9. When ties are re-spiked, the spike holes shall be chemically plugged.

10. Ties must not be allowed to become centre-bound.

11. When ties are being installed in turnouts, at insulated joints, within the limits of signalised crossings, or wayside equipment scanner locations, the work must be coordinated with the Signals Group and Electrification Group. See Track Standards Section 3 .

12. All ties must be examined early in the second quarter of the year by the Track Supervisor or his designate and defective ties will be marked for renewal.

13. The Track Supervisor or person designated by the CM Senior Manager of Track and Structures must personally inspect ties marked for removal and prepare a list showing the number of defective ties.

14. On main track where defective ties to be replaced are in excess of 300 ties per mile, consideration will be given for installation by a mechanized production gang.

15. In preparation for a tie renewal program:

    a. The Track Supervisor will prepare a list that will show the number of defective ties in each track mile to facilitate accurate distribution. The Track Supervisor is to ensure that this is done, and report the number of ties marked to the Track Evaluation Officer;

    b. The Track Supervisor will mark ties to be replaced, and place a suitable marker every 20th or 25th tie prior to the unloading of the ties depending on the bundled amount. Ties are to be marked in a manner readily identifiable to the operators of the tie equipment. In no case shall ties marked in track exceed the number allotted for the program.

    c. Ties scheduled for installation by large production tie gangs shall be unloaded and properly distributed.

        i. Avoid distributing ties along the right of way on high fills. Place ties at the nearest high ground or flat spot to avoid losing ties down the banks or into waterways.

ii. Avoid distributing ties far in advance of a tie program in residential areas.

d. The Track Supervisor shall determine the ballast quantities required for a major tie program to accommodate surfacing and to restore cribs and shoulders to standard section (Standard Plan GTS-2205).

e. The Track Supervisor will arrange to distribute ballast prior to the arrival of a tie gang when practicable. Ballast should be distributed along the shoulders of the existing ballast section on tangent track but only on the high side of curves unless otherwise required. Unloaded ballast must not bury spike heads.

f. Defective ties removed from track by a tie gang will be stacked in piles of 25 to 40 and placed parallel to the track. These piles must be on the opposite side of the track from any wire line where possible, and where they will not obstruct the sight lines or affect drainage. Ties must not be piled adjacent to timber trestle back walls, high track embankments, rock cuts, or where there is a possibility that they may slide into a lake or river.

g. In NO case shall scrap ties be left in between the rails or between tracks.

h. In NO case shall scrap ties remain on GO Transit property over the winter.

i. Ties removed from the track must be disposed of as directed by the CM Senior Manager of Track and Structures.

j. Scrap ties shall be piled at the end of every shift and disposed of weekly. In NO case shall any scrap ties remain on GO Transit property 7 days after the completion of the tie program.

16. The following definitions of defective ties will be used:

a. Broken Tie - Tie that is broken through the entire depth of the tie

b. Split Tie - Tie split end to end for the entire depth and length of the tie.

c. Split Tie End - Tie end split into the spike holes, or split the full depth and wide enough to permit ballast to come through, resulting in poor surface and gauge

d. Cut Tie - Tie that is rail or plate cut or adzed to a depth of 2 in. (51 mm) or more on No. 1 ties, or 1 in. (25 mm) or more on No. 2 ties

e. Crushed Tie - Tie that has the bearing surface under the rail crushed or splintered, 1 in. (25 mm) or more, to the extent that it cannot hold surface, line or gauge.

f. Spike Killed Tie - Condition may be indicated by numerous splits at the tie end, loose or high spikes, rail or plate movement of more than 1/2" (13 mm) or wide gauge (including dynamic wide gauge).

g. Decayed Tie - Tie that is decayed and cannot hold spikes, gauge or surface.

h. Damaged Tie - Tie that has been damaged by derailment, dragging equipment, or fire to the extent that it cannot hold surface, line or gauge.

i. Worn Tie - A tie worn or rounded on the bottom from movement of the tie in the ballast, resulting in poor surface and line and an inability to hold spikes.

17. At least one tie at each rail joint with the centerline within 18 in. (457 mm) of the center of the joint must be sound,

    a. In class 3 and above track, a second non-defective tie must be installed within 30 days of discovering the above condition. The second tie must be within 24 in. (609 mm) of the center of the joint

18. The number of non-defective ties in any 39 ft. (11.9 m) length of track shall never be less than that indicated in Table 17 and shall be so distributed as to effectively support the entire 39 ft. (11.9 m) length.

Table 17 - Number of Sound Ties Per 39 ft. (11.9 m) Length

Class of Track	Minimum # of Non-Defective Ties per 39 ft. (11.9 m)	
	Tangent up to 2º	Turnouts and curves more than 2º
5	12	14
4	12	14
3	10	10
2	8	9
1	5	6

19. A cluster (or spot renewal) program should be undertaken when there is:

    a. Four or more consecutive defective ties;

    b. Three or more consecutive defective ties in a curve greater than 2°; or

    c. Defective ties in the joint area.

20. The maximum number of defective ties per mile shall in no case exceed the numbers in Table 18.

    a. A tie program MUST be planned prior to the defective ties reaching the limits in Table 18.

    b. Speed Restrictions shall be applied based on the values in Table 17.

Table 18 - Maximum Number of Defective Ties per Mile

Class of Track	Max # of Defective Ties / Mile
5	930
4	930
3	1200
2	1400
1	1600

21. When renewing ties, regardless of method of installation:

    a. Correct gauge where required;

b. Where required, no more ballast than is absolutely necessary should be removed from the crib or shoulder;

c. All ties installed must be spiked and anchored, the ballast shoulders restored, and the ties properly tamped before the close of each day. Any adjacent ties that may be left hanging should also be tamped;

d. All ties installed must be perpendicular to the rail and centred.

e. Tie spacing needs to be adjusted as new ties are installed.

f. Do not adze new ties more than 1/8 in. (3 mm).

g. When necessary to allow trains to operate through tie gang renewal areas during working hours, not more than three consecutive ties on tangent track or two consecutive ties on curved track can be left un-spiked, when the 3 adjacent ties are sound. Ties on either side of all joints must be spiked, and the speed must be limited to a maximum of 10 mph;

h. Any broken, damaged, defective, and excessively worn (¼" or greater shoulder wear) plates must be changed out; and

i. All new anchors installed are to be Improved Fair type or equivalent as approved by the CM Senior Manager of Track and Structures.

22. **No ties will be installed when the temperature is above the PRLTR** unless directed by the CM Senior Manager of Track and Structures, who must specify all necessary precautions to be taken, including but not limited to increased inspections, more restrictive speed restrictions, mandating the use of a stabilizer, a production tamper, or limiting work to emergency applications.

23. The track must be left in good surface and line before the end of each shift and of a tie renewal program.

24. The track will be protected by the appropriate speed restriction as per Appendix J – Speed Restrictions for

Track Work until track has been surfaced, backfilled and consolidation has occurred.

25. To reduce temporary slow orders, production tampers and dynamic track stabilizers shall be incorporated into the production tie gangs.

26. Prior to moving from a work site, it is the responsibility of the Tie Gang Program Supervisor to ensure that slow orders associated with the tie installation are transferred to the Track Supervisor. The Track Supervisor is then responsible to monitor the slow orders and reduce or remove them as conditions permit.

27. In CWR territory the maximum number of consecutive track ties that can be renewed in a single pass shall be as per Table 19:

Table 19 - Maximum Number of Consecutive Ties that can be renewed.

	# of Consecutive Ties	
	Tangent track up to 2º curves	**Greater than 2º**
With a Junior or Production Tamper	5	4
With Hand tamping or Hydraulic Tools	3	2

* Note that if more than 4 consecutive ties are renewed, the track will also require gauging.

28. Turnout ties and track ties in a Control Location in CWR territory may be replaced in a single pass provided the appropriate speed restriction is applied for spot surfacing.

29. Fibre optic cables and obstructions such as rail lubricators, transponders, and guard rails for protection of structures, or turnouts, which may be damaged, or cause interference to the production gang must be clearly marked or removed. (Note: If guard rails for bridges, tunnels, or overhead structures are removed the appropriate guidelines outlined in Track standards Section 21.1 must be followed)

30. Gauge rods shall NOT be used on GO Transit territory. Any Gauge rods found shall be promptly removed and the appropriate number of ties shall be installed.

31. Track shims can be installed on wood and concrete ties:

    a. As the last option to correct surface during frozen ballast conditions

    b. Ensure the shims are the same size as the tie plate and have holes corresponding to the tie plate they are under

    c. With the minimum number of shims installed to correct the defect

    d. So that the spikes penetrate at least 4 in. (102 mm) of the tie.

    e. With all anchors removed through the area of shimming

    f. With shims installed per Standard Plan TS-2206

    g. With shims removed within 30 days of the Spring thaw and permanent repairs made.

9.2. Transition Ties

1. Transition tie sets in CWR territory may be changed out in a single pass provided that:

    a. The ties are being replaced in conjunction with ballast rehabilitation work;

    b. Upon completion of work, the ballast section is fully restored with a minimum 12" (305 mm) shoulder;

    c. The appropriate speed restriction is applied for spot surfacing;

2. Transition ties must extend far enough to ensure that any rail joint, including bonded insulated joints, are placed on the same composition of tie and the rail joint is separated from another tie composition by at least four track ties.

3. Where wood ties adjoin an open-deck bridge structure or trestle, a set of approved transition ties must be

installed. This set shall consist of two 9 ft. (2.7 m) ties, two 10 ft. (3.0 m) ties, and two 11 ft. (3.4 m) ties spaced at 20 in. (508 mm). Where ballast wall will not permit tie lengths specified, use longest tie lengths possible. Use Standard Plan GTS-1108;

4. Where concrete ties adjoin an open-deck bridge structure, concrete ties must not be installed closer than 20 ft. (6.1 m) to the back-wall and a set of approved transition ties must be installed. This set shall consist of twelve 11 ft. (3.4 m) ties spaced at 20 in. (508 mm);

5. Where 10 ft. (3.0 m) crossing ties adjoin concrete ties, a set of approved transition ties must be installed. This set shall consist of five 10 ft. (3.0 m) ties spaced at 20 in. (508 mm).

6. Where concrete ties adjoin wood ties, a set of approved transition ties must be installed. Unless otherwise approved in writing by the CM Sr. Manager of Track and Structures, this set consists of four 9 foot (2.8m) ties, four 10 foot (3.1 m) ties, and four 11 foot (3.4m) ties spaced twenty inches (508 mm) apart. The spacing between the last transition tie and the first concrete tie shall be 20 inches (508 mm);

7. Where concrete ties adjoin a wood tie turnout, a set of approved transition ties must be installed. This set consists of four 9 foot (2.8m) ties, four 10 foot (3.1 m) ties, and four 11 foot (3.4m) ties spaced twenty inches (508 mm) apart. The spacing between the last transition tie and the first concrete tie shall be 20 inches (508 mm);

8. Where steel ties adjoin wood ties a set of approved transition ties must be installed. This set consists of four 9 foot (2.8m) ties, four 10 foot (3.1 m) ties, and four 11 foot (3.4m) ties spaced twenty inches (508 mm) apart.

9. Where steel ties adjoin concrete ties a set of approved transition ties must be installed. This set shall consist of forty 10 foot (3.1m) steel ties designed for that purpose. The spacing of these ties shall be as per the manufacturers recommended installation instructions or as per the written direction of the CM Sr. Manager of Track and Structures.

9.3. Concrete Tie Installation and Maintenance

1. Concrete ties shall be handled in such manner to prevent chipping, spalling, cracking or other damage during loading, shipping, unloading and stockpiling. Do not drop or skid ties. Use only lifting devices appropriate for handling ties.
2. Concrete ties shall be spaced at 24 in. (609 mm) on center except as noted in Track Standards section 4.5.5 or in special track applications as directed by the CM Sr. Manager of Track and Structures.
3. All components of the running rail fastening system shall be of thread-less design.
4. The components required to be used with the standard GO Transit concrete tie specification is as follows. Any proposed replacement components must be approved by the CM Senior Manager of Track and Structures prior to their use.
    a. Rail Clips
        i. Only elastic spring rail clips are accepted.
        ii. Rail clip installation and removal shall not damage the tie, shoulder, rail clip, insulator or the rail
        iii. Rail clips shall be galvanised at heavy salt locations such as station platforms, and road crossings.
    b. Rail Tie Pads (Seat pads)
        i. The rail tie pads shall have a minimum 5 mm thick polyurethane
        ii. Rail tie pads shall be compatible with the fastening system to minimize abrasion of the rail seat area, reduce wheel impact loads and vibration effects on the track structure and provide electrical insulation of the rail.

iii. Rail tie pads shall provide a positive means of preventing movement of the pad parallel to the rail.

iv. Rail tie pads shall be manufactured from natural rubber thermoplastics, to provide the required chemical and physical properties to resist effects of temperature ranging from -40º C to +70º C (-40º F to +160º F), as well as oxidation, water, alkali, petroleum products, synthetic lubricants, sunlight and climatic conditions typical of Southwestern Ontario, Canada.

v. Oil-extended rubber, reclaimed rubber, or rubbers containing wax are not acceptable.

c. Insulators

i. Insulators shall provide electrical isolation, reduce abrasion, position the rail to the required gauge and transfer dynamic loading from the rail to the rail clip to prevent relative motion in any direction.

ii. Insulators shall be protected against degradation from oxidation, water, alkali, petroleum oils, synthetic lubricants, and sunlight without having detrimental effect on the performance and electrical insulation properties of the insulator.

iii. Recycled materials are not acceptable.

d. Embedded Shoulders

i. Embedded shoulders shall be twin-stem, thread-less, casted to provide and maintain proper position and alignment of the rail, rail clip, insulators, rail tie pad and running rail base.

ii. Embedded shoulders shall be made of ductile cast iron conforming to ASTM A536 Grades 80-55-06 or 65-45-12.

iii. Embedded shoulders shall not be directly anchored to the pre-tensioned steel.

5. When rail heaters are used during rail installation or destressing, remove insulators prior to heating. Care must be taken to keep the heater moving so as not to damage the rail tie pads. Rail tie pads must be inspected after the use of heaters.

6. To avoid damage to the insulator post or possible shattering of plastic insulators, insulators must not be forced into position by aggressive hammering. A rail positioner tool must be used to provide a suitable gap between the base of the rail and the embedded shoulder.

7. If for any reason temporary joint bars are installed, they must be removed as soon as possible and replaced with field welds.

8. When changing out rail, the rail tie pads and the concrete tie rail seat area must be closely inspected for signs of rail seat abrasion.

   a. Rail seat abrasion is erosion of the concrete surface under the rail tie pad. It can cause wide gauge and loss of rail cant. The surface of the rail seat becomes rough in the early stages. If not corrected, this condition will advance and will result in the loss of several millimeters in depth of concrete in severe cases. The Track Evaluation Officer and the CM Manager of Track must be notified promptly so that corrective action can be planned.

9. Rail tie pads must be inspected for indentations, wear and thinning, especially on the field side.

10. Field side insulators will be inspected for crushing or wearing of the post section. Crushed insulators will be replaced.

11. Track Geometry for any track with concrete ties shall be maintained to a minimum of Class 4 track requirements.

12. When mechanically surfacing the track, the tamping heads must be adjusted for the increased width and

depth of the concrete tie. When using ballast regulators on concrete ties, the plow should be modified to avoid disturbing the rail clips. Track must be inspected for missing rail clips after regulating by the operator or Foreman.

13. Rail seat abrasion (degradation) occurs when the concrete in the rail seat degrades over time. The degradation erodes the surface of the tie under the rail resulting in the loss of restraint by the rail clip, rail cant and gauge widening.

14. Inspect for signs of rail seat abrasion (degradation). These include:

    a. Rail tie pads curling, squeezing out, or bleeding at the sides of the rail seats.

    b. Rail tie pads are worn through or indenting into the surface of the rail seat.

    c. Excessive rail cant

        i. Each degree of cant is equal to 1/8 in. (3 mm) of gauge widening.

    d. Signs of rail running through the rail clips or missing clips.

    e. Displaced or missing insulators.

    f. Concrete dust or slurry adjacent to the rail tie pad.

15. When signs of significant rail seat abrasion appear, a more detailed inspection must be undertaken by unclipping the rail and jacking to view the rail seat. The CM Senior Manager of Track and Structures must be notified immediately.

    a. Defective ties shall be identified and marked for replacement.

16. Ties with any of the following conditions shall be considered defective:

    a. Tie broken transversely under one or both rail seats;

    b. Tie broken transversely between the rail seats and showing signs of further deterioration (loss of tension in pre-stressing wires, exposure of wires, crumbling, etc.);

c. Tie broken longitudinally resulting in loss of ability to hold cast shoulder(s) in place;

d. One or more embedded shoulders are loose;

e. Broken, damaged or worn embedded shoulders such that the rail clips will not remain in place or cannot be inserted;

f. Concrete worn from the bottom of the tie to the lowest level of pre-stress wires;

g. In any 39 foot (11.9 m) length of track, there must not be more than:

h. 7 defective ties on tangent track,

i. More than 5 defective ties on curves, and

j. No more than two defective ties in a row.

k. Special attention must be paid to areas of derailment damaged ties for evidence of progressive deterioration.

17. Ties must not be allowed to become centre bound (transverse cracks in the middle third of the tie indicate a centre bound condition).

18. About one inch (25 mm) of ballast should be left over the tops of the depressed portion of the ties, but ballast shall not be left around the rail clips and shoulders.

19. Broken or missing clips must be replaced as soon as possible.

20. Concrete ties shall not be drilled or modified in any way from their design.

NOTE: Cracked ties should not be confused with broken ties. A tie is not broken until the crack extends through the entire depth of the tie;

A tie can sustain substantial damage to the concrete at the ends without seriously affecting the performance of the tie. If the concrete ends are damaged but the tie maintains gauge and the embedded shoulders are not damaged or loose the tie shall not be considered defective;

Special attention should be paid to embedded shoulders on the field side of the high rail in curves. Hairline separations of the shoulder where it enters the tie have occurred and can result in several consecutive ties failing. Should one broken embedded shoulder fail in this manner, the adjacent ties should be well inspected.

9.4. Concrete Tie Repair Procedure

1. Ties with honeycombing and air voids are indicative of conditions such as poor mixing, vibration, consolidation, etc. cannot be repaired and they shall be rejected.
2. The surface of the rail seat shall have a smooth, formed finish. Rail seat air voids in excess of ¼ in (6 mm) diameter by 1/8 in (3 mm) deep are unacceptable.
3. Voids in the rail seat between 1/8 in (3 mm) diameter and ¼ in (6mm) diameter may be repaired with high strength epoxy paste.
4. At the tie ends, exclusive of tendon extending beyond the end of tie, ties with any tendon exposed more than 1 in (25 mm) due to honeycombing, air voids, spalling, corner and edge breaking must be repaired or they shall be rejected.
5. Simple air voids in the side of ties (45 degree slopes outwards below the rail seat) up to 3/8 in (10 mm) diameter x ¼ in (6 mm) deep are acceptable. Voids between 3/8 in x ½ in (10 mm x 13 mm) and ¾ in x ½ in (19 mm x 13 mm) may not exceed 2 per tie, but may be repaired with high strength epoxy paste. Air voids larger than ¾ in x ½ in (19 mm x 13 mm) are to be rejected.
6. Tie corner / top / side / bottom breakage that exposes a broken surface in excess of 10 in^2 (645 cm^2) shall be repaired in accordance with approved repair material in accordance with the manufacturers recommendations for all breaks above the top row of wires.
7. Surface breaks less than 10 in^2 (645 cm^2) may need to be patched, at the CM Senior Manager of Track and Structures' discretion, for any ties within 50 feet (15.2 m)

of station platform limits, grade crossings, or pedestrian crossings.

8. Tie patching should only be done on concrete breaks that are greater than 10 in^2 (645 cm^2) and only when the break has not structurally affected the tie.

    a. Note that patching of the tie is for cosmetic purposes only, and does not improve the performance of the tie for the design loads.

9. It is recommended that for any patching of the concrete ties Ardex TWP mortar mix is used. Other products must be approved by the CM Senior Manager of Track and Structures.

10. A latex binder is optional with the above specified mortar mix. Where a latex binder is required, DA4 CHEM AD Bond (J-40) or equivalent Dayton Superior Product.

11. Before mixing the patching materials, the proposed area must be dry and free of dirt and loose materials. It is recommended to use a wire brush or wheel, and a propane torch to remove surface water.

12. Thoroughly spray the damaged area with the latex binder, if applicable.

13. Mix ½ cup of water and 2 cups of mortar mix. Add small amounts of water to achieve a consistency similar to wall plaster.

14. Apply patching material in thin layers over the broken area until the broken area is completely filled. If required, spray additional latex binder to aid in finishing.

15. Cover the patched area with plastic during the curing process.

16. Any repairs to concrete ties cannot be made when the ambient temperature is below or is expected to dip below 5°C (41°F).

9.5. Steel Tie Installation and Maintenance

1. Steel ties shall not be permitted on main line track, unless permitted by the CM Senior Manager of Track and Structures.

2. Uninsulated steel ties shall not be permitted in electrified territory or in signalised territory.

3. Steel ties shall only be permitted for yard use and within the Union Station Rail Corridor.

   a. Within the Union Station Rail Corridor, insulated steel ties are permitted between the John St and Jarvis St ladder tracks.

4. In areas of excessive winter salting, all connecting hardware shall be galvanised.

5. Steel ties shall be installed on a pre-ballasted grade as defined by Track Standard section 11.2.2.

6. Steel ties shall be installed as per the Manufacturer's Instructions (For example, when using Narstco ties, use the Narstco Steel Tie and Turnout Set Assembly Instructions).

7. Hollow steel ties are permitted for use at turnout locations, and other locations as approved by the CM Sr. Manager of Track and Structures.

9.6. Composite Tie Installation and Maintenance

1. Installation locations for composite ties MUST be approved in writing by the CM Senior Manager of Track and Structures. See Recommended Method 1802-0: Covering the Acceptance of New Material and Conducting an In-Service Test of New Material

2. Traditionally these ties are only installed within crossings.

3. Storage

   a. Composite ties shall be stored un-banded, and distributed only just prior to installation

   b. Un-banded ties shall be supported evenly when stored.

4. Installation

   a. Both screw spikes and cut spikes are acceptable.

b. All spike / bolt holes must be pre-drilled.

c. Use only carbide tipped/laced drill bits.

d. Do not drill within 1 in (25 mm) of the outer perimeter of the tie.

e. Ties must **NOT** be dapped or adzed or have any portion of the outer surface machined away.

f. Screw Spikes (Bolts)

   i. During the pre-drilling process, work the drill bit in and out of the hole to remove excess material.

   ii. Ensure proper alignment by centring the plate on top of the tie.

   iii. Ensure that the hole is drilled straight.

   iv. Do NOT over-torque the bolt. Once the bolt is tight to the tie plate/tie, no further torqueing is required. The material will cool and harden around the threads of the screw.

g. Cut Spikes

   i. Follow the same pre-drilling process as for the screw spikes (bolts)

   ii. Pre-drill a 3/8 in. (9.5 mm) hole the entire depth of the anticipated cut spike insertion.

   iii. Note that no pre-drilling is required for steady compression installation.

9.7. Other Types of Ties

1. No other types of ties shall be permitted on GO Transit territory without the written approval from the Metrolinx Track Standards Committee and the CM Senior Manager of Track and Structures.

2. Should a new type of tie be proposed to be used on GO Transit territory, the appropriate procedures must be followed. See Recommended Method 1802-0: Covering

the Acceptance of New Material and Conducting an In-Service Test of New Material

Section 10 Plates, Fasteners, and Other Materials

10.1. Tie Plates

1. Tie plates shall be installed on all hardwood and composite ties. Tie plates will not be installed under guard rails.
2. The use of new or second hand tie plates shall be as directed by the CM Senior Manager of Track and Structures, however:
    a. Broken or damaged tie plates must not be reused.
    b. Tie plates with excessively worn spike holes, or shoulders greater than the limits shown below must NOT be reused:
        i. spike holes worn more than ¼ inch (6 mm)
        ii. timber screws holes worn more than ¼ inch (6 mm)
        iii. Tie plate shoulders worn more than ¼ inch (6 mm)
3. Tie plates must be installed so that:
    a. The tie plates have full, even bearing on the ties.
    b. The field side tie plate shoulder is square against the field side base edge of the rail.
    c. The tie plate is centred on the tie.
    d. The rail is canted toward the centre of the track.
    e. Each tie plate has the same cant. (1:40)
        i. Tie plates used for maintenance works on the Galt subdivision shall match the adjacent track tie plates. The use of 1:20 cant plates shall be permitted for this purpose.

4. In Classes 3 through 5 tracks where timber crossties are used, there shall be tie plates under the running rails on all ties.

5. Ensure that there are no metal objects that cause concentrated loading solely supporting the rail between the rail and the tie plate. This includes the tie plate shoulders and spike heads.

6. Torch cutting of tie plates is not permitted.

7. Rolled plates shall not be installed or reinstalled in any GO Transit owned track unless approved in writing by the CM Senior Manager of Track and Structures.

    a. Approved rolled plates shall be permitted in turnout applications only as per the current turnout Standard Plans.

8. Where forged tie plates are used, as per Standard Plan GTS-0501, they shall be installed either on every tie or on every other tie as directed by the CM Manager of Track.

9. Tie plates shall be used in accordance with Appendix S – Recommended Tie Plate Usage

10.2. Rail Anchors

1. Anchors shall be applied:

    a. Uniformly along the rail firmly against ties.

    b. Directly opposite of each other on the same crosstie or turnout tie

    c. On ties that are perpendicular to the rail. Skewed ties shall be straightened before anchoring.

    d. On the gauge side of the rail unless otherwise instructed. Rail anchors on stock rails are applied, where allowable, on the field side

    e. Using only the proper tools or machines when applying or removing rail anchors in order to avoid damaging the anchor or risk injury. The use of a spike maul is prohibited.

i. In electrified territory, all tools must have insulated handles.

f. No closer than 2 in. (50 mm) from a plant or field weld.

g. In a location where the application will not interfere or damage signal wires

h. So that the rail anchor is fully engaged with the base of the rail and so that the base of the rail is just inside the lip of the rail anchor. Do not overdrive the rail anchor.

2. When changing rail or renewing ties, all rail anchors removed must be reapplied.

3. Sprung or damaged rail anchors will not be installed.

4. Rail anchors should be removed from the rail while the rail is still in track.

5. Do not install rail anchors on the rail opposite joints.

6. Rail anchors are not to be used on shimmed track. Rail anchors removed during shimming shall be replaced promptly when shims are removed.

7. Rail anchors are not required on ties with elastic fastening systems unless additional restraint is required.

8. Rail anchors can be slid along the rail base only with a mechanical rail anchor squeeze / spreader

9. Rail anchors required to be manually adjusted shall be removed and reapplied.

10. Rail anchors will only be removed using the approved maul or removal machine

11. In jointed rail track, the minimum number of evenly spaced rail anchors for maintenance use only per 39ft (11.9 m) of track is indicated in Table 20.

Table 20 - Minimum Number of Evenly Spaced Anchors

Class of Track	No. of Ties to Box Anchor
1	6 (every 4th tie)
2 - 5	10 (every other tie)

12. For new construction of jointed rail track, rail anchors will be installed in a box pattern on every other tie.

13. Turnouts should be fully anchored to the extent possible in both jointed and CWR track.

14. In all CWR track, rail anchors will be installed in a box pattern on every other tie except:

    a. At permanent joints within CWR (joints that will not be welded), then every tie will be box anchored for a minimum distance of 200 ft. (61 m) each direction from the joint.

    b. When jointed rail abuts CWR, a minimum of 200 ft. (61 m) of rail on either side immediately adjacent to the joint will have every tie boxed anchored.

    c. At turnouts, non-glued insulated joints, diamond crossing frogs, and/or a lift rail system, every tie will be box anchored for a minimum distance of 200 ft. (61 m) each way from the turnout or joint.

    d. At location of an open-deck bridge, every tie will be box anchored 200 ft. (61 m) of rail in each direction from the abutments

    e. At locations where steel or concrete ties adjoin hardwood ties, every tie will be box anchored 200ft. (61 m) of rail in the direction of the hardwood ties.

    f. At road crossings every tie will be box anchored for a minimum distance of 200 ft. (61 m) each direction unless the track through the crossing is fully anchored.

15. When CWR is installed on a bridge with an open deck span, the requirements outlined in Table 21 will be used, where practical.

    a. The CM Manager of Bridges & Structures to identify fixed ends of spans prior to installing CWR.

    b. Prior to anchoring CWR on open deck steel TPG, TT, and DT spans, the Manager of Bridges

& Structures will confirm the requirements for bridge traction bracing.

c. Rail anchor requirements and pattern should be confirmed with the CM Manager of Bridges & Structures.

d. Box anchor as per Track Standards section 10.2.14.d.

e. On timber span bridges, only box anchor the ties that are attached to the span with boat spikes, usually every other tie or as directed by the CM Senior Manager of Track and Structures.

f. Movable spans will be anchored as directed by the CM Senior Manager of Track and Structures.

g. Where elastic fasteners provide longitudinal restraint, they will be considered equivalent to anchoring.

16. CWR installed on a ballast deck bridge or span will be box anchored a minimum of every second tie.

17. CWR installed on an effective 2% grade or greater shall have every tie box anchored for the length of the grade. Any effective grade that exceeds 2% must be approved in writing by the CM Senior Manager of Track and Structures.

18. Trains may operate over unanchored track at a speed restriction not exceeding 10 mph under authorization from the Track Supervisor. Such authorization should include instructions to avoid unnecessary brake applications through or near the work area.

Table 21 - Anchor Requirements for CWR Track on an Open Deck Bridge

Length of Continuous Open Deck Portion (ft.)	Individual Span Length (ft.)	Rail Anchor Requirements	Sliding Joint Requirements
100 ft. (30.5 m) or Less	All Spans	No anchors	None required
Greater than 100 ft. (30.5 m)	100 ft. (30.5 m) or Less	Box anchor every second tie*	None required
		Or	
		No anchors	Sliding joint(s) required
	Greater than 100 ft. (30.5 m)	Box anchor every second tie for 100' from fixed end of span*	None required
		Or	
		No anchors	Sliding joint(s) required

* Box anchors are to be applied only to ties that are hook bolted to the span (generally every second tie). Box anchor spacing may be extended to every third tie if required to match the bolt spacing. If rail clips are used, every non-hook bolted tie should have a rail clip without longitudinal restrain.

10.3. Derails

1. Derails must be installed:

   a. Where there is any possibility of equipment that has been left standing on tracks other than main tracks or designated sidings, may be moved by gravity or weather so as to obstruct a main track or siding;

b. At tracks used to tie up locomotives on a regular basis. Through tracks so used must be equipped with derails at both ends. Locations used to tie up locomotives will be specified by the GO Transit Operations Division;

c. At entrances and exits of Main and Running Repair Shops. Derail must be applied to each track not less than 40 feet from doors. Where further safety measures are required, a derail pit may be installed in accordance with drawing Standard Plan TS-2212;

d. On tracks on which an industry will move cars or equipment;

e. On mining and other bulk loading facility tracks where equipment is dropped by gravity toward the main or other track that is to be protected; and

f. Where required to protect track conditions, equipment or on track work where allowed by Operating Rules.

2. Portable derails will be installed when protecting temporary conditions, workers, and equipment, or activities as prescribed in the CROR 841, and when it is not possible to line and lock, with a private lock, a switch to protect the work location.

3. Portable derails must be correctly installed to ensure proper function. Portable derails will:

   a. Be sized to fit the rail section on which to be mounted.

   b. Not be used where the speed of equipment to be derailed will exceed 15 mph

   c. Be of the correct hand to derail equipment away from adjacent track, structures, stored material, equipment, roadways, or environmentally sensitive areas if possible

   d. Not be installed on the inside of a curve

e. Be placed with the graduated teeth firmly against a sound tie on the gauge side of the rail. Ballast may have to be removed to ensure the proper fit of the derail.

f. Have the set screws and the locking screw backed away so the block sits flat on top of the rail. Once fitted, have the set screws tightened, locking screw tightened to the ball of the rail and a private (special) lock applied.

g. Be disposed of if involved in a derailment

h. Be stored, locked and secured, when not in use to prevent theft or vandalism.

4. Permanent derails shall only be installed or removed as directed by the CM Senior Manager of Track and Structures or designate.

5. The Rail Services department must advise the CM Senior Manager of Track and Structures of all operational changes in writing which pertain to derail placement. The CM Senior Manager of Track and Structures will confirm whether or not said operational changes require the installation of additional derails and that adequate operating procedures are in place to protect the situation. Whenever operational changes so dictate, the CM Senior Manager of Track and Structures must ensure that derails are installed in accordance with 10.3.1.

6. Whenever new tracks are designed or constructed, the CM Senior Manager of Track and Structures must determine if a derail is required in accordance with Track Standards Section 10.3. CM Senior Manager of Track and Structures must ensure that required derails are installed prior to placing the track in service.

7. Consideration for the removal of derails will occur only upon written request from the Rail Services department to the CM Senior Manager of Track and Structures, with a copy to the Director of CM. The written request must include:

a. Details of proposed operating conditions that will ensure protection from unattended movements;

b. Confirmation that these operating conditions are in place; and where necessary, operating simulations may have to be carried out to confirm that the derail is no longer required.

8. Only the following approved types of derails are to be installed:

   a. Hinge Type Derail, Hayes Model EB, Standard Plan GTS-2208*

   b. Sliding Type Derail, Hayes Model HB, drawing Standard Plan GTS-2209

   c. Double Switch Point Derail, drawing Standard Plan GTS-2210

   d. Western Cullen Hayes bi-directional derail models SAEBX and HBXS*

   e. Portable derail, Hayes Model LPTS, is approved for use under CROR Rule 841. (Replaces model TS). Derail to be appropriate for the tie composition in section of track applied.

* Wheel crowders can be used in conjunction with hinge or sliding type derails.

9. Older type Hayes cast derails of type A, AP, G, GP, and D are not to be used.

10. Power operated derails shall be installed and maintained in accordance with plans and instructions provided by the CM Signals and Communications department.

11. The CM Senior Manager of Track and Structures will approve the derail selection for each installation.

12. To eliminate the possibility of equipment running over hinge and sliding derails without derailing, they must be the proper model, size and hand (e.g. right or left hand) to fit the running rail.

   a. A right-handed derail is installed on the right-hand rail and derails towards the right.

   b. A left-handed derail is installed on the left-handed rail and derails towards the left.

13. In the derailing position the derail block must cover the ball of the rail, lie flat on the top of the rail throughout the

underside of the derailing block surface, will bear directly on sound ties, and have no excessive motion when locked.

14. In the non-derailing position, for hinge and sliding type derails, ensure that the derail is lower than the ball of the rail to prevent contact with rolling equipment.

15. The direction of movement of the equipment to be derailed determines whether a right or left-hand derail is required.

16. The correct size of derail to be used on various rail sections is as follows:

    a. Size 6: 100 ARA

    b. Size 7: 115 RE

    c. Size 8: 132RE and larger

    d. On heavily worn 115 RE rail a Size 6 derail may be used at the discretion of the CM Sr. Manager of Track and Structures.

17. A plywood or steel shim of the correct thickness with holes punched or drilled for all fasteners may be necessary under the derail to ensure the block lies flat on the top of the rail. Shimming should be limited to ½ in. (13 mm) before choosing the next derail size.

18. If the rail at the derail location is replaced, the derail should also be replaced with one of the correct size for the rail or shimmed within acceptable limits.

19. Operating stands of a rigid type (for example 31B, 36D or 112E) must be used with switch point derails. Rigid stands or Hayes operating stands must be used with sliding type derails. All derails designated as Special Derails in Special Instructions must be switch stand operated.

20. Throw of switch point type derails is 5 inches (127 mm).

21. Throw of sliding type derails is 6¼ inches (159 mm)

22. Hinge and sliding derails must be painted yellow.

23. All derails not equipped with high operating stands shall have a derail sign in accordance with drawing Standard Plan GTS-720 mounted on a separate post, and erected

adjacent to the derail as shown in Standard Plan GTS-2208. Conventional switch targets and tips shall not be used.

24. All derails equipped with high operating stands shall have a derail switch target in accordance with Standard Plan GTS-720 mounted on the mast of the operating stand, as shown in Standard Plan GTS-2209 and GTS-2210.

25. Derails designated as Special Derails in Special Instructions shall have a special derail target installed in place of the standard derail target in accordance with drawing Standard Plan GTS-720. Special derails must be operated by a switch stand.

26. When derail signs are mounted on the mast of high operating stands, they shall be attached to the mast so that they are visible when in the derailing position.

27. When directed by Special Instructions, derails protected by signals (or otherwise marked), will not require derail signs.

28. Targets and target tips, whether reflectorized or not, shall not be used in connection with derails.

29. Tracks equipped with a derail shall have the switch stand lever painted yellow.

30. Location for a derail is governed by local conditions such as grade and length of track, but when practicable should never be located less than 20 feet (6.1 m) behind the fouling point and installed so as to derail equipment away from the track being protected. Sufficient distance should be allowed so that the derailed equipment cannot continue to move and foul the track being protected.

31. When the derail must be located close to the clearance point, a "bent type guard rail" must be installed between the rails, as shown on Standard Plan GTS-2208, GTS-2209 and GTS-2210, to provide additional assurance that the derailed equipment will not foul the track being protected.

32. Derails should not be installed on the inside of curves if it can be avoided. If necessary to install a hinge type or sliding type derail on the inside of a curve, a derail wheel

crowder must be installed on the outside rail on the same ties.

33. Where there are insulated joints, derails must be placed far enough behind the insulated joints so that equipment derails before fouling the track circuit. In CTC territory, derail placement must comply with the associated Signal SCP.

34. Maximum distances for derail placement shall be calculated using the TPC simulation program with 263,000 lbs. (120,000 kg) equipment. Table 22 is intended to be used as a guideline to assist field personnel in determining the proper derail for a specific location.

Table 22 - Guideline for Selection of Derail Type

Gradient (%)	Distance in which Free-Rolling Equipment will achieve the following speed: ft. (m)			
	8 mph	9 mph	12 mph	15 mph
0.30	1000 (305)	1280 (390)	2350 (716)	3800 (1158)
0.50	485 (148)	615 (187)	1125 (343)	1805 (550)
0.75	310 (94)	395 (120)	700 (213)	1090 (332)
1.00	225 (69)	285 (87)	555 (169)	785 (239)
1.50	155 (47)	190 (58)	330 (101)	510 (155)
2.00	115 (35)	140 (43)	245 (75)	380 (116)

35. The CM Senior Manager of Track and Structures will specify where guard rails are to be used. Installations must be in accordance with Track Standard plan.

36. Straight guard rails will be required where the derailing point is:

    a. On a high embankment;

b. Near structures that could be struck by derailed equipment; or

c. On a sharp curve.

d. Where possible equipment roll could foul the track to be protected.

e. Refer to Standard Plans GTS-2208, GTS-2209 and GTS-2210 for details.

37. All derails must be equipped with an approved switch lock that has been chained, or cabled, to the derail or operating stand.

38. Derails and switch locks must be kept lubricated and adjusted to maintain ease of movement.

39. Track ties to which derails are fastened must be sound and well tamped, and have the top surfaces in the same plane. Hardwood ties shall be used, unless otherwise directed by the CM Sr. Manager of Track and Structures.

a. In steel tie construction, steel ties may be used on sliding and hinge type derails with approval from the CM Sr. Manager of Track and Structures.

40. Sliding and hinge derails must be installed at right angles to the rail. In new installations, the derail should be fastened to the ties with 1 inch x 6½ inch (25 mm x 165 mm) lag screws as per Standard Plan GTS-1315.

a. Note that tie plates are to be removed at the derail location.

41. Derails must be fastened with all available holes filled.

42. An interlocked derail must not be disconnected or adjusted until the Signal Maintainer has been notified.

43. Derails must be inspected by the Track Supervisor or other qualified track inspector per the frequency defined in Appendix B – Track Inspection Frequencies in Table 46

a. Particular attention should be paid to track or turnout tie, fastener, and ballast conditions.

b. Check for any distortion, fractures, damage from derailments or accidents, or unusual wear on the derail.

c. The switch lock is in place, secured, and locked.

44. To prevent hinge derails from freezing to the top of the running rail, a narrow weld bead may be added to the underside of the derail body at the rail centre line.

45. A handle may be welded onto the body of a hinge derail to make operating the derail easier.

46. Hinge and sliding derails may be installed where the speed of equipment to be derailed will not exceed 15 mph.

47. On industrial track a wheel crowder will be installed when:

a. A car mover is in use; or

b. Equipment speed could exceed 10 mph.

48. At locomotive and equipment repair facilities, wheel crowders will be installed with Hinge or Sliding type derails.

49. On industrial track a double switch point derail will be installed when:

a. The speed of the equipment to be derailed could exceed 15 mph;

b. A private locomotive is in use;

10.4. Track Spikes

1. Each rail shall be spiked as per the appropriate spiking pattern in Appendix R – Spiking Patterns.

2. Ties plates with square holes will only be secured by cut spikes. Tie plates with round holes will only be secured with screw spikes or drive spikes.

3. Track and turnout ties will be spiked:

a. With the cross tie square to the rail and tie plates centered on the tie.

b. With rail at uniform standard gauge

c. With track spikes driven vertically with the throat of the track spike in contact with the base edge of the rail. Do not drive the track spike head onto the rail base causing damage to the rail.

d. Using only standard spike mauls, pneumatic or hydraulic spiking hammers, or with a spiking machine. Do not strike the base of the rail while spiking.

e. With track spike heads turned away from the joint bars of insulated joints

f. At joints with toe-joint bars, so that the track spikes are not driven into the spike holes of the joint bar or within 2 in. (51 mm) of the end of the bar.

4. Track spikes must be driven to a depth such that the track spike head is within 3/16” (5 mm) of top of the rail base. Every effort should be made not to overdrive track spikes.

5. When pulling track spikes, a track spike lifter will be used when track spikes cannot be loosened with a claw bar.

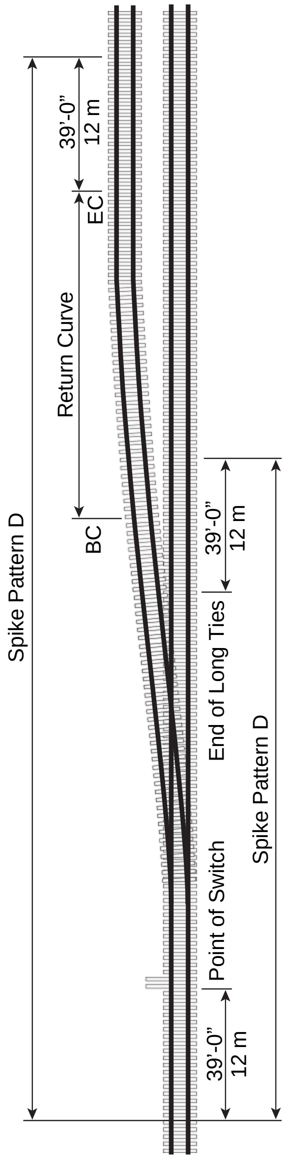
6. Track spikes between the running rail and guard rails, as well as track spikes in tight areas around heel blocks and frogs will be removed using a four-ball track spike puller and claw-bar.

7. Claw bars will not be struck with mauls or other tools.

8. Plug spike holes with approved plugging material, preferably an approved chemical compound, before re-spiking.

9. Turnouts shall be spiked as per the pattern identified in Figure 19.

Figure 19. – Spiking Through Turnouts



10.5. Timber Lag Bolts (Timber Screws)

1. Timber screw installation will require an 11/16 in. (17 mm) pilot hole drilled a minimum 6 in (152 mm) into the turnout or track tie.
2. Timber screws will be run (turned) into turnout or track tie and not driven.
3. Timber screws will NOT be used with washers.
4. Tie plates fastened with screw spikes or drive spikes will have a screw in each hole of the tie plate.
5. Drive screw spikes can be either driven or turned into the turnout or track tie.
6. Do not overtighten the screw or screw spikes.
7. Screws shall be removed using an impact wrench or other power wrench. Screw spikes will be withdrawn using either a claw bar or impact wrench.

10.6. Rail Clips

1. Rail clips must match the fastening system of the tie plate or concrete tie. Rail clips must be replaced when the rail clip is sprung or damaged.
2. Modified “E” 2063 A rail clips and modified 4277 insulators shall be used at insulated joint locations.
3. Care must be taken to drive the rail clips correctly
    a. On concrete ties the “e” rail clips should be driven so that the leg is flush with the shoulder. The radius shall not contact the shoulder. There should be a 3/8” clearance between the bend and the rail clip housing.
    b. On turnout plates on timber ties, rail clips must be driven flush with the shoulder
    c. On tie plates, rail clips will be driven so that the radius in the clips does not contact the shoulder portion of the plate used to house the rail clip.

4. Where rail clips are installed by hand, care must be taken not to strike the shoulder or tie with the striking tool.

5. Where rail clips are installed by machine, the operator must ensure that the machine is adjusted to insert the rail clip horizontally into the hole without binding.

6. When fastening rail to concrete ties, ensure rail tie pads, insulators, and rail clips are installed and in good condition.

7. Do not attempt to nip or lift a tie using the rail clip.

8. When removing rail clips:

    a. Use the removal tool for Safelok rail clips

    b. Ensure rail clips are not allowed to fly freely when released.

9. The appropriate rail clip type must be used in their application. Insulated joints and joint bars use special rail clips.

    a. In concrete tie territory where a temporary joint is required, before reopening track for service, rail clips shall be removed from 1 side of the concrete tie to prevent possible shunting of signal system through the inside of the concrete tie.

10.7. Bumping Posts

1. Unconnected ends of non-main tracks must be curved away from adjacent tracks.

2. Where there is danger of injuring persons or property if equipment should be run off the end of the track, a bumping post or wheel stop, of an approved type as determined by the CM Sr. Manager of Track and Structures shall be provided.

3. For new construction, wheel stops shall not be used on tracks used by passenger equipment.

Section 11 Ballast

11.1. Ballast Conditions

1. Track must be supported by material which will promote drainage of the track structure, and restrain the track laterally and vertically under dynamic loads imposed by railroad equipment and thermal stress exerted by the rails.
2. Ballast must conform to the current version of the GO Transit Crushed Rock Track Ballast Specification.

11.2. Ballasting

1. Ballast cross sections for new construction shall conform to Standard Plan GTS-2205. For ballast on rail bridges or structures refer to Metrolinx General Guidelines for Design of Railway Bridges and Structures.
2. For all new construction, place and proof-roll a minimum of 6 inch (152 mm) of pre-ballast.
3. For the unloading of track ballast using rail equipment or hi-rail trucks, Recommended Method 3706-2: Ballast Unloading shall be followed.
4. Ballast cross section shall have:
    a. In wood tie territory, cribs filled to a minimum of 1 in. (25 mm) below the top of tie.
    b. In concrete tie territory, cribs filled to a minimum of 1 in. (25 mm) below the top of tie ends.
        i. Ballast shall be up to 1 in. (25mm) above the centre of the concrete tie.
    c. No ballast left on top of track or turnout ties, fasteners and tie plates, except as noted in Track Standards section 11.2.4.b.i.
    d. Shoulder ballast for jointed rail track to be maintained to a minimum of 6 in. (152 mm) out from the end of the tie before sloping at 2:1.

e. Shoulder ballast for CWR track should be maintained to a minimum of 12 in. (305 mm) out from the end of the tie before sloping at 2:1.

f. On double main track and between main and siding tracks, a ballast trough between tracks should be maintained ensuring a proper 2:1 shoulder slope within the trough.

5. Ample clearance for rolling stock shall be provided when distributing and dressing ballast. Remove ballast from turnouts, switch points, flange-ways through frogs, guardrails, and road and rail crossings at grade, which will impede proper operation or passage of wheel flanges.

6. When unloading ballast, only the amount of ballast required should be unloaded and in the correct location in order to reduce wasting ballast. Extra care should be taken when unloading near open deck bridges or road crossings. Car doors should be closed prior to any movement across open deck bridges. Ballast shall not be allowed to accumulate on road crossings.

7. When unloading ballast in the centre of the track, a plow track or turnout tie may be used in order to evenly spread ballast and prevent excessive rock from accumulating on the rail and possibly derailing cars.

8. Remove any windrowed ballast such that it does not extend more than 2½ in. (63 mm) above the top of rail. This will prevent damage to the equipment on the IRIS test trucks.

9. When unloading ballast, all cars must be completely empty and doors closed and locked prior to releasing.

10. Care must be exercised when unloading ballast from cars on one side or on curves with super-elevation. Prior to movement, the load should be inspected and levelled, as required.

11. The typical ballast profiles can be found in Appendix T – Typical Ballast Profiles, for CWR track and jointed rail track on concrete, steel, and timber ties.

11.3. Clearances

1. For any work which will reduce the allowable clearances, such as ballast stockpiling, permission must be obtained from the CM Manager of Track
2. Any lifts or realignment that may affect clearances to adjacent or overhead structures or OCS wiring must receive prior approval from the CM Senior Manager of Track and Structures, and when warranted, operational bulletins issued restricting train movements.
3. Prior to releasing the track for railway movements the OCS clearances shall be measured and confirmed with the CM Senior Manager of Track and Structures.
    a. In some instances, OCS adjustment and realignment may be required prior to releasing track.

11.4. Bridges

1. If bridges are within the section of track planned for re-ballasting, plans must be made to undercut each bridge approach for a sufficient distance to permit a safe and smooth runoff.
2. Ballast on train crew walkways is to be removed to avoid a tripping hazard and to protect the safe passage of the public and traffic under the bridge.
3. Provide from the end of the train crew walkway a well graded transition zone to the ballasted section
4. On ballast deck bridges, provide temporary barriers to protect the public and traffic under the bridge from falling ballast, during ballasting operations.
5. When ballasting adjacent to open deck bridges, care shall be taken to prevent ballast from falling on or collecting around the bridge seats.

11.5. Public Crossings

1. At public crossings, re-ballasting must be done without risk or major inconvenience to the public. Well in

advance of the planned work, advise the road authority of the nature and extent of the work to be done. Arrange for the installation of barricades, warning lights, and other safety devices to protect people and vehicles from using the crossing.

11.6. Undercutting

1. Take all necessary precautions to avoid track buckling. Pay close attention to the temperature when planning to use under-track plows, sleds, and other specialized undercutting equipment. Fill cribs and restore shoulders with new ballast as soon as possible, but must be completed before train operation.
2. Prior to conducting an undercutting program a tie condition survey shall be completed and all defective ties shall be replaced.
3. The transitions or runoff off gradients must be made on tangent track and must be fully tamped and level to provide a smooth transition from newly ballasted track to old ballast. In no case can the rate of runoff be more than described in Track Standard Section 16.2.8.
4. Following an undercutting program, the track disturbed shall be destressed including 200 ft. (61 m) in either direction away from the disturbed section.

Recommended Method 3706-2: Ballast Unloading

The following process description considers unloading ballast from rail cars. Various unloading requirements (i.e. shoulders, centres, one side) are considered.

There are 3 stages to the ballast unloading process:

1. Plan to Unload Ballast
   a. There are three general levels of planning to be considered to complete a ballast unloading project:

Table 23 – Levels of planning

Level	Action
1	Pre-project planning (weeks to months prior to job) • emergencies (safety) • work environment • ballast requirements • project impediments • etc.
2	Pre-job planning (done days ahead of the job) • emergencies (safety) • work environment • ballast requirements • production impediments • etc.
3	Pre-block planning (done hours before the job) • shortages of ballast delivered • change of plans • marshalling of train • etc.

2. Prepare to Unload Ballast
   a. Prior to unloading ballast, a series of preparation tasks must be performed to ensure that the safety of employees is considered, S&C or other installations are not damaged, ballast is not unloaded where it is not required (wasted) and all employees involved

including the train crew are familiar with the locations and unloading procedures.

Step	**Action**
1	Ensure unloading employees are provided with proper breathing apparatus
2	Provide train crew with list of unloading sites (should be pre-marked in the field)
3	Ensure that there is enough ballast on hand to complete the proposed work. If enough ballast is unavailable, prioritize where unloading will be done.
4	Job briefing by the unloading foreman, including: • locations and how much ballast will be unloaded at each • obstructions • direction of unloading • whether you will be unloading centres, shoulders, or both • speed of unloading • signals for shaking cars • where employees will meet to leave the site and be in the clear of trains. • etc. note: this should be done at each unloading site
5	Job briefing by train crew, including: • the time available to unload ballast • where trains will be cleared • how track gradients may affect unloading process • etc. Note: this should be done at every unloading site

3. Unloading Ballast

The following is a general outline to follow when unloading ballast from railcars.

Step	**Action**
1	Ensure proper unloading bars/cranks available for old/new cars Crack doors on Morrison/Knudsen ballast cars
2	Move ballast train into position ensuring that train is marshalled so that: • same car types are marshalled (should be done prior to obtaining work block) • only loaded cars will move over flooded track • spreader is next to unit and train is “pushed” during unloading (where possible)

	• unloading is in the direction away from obstructions (where possible)
3	Unload ballast ensuring train travels at "walking speed" for unloading employees. Unload: • between rails first • on shoulder only after centres have been unloaded if applicable If it is necessary to unload toward obstructions, stop unloading a few car lengths before the obstruction, unloading "heavier" near the end (allow regulator to move excess closer to obstruction) If unloading to strengthen weak shoulders, use 6-10 cars per mile, unloaded on the shoulders approximately 3-4 inches (76-102 mm) higher than the ties. Level off any ballast that is above top of rail. If unloading to spot surface, unload light amounts of ballast on the shoulders (often 3-5 cars per mile is sufficient) If unloading for out-of-face surfacing, unload through centre doors (3-4 inch (75-100mm) ridge above the ties for minimum surface lift). A light unloading on the shoulders may also be required. Level off any ballast that is above top of rail. If more ballast is required on one side than on the other, unload in several passes, and shake the cars periodically to ensure ballast does not sit on one side of car. Never have two doors open on one side without having at least one door open on the opposite side. Unloading from one side only will cause the cars to become unstable and possibly tip or cause a wheel climb derailment particularly where track geometry is marginal. Caution: When unloading ballast on curves with superelevation, extreme care must be taken. Frequent visual inspections of the car(s) to ensure the ballast is level or nearly level may be required. If ballast is not level steps should be taken as per #5 below Note: unloading to fill empty cribs on short spots is not recommended since it may be too difficult to control the flow of ballast. Allowances should be made to dump on shoulder and regulate into centre.
4	Level ballast to top of rail • use spreader nose; or • plow ties under loaded car
5	Ensure ballast is level within the car. If it is not level, steps should be taken to either level the ballast by hand or to shake the cars. This is especially critical if traveling on curves with superelevation or through turnouts. Do not shake cars on: • flooded track

	• open deck bridges • turnouts, especially in switch area • road crossings • skeletonized track
6	When finished unloading, close ballast car doors If using older enterprise cars, clean all ballast off centre doors and close them, then clean side doors prior to closing. Using Morrison-Knudsen, close chute and engage lever and lock
7	Clean any turnouts (especially in the switch area) , road crossings, railway crossings at grade, flange-ways, etc. that may be affected by ballast

Section 12 Surfacing and Lining

12.1. Surfacing and Lining

1. Do not lift track more than is necessary to maintain proper surface.
2. When track is lifted during surfacing operations, do not allow the rate of change in surface, (e.g. the rate of runoff), to be more than specified in Track Standard Section 16.2.8.
3. Special attention is to be given to the surface and line of track at approaches to bridges, culverts, turnouts, rail-to-rail crossings, road crossings, and through tunnels.
4. During surfacing work, employees must check the surface using a track level.
5. Any rail anchors removed must be replaced, rail anchors adjusted, missing rail clips replaced, high track spikes plugged and re-driven, and hanging track ties brought up tight to the rail base. After all work is completed, employees should check for missing rail clips.
6. On completion of surfacing, the surface must be in compliance with Track Standard Section 16.2 and if applicable, Track Standard Section 19 .
7. Prior to releasing the track for railway movements the overhead and horizontal catenary clearances shall be measured and confirmed with the CM Senior Manager of Track and Structures.
    a. In some instances, overhead catenary adjustment and realignment may be required prior to releasing track.
8. When tamping, only 16 in. (406 mm) on either side of the rail is to be tamped.
9. The centre of the tie must not be tamped, except for turnout ties, crossing ties, and steel ties.
10. When tamping transition ties, the entire length of the tie outside the rail must be tamped.

11. Steel ties must be tamped as per the manufacturer's recommendations.

12. When surfacing in concrete tie and steel tie territory:

    a. Adjust the tamper head limits to ensure the correct penetration of the tamping tools below the tie

    b. Adjust the ballast regulator plows to ensure no impact to the fasteners

    c. Fastening system must be inspected upon the completion of the surfacing

13. Track raises in excess of 6 in. (152 mm) shall be avoided.

14. Individual track lifts shall not exceed 3 in. (76 mm).

    a. The final lift shall not exceed 1 in. (25 mm)

15. Dynamic stabilizers shall be used between each lift. Any exemptions to this requirement must be approved in writing by the CM Senior Manager of Track and Structures.

16. Frogs should not be tamped without jacks set on the side opposite tamper to help prevent tamper from bending the base plate.

17. When surfacing through spring frogs, care must be taken to ensure no lifting action is applied to any part of the moveable wing rail or frog plate.

18. When regulating through a spring frog the frog must be inspected on foot and cleaned to ensure there are no obstructions in both flange-ways and the wing rail is lubricated and free to move.

19. Track surfacing and lining which eliminates long line swings or lines curves to the inside may generate additional rail and should, when practicable be monitored to determine if adjustment is needed. Destressing is to be completed as per Track Standards Section 4.9.

20. When surfacing curves in Class 2 track and above, a minimum superelevation is required to be installed in the track as per Track Standards Section 19.4.

21. When surfacing track:

    a. The rail temperature must be monitored, and measured regularly.

    b. Employees must regularly check the track surface with a track level.

22. When rail has been added or the track lined inwards within 400 feet (122 m) of a high risk location listed in Track Standard Section 12.2 AND the rail temperature is above the PRLT, the precautions in Track Standard Section 12.3 must be followed.

23. When surfacing a turnout, any tie that cannot be tamped mechanically to allow for 16 in. (406 mm) on each side of the rail must have ballast firmly packed using hand tamping tools. This includes but is not limited to the head-block ties, ties adjacent to the rods, frog ties, guard rail ties, point heel block ties, etc.

24. When surfacing operations affect signal related track components, the CM Signal Manager must be notified in writing and provided a work plan for review, in order to perform needed adjustments, repairs, or inspections.

25. When surfacing around insulated joints, switch machines, crossing protection equipment, or other signal devices, care must be taken to prevent damage to bond wires, conduits, or other signal connections to the track. Particular attention is to be given to Hotbox Equipment, Dragging Equipment, and Wheel Impact Load Detectors.

26. Surfacing at impedance bond locations shall be completed under the direction from a qualified Signals and Communications employee.

27. When surfacing adjacent or near passenger platforms, special care must be taken to ensure that the distance between the top of rail and the top of platform and accessibility platform meet the requirements of Track Standard Section 23

    a. Where existing conditions do not permit both the platform and the mini platform to meet these requirements, the accessibility platform tolerances shall take priority.

i. This is not applicable to new construction.

28. Ensure that the surfacing broom and regulating operations do not damage adjacent property especially at highway underpasses, pedestrian walkways, station platforms and shelters, etc.

    a. Any ballast that is left on a station platform or a train-man’s walkway shall be swept off prior to the next train or end of shift.

29. Whenever it is necessary to disturb the ballast to permit surfacing and lining, whether it is manual or mechanical, the ballast shoulder must be restored and the ballast cribs must be filled before returning the track back to train service.

30. When regulating ballast, the ballast section must adhere to the requirements of Track Standard Section 11.2.4.

31. Do not pull dirt, fines, or vegetation into the track when dressing shoulders

12.2. High Risk Locations and Clearances

1. Examples of high risk locations are as follows:

    a. Bottom of a grade near a fixed track location such as a bridge, turnout, road crossing or a rail-to-rail crossing.

    b. Known areas of heavy train braking at or near fixed track locations.

    c. Areas of insufficient rail anchors (non-compliant to the GO Transit Track Standards).

        i. Areas of insufficient rail anchors shall be scheduled for correction.

    d. Fixed track locations within a directional running zone.

    e. Any areas showing signs of high rail compression.

2. When surfacing or lining track where vertical or horizontal clearances are involved (e.g. electrified territory, at tunnels, snow sheds, approaches to the ends

of bridges, alongside signals, fueling stations, and platforms), the general level of the track, its alignment, its curve elevation, and its distance from adjacent tracks must not be changed without the authority of the CM Senior Manager of Track and Structures.

3. Where permanent reference points are situated to indicate the location and elevation of the tracks (e.g. tunnels, or at some road overhead bridges) these reference points must be adhered to and before commencing the surfacing and lining task, a work plan shall be submitted for the review and approval of the CM Senior Manager of Track and Structures or their designate.

4. Particular attention must be paid to tracks adjacent to station platforms where the Metrolinx Design Requirement Manual (DRM) elevations between top of rail and top of platform, gauge face of rail and edge of platform measurements are provided.

5. Track Standards Section 23 , Table 41 summarizes the requirements for station platforms. In the case of discrepancies between the GO Transit Track Standards and the Metrolinx DRM with respect to platform clearances, the Metrolinx DRM governs.

12.3. Precautions

1. If possible, surface away from the fixed location and not towards it.

   a. If not possible, destress the both rails immediately following the surfacing work. Follow the requirements of Track Standards section 4.9, 13.3, and 14.5 for destressing.

2. When surfacing operations are required in a curve, the entire curve must be surfaced from tangent to tangent.

3. Before surfacing and lining a curve on main tracks, the curve must be staked if it is more than 3° or if the rail temperature is more than 50°F or 28°C below the preferred rail laying temperature, or is expected to be in the next 24 hours.

4. Compound curves shall be staked prior to surfacing.

5. To stake a curve prior to surfacing and lining, place at least 3 reference stakes uniformly spaced around the curve with the middle stake located near the middle of the curve. Also place 4 stakes at key transition points on the curve including TS, SC, CS, and ST locations. Additional stakes may be used due to the overall length of the curve.

   a. Stakes can be placed outside the reach of track equipment, or can be ½ in. x 24 in. (12 mm x 600 mm) rebar driven in the middle of the track. The track at the location of the stake should be painted and the measurement from the stake to the near base of the rail, recorded on the web of the rail with paint marker.

6. Inspect for curve movement periodically after the work, especially during periods of large temperature changes of 40°F or 23°C. If the curve is found to have shifted inward more than 1 inch, it must be lined out or destressed prior to ambient temperature reaching 70° F (21°C). If the curve is not lined out or destressed then a speed restriction must be placed per Track Standard Section 4.9. The effective rail length added to a curve as a result of chording inwards is calculated in Appendix M – Effective Length Added For Curves Chording Inward.

7. After surfacing, track seen to exhibit signs that CWR is out of adjustment shall be reported to the Track Supervisor and the CM Manager of Track and the track protected until remedial action is taken.

8. Turnouts in CWR mainline shall not be surfaced with a tamper until the anchor pattern meets the requirements of Track Standards section 10.2.

9. When surfacing through a turnout with boltless adjustable rail braces, the switch points and stock rails should be blocked to prevent displacing the stock rail from the switch plate.

10. When surfacing switches at ends of sidings or double track, ensure the diverging route is tamped after surfacing the turnout straight route. As much as practicable, the top of rail elevation of the diverging route should be held even with that of the normal route

through the return curve. See Track Standard section 19.4 for details on curve design requirements.

12.4. Surfacing Concrete and Steel Ties

1. The surfacing and lining of concrete ties should follow the same procedure as that for timber ties.
2. For tamping steel ties:
   a. Track tie cribs and shoulders must be full to ensure sufficient ballast is available for tamping
   b. Inspection holes are located on either side of the rail seats to ensure the tie pods are full
   c. Tamping tools must be raised to compensate for the depth of steel ties vs. wood ties. Steel ties are up to 2.5 inches (64 mm) shallower than wood ties.
   d. Steel Ties must be centre tamped with the tampers traversing work heads
   e. The tamping cycle shall consist of at least two insertions at the rail seats and one in the centre of the tie to ensure proper compaction
   f. When steel ties are interspersed with wood ties, two full surfacing passes shall be made, with the first pass, surface the entire track in accordance with normal procedures, for the second pass, only tamp the steel ties, without lifting the track, always tamp the steel ties last.
   g. Refer to the steel tie manufacturer’s instructions for tamping tool settings and further details. For example: for Narstco steel ties use the Steel Tie and Turnout Set Assembly Instructions.

Section 13 Installation and Maintenance of Turnouts

13.1. General

1. Care must be taken when working around turnouts to avoid interfering with the Signal Systems:
2. Use extreme care not to short across an insulated gauge rod, insulated gauge plate or insulated joints when using any tool that conducts electricity, such as: track wrench, shovel, ballast fork, tie tongs or metal broom.
   a. Tools used in electrified territory must have insulated handles.
3. At locations where snow-clearing devices are installed, use extra precautions. There is the possibility of creating a short circuit through the metal ductwork.
4. Responsibility for lubrication of switch point plates at any particular location will be assigned by the CM Manager of Track.
5. Turnouts shall not be installed with spring frogs unless so authorized by the CM Senior Manager of Track and Structures in writing.
6. Number 9 turnouts and smaller, require approval in writing from the CM Senior Manager of Track and Structures before being installed or included in a design.
7. Any odd number turnouts require approval from the CM Senior Manager of Track and Structures in writing.
   a. Number 11 and 13 turnouts are permitted in the Union Station Rail Corridor only.
8. On main track, only number 12 lateral and number 20 lateral turnouts shall be permitted, unless authorized by the CM Senior Manager of Track and Structures in writing.
   a. Equilateral turnouts may be installed in select locations upon approval in writing from the CM Senior Manager of Track and Structures.

9. Number 24 turnouts may be used with approval from the CM Senior Manager of Track and Structures.

10. Concrete tie turnouts may be used with approval from the CM Senior Manager of Track and Structures. The turnout design must also be approved in writing.

11. Design of turnouts and crossovers shall also conform to Track Standards Section 19.4 Curve Design. Special attention shall be taken to avoid car body twist between turnouts and crossovers.

13.2. Installation of Turnouts

1. Each newly constructed turnout must have a detailed inspection by the Track Supervisor and a CM Representative before it is placed into service, or a 10mph speed restriction will apply.

    a. A turnout will not be placed into service without an In-service inspection consistent with the RCI Handover Protocols

2. Do not reuse non-premium components (e.g. points that are not FHH) on any turnout that is 115 RE or greater in weight.

3. Turnouts must not be installed, rehabilitated, or renewed on main track curves, except in special cases as authorized by the CM Senior Manager of Track and Structures.

    a. In Yard applications, the CM Senior Manager of Track and Structures must review the design prior to construction and provide written approval for turnouts in curves.

4. Turnouts must not be installed in vertical curves.

5. Turnouts must not be installed on bridges, except in special cases as authorized by the CM Senior Manager of Track and Structures.

    a. In no case shall a turnout be installed on an open-deck bridge or within 200 ft. (61 m) off of the back-wall in order to allow for the appropriate anchoring pattern.

b. Turnouts shall not be installed within 100 ft. (30.48 m) of a ballast deck bridge.

6. Turnouts shall not be installed within 200ft. (61 m) off the end of a crossing unless authorized in writing by the CM Senior Manager of Track and Structures.

7. Main track turnouts shall be separated by a minimum distance of 80ft (24.38 m) between number 1 gauge plate and the last long tie on the preceding turnout unless otherwise authorized by the CM Senior Manager of Track and Structures in writing.

8. See Track Standards section 19.4.26 for reverse curve requirements.

9. Power, Dual Control, Spring and Electrically Locked switches shall be installed only at locations approved by the CM Senior Manager of Track and Structures and the CM Manager of Signals.

10. When turnouts are delivered prefabricated and in panel cars, the following precautions will be taken when unloading and transporting:

    a. Panel turnouts must be completely secured to the racks of the cars whenever the car is moved.

    b. De-energise and ground any OCS prior to unloading or moving turnout panels.

    c. The weight of each panel must be known and compared to the load chart of the crane prior to attempting a lift.

    d. Each panel in the car will be fully secured until it is ready to be lifted from the car. The panel will only be released once the crane lift lines are secured to the panel.

    e. Removal of panel tie-down chains will be done from behind the turnout panel.

    f. No one is allowed in a panel turnout car when the panel is being lifted.

    g. Panels will be placed where they will not affect the safety of railroad operations or the public.

    h. All tie-down chains must be placed in the car when the car is empty.

11. When assembling and installing turnouts:

    a. Turnouts shall be laid out flat, straight and level to facilitate welding.

    b. For turnouts with heater ducts, excavate deep enough at duct locations to prevent humping of track.

    c. Drive hardwood wedges between the open switch point and the stock rail, at each rod location, to prevent the stock rail from lifting out of the slide plates

        i. Place opposing track jacks in the centre of the track to push the switch points against the wedges and stock rails.

12. When turnouts are being constructed, trains should not be permitted to move in either direction until:

    a. The frog is properly protected by a guard rail; and

    b. The main track switch point is clamped or lined and locked against the stock rail. At least two switch point clamps shall be applied and locked with private locks and the switch point shall be spiked where possible.

    c. Broken switch point clamps shall immediately be removed from service and shall not be welded.

    d. Ballast from between switch points and stock rails, from switch point and slide plates, and frog and guard rail flange-ways is removed.

    e. A speed restriction of 15 MPH for facing point moves and 30 MPH for trailing point moves will apply until a switch stand or switch machine is attached. All movements must be supervised by a qualified employee until a switch stand or machine is attached.

13. If turnout is to remain out of service temporarily, the point shall be secured to a hand throw switch stand, which will be locked with a private lock and a tag applied indicating the name and contact information of the foreman.

14. When a new turnout is installed in main track, a new 80 ft. (24.3 m) panel shall be installed from all three ends except in crossover applications where the panels shall be installed on all four ends.

    a. In hardwood tie territory, the panels shall be constructed using forged type plates such as MSR.

    b. In non-main track territory, every effort should be taken to install the required panels; however physical restrictions may prevent this.

15. Place packing material between the open switch point and stock rail to block ballast.

    a. Any ballast that falls between the switch point and stock rail must be removed.

16. Cover switch point roller bodies with duct or other tape to prevent their openings from filling up with rock and rock fines.

17. Clean ballast from tie cribs to a depth adequate to prevent contact with rods and to facilitate winter switch maintenance and drainage.

18. Switch stands shall be plumb and be securely spiked, bolted or lagged to the head block ties. Stands on spring switches shall be securely bolted through the head block ties.

19. Whenever possible, switch stands are to be located on the diverging route of the switch, so that the connecting rod is in tension when the switch is in the normal position.

20. Main track switch stands shall be of an approved rigid type

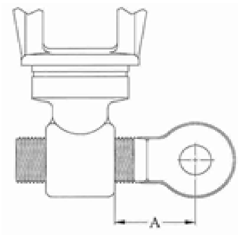
21. Semi-automatic stands of an approved type (22E) may be used on yard tracks only.

22. Low profile switch stands are to be used where they are located between tracks having track centres of 18 ft. (5.49 m) or less.

23. For type 22 switch stands ensure that the throw and crank eye adjustment match the values in Table 24.

Table 25 has adjusting recommendations for any crank eye style switch stand.

Table 24 – Throw for Type 22 Switch Stands



Throw	Crank Eye Adjustment
± 1/32” (0.8 mm)	± 1/16” (1.6 mm)
4½” (114 mm)	2-1/16” (52 mm)
4-5/8” (117 mm)	2-3/16” (56 mm)
4¾” (121 mm)	2¼” (57 mm)
4-7/8” (124 mm)	2-5/16” (59 mm)
5” (127 mm)	2-7/16” (62 mm)

Table 25 – Switch Adjustment

Near Point	Far Point	Crank Eye on Stand	Clevis on Connecting Rod
Fits properly	Too tight	Screw in	Screw in
Fits properly	Too loose	Screw out	Screw out
Too tight	Fits properly	Screw in	Screw out
Too loose	Fits properly	Screw out	Screw in
Too tight	Too tight	Screw in	None
Too loose	Too loose	Screw out	None

24. Switch point protectors or switch point guards may be installed to protect switch points on yard, back tracks, and industry tracks. The maximum train speed and curvature for the application of the protectors and guards is indicated in Table 26.

Table 26 – Switch Point Protector Usage Guidelines.

Product Name	Maximum Curvature	Maximum Speed	Traffic Volume
Nolan SPP	All Curves	10 MPH	< 25 cars / week
Inside PP Guard Rail	20°	15 MPH	All
Weld on PP	20°	15 MPH	< 25 cars / week
Field Side PP	2°	15 MPH	All

25. Ensure the field mounted protector fits properly against the field side web of the rail and that any flow on the gauge side of the straight stock rail is ground off.

26. The limits for adjustable switch point guard bar settings are 3 15/16 in. (100 mm) minimum to 4¼ in. (108 mm) maximum. See Figure 20 and Track Standard Section 13.4.19.

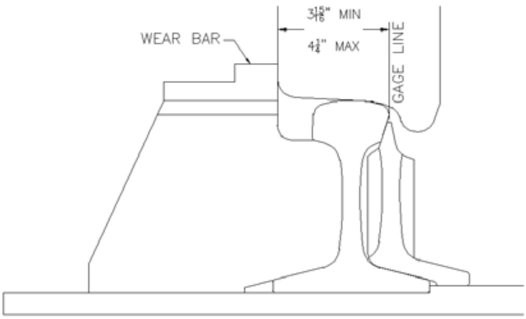


Figure 20. Limits for adjustable switch point guard.

27. On mainline track where a switch point experiences excessive wear because the switch is located close to, or in a curve, a guard rail may be installed ahead of the switch point, at the approval of the CM Senior Manager of Track and Structures to provide protection from facing point moves.

28. All main track switch stands must be equipped with an approved switch lock in good working order and properly chained to the stand on high mast switch stand or to the ties on low mast switch stands. Switch stands on non-main tracks are to be equipped with a hook type keeper unless otherwise directed.

29. On ALL main track hand operated switches, regardless of the method used to control train operation, as well as within yard limits, high security switch locks must be installed.

    a. This applies to all dual control and power switches, including self-restoring, and auto-normal switches.

b. At locations where vandalism is a concern, high security switch locks may also be installed as directed by the CM Manager of Track on the following.

i. Hand operated turnouts on non-main tracks

ii. Other devices such as derails, electric switch locks, foot pedals, push button operation panels, etc.

30. Switch rods and connecting rod bolts must be inserted with the nuts on the top side and secured with cotter pins. Ensure the connecting rod jaw openings, bolt holes and bolts correctly match the switch rods. The connecting rod bolt under the switch stand must be installed with the head of the bolt on the top side.

31. Where switch point locks are installed, the switch will be identified by painting the top of the switch stand castings white.

32. When installing parallel or ground thrown switch stands, the operating lever must point towards the frog for the normal position.

33. When installing a high switch stand, the handle should be positioned so that when the switch is in the normal position, the handle faces away from the frog and away from the track.

34. Switch points shall fit snugly against the stock rails for the entire length of the planed portion.

35. Turnout stock rails shall be horizontally bent as shown on the Standard Plan. The JB-60-141 is the only rail bender permitted to field bend stock rails of all metallurgy, for rail weights up to and including the 141 RE section. All other benders, without exception, are limited to bending 115 lb. or lighter rail in standard carbon and 3HB metallurgy only.

a. A work methodology for the use of rail benders must be approved in writing by the CM Sr. Manager of Track and Structures prior to their use.

36. It is important that stock rails are properly seated in the switch plate have no lateral movement in the plates, and that switch plates have no movement on the ties. Care must be taken in adjusting braces to avoid over-driving and rotating the stock rails out of the rail seat of the plate.

37. Frog type for a turnout will be determined by traffic patterns:

    a. SGM frogs shall not be used on tracks with speeds exceeding 15 mph.

        i. SGM frogs should be avoided on the GO Transit network for all new frog installations or replacements.

        ii. SGM do not require guard rails

        iii. The raised guard face of the frog body must not be worn more than 3/8 in. (10mm).

        iv. Restoring the guard face of the frog must be done before rebuilding the frog point.

    b. RBM frogs with low impact heels can be used in any situation, and are preferred for all applications.

    c. Jump Frogs will only be used:

        i. At the written direction of the CM Senior Manager of Track and Structures.

            - Where diverging volume is light
            - With operating speed on the diverging route over the frog limited to 10mph.
            - With gauge on the main line not in excess of 57 in. (1448 mm).

    d. Spring frogs are not to be used on GO Transit Territory.

38. When surfacing through a turnout with boltless adjustable rail braces, refer to Track Standards section 12.3.9.

39. Ballast will be cleaned from cribs to a depth adequate to prevent contact with rods and to facilitate winter switch maintenance and drainage.

40. In CWR territory, when a turnout or the rail must be destressed. Track Standard Section 4.9 and 13.3 outlines the method that shall be used to destress such locations.

13.3. Destressing at Turnouts

1. Prior to cutting the rail, make reference marks on the field side of each rail at both ends of the existing turnout or length of tangent track, where the track is to be cut for installation of the turnout. Measure and record the distance between these marks on the rail and on paper.

2. Cut and remove existing panel and install new.

3. Starting at the reference mark, make match mark on each rail approximately every 50 ft. (15 m) for a distance of 400 ft. (122 m) beyond the point end and frog end of the turnout. Ensure that the match marks start on the rail base and onto a tie plate on an unanchored tie. Ensure that the match marks are made with paint stick pen and are straight.

4. Measure between your reference marks to see if any rail has been added.

5. All welds must be made before de-stressing the new turnout unless approved in writing by the Corridor Maintenance (CM) Senior Manager of Track and Structures.

   a. The CM Senior Manager of Track and Structures shall be notified of all new turnouts and road crossings.

6. The following steps shall be taken to destress a turnout location:

   a. Follow the procedures in Track Standards section 4.9.

   b. Measure 400 ft. (122 m) beyond the long ties of the installed turnout.

   c. Measure the rail temperature.

d. Half way through this stretch (about 200 feet – 61 m) cut the rail.

e. Remove the rail anchors/rail clips on all rails in the 400 ft. (122 m).

f. Calculate the amount of rail to be removed; Use a rail length of 400 ft. (121.9 m) plus half the length of the turnout installed on each side. Add to this amount any rail added when the panel was installed (see reference marks) and 1 in. (25 mm) for welding; this will be the amount of rail that will need to be removed. The distance to either heat or pull the rail will be this amount less the one inch for welding. If heat is used, check match marks to insure expansion is throughout the 400 ft. (122 m) unanchored section.

g. Repeat for the other sides of the turnout / crossover.

7. Make the weld. After the weld has cooled, re-apply anchors to the 400 ft. (122 m) of rail behind the turnout that was previously de-anchored.

   a. For cold weather welding, it is recommended that rail anchors be applied prior to welding.

8. Prior to destressing and at the end of the project make sure switch points are square and rods are not rubbing ties.

9. Recommended Method 3205-2A: Destressing at Turnouts provides an example for destressing at turnouts.

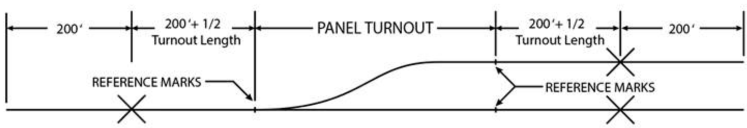


Figure 21. Destressing of Turnout Locations

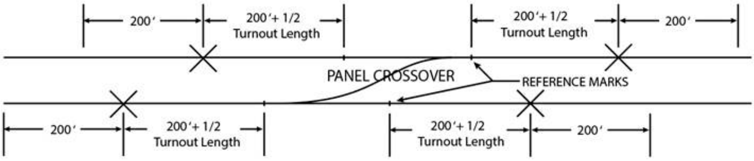


Figure 22. Destressing of Crossover Locations

Recommended Method 3205-2A: Destressing at Turnouts

Example

A number 12 - 136 lb. turnout is replaced in track. A length of 200 ft. of track is removed. The reference marks were 3/4" further apart after the panel was installed. At the time of de-stressing the rail temperature was 70°F (21°C) and that the PRLT is 100°F. How much expansion is required at both the point and frog end of the turnout?

Temperature differential	30°F.	(PRLT – 70)
Length of Turnout	141 ft.	from Standard Plan GTS-0271 (use 150 ft. for tables)
Adjustment for 200 ft. gap	0.48 in.	(141*30*0.00008) (use ½ in. for tables)
Adjustment for half the length of #12 turnout	0.169 in.	(141*30*.00008/2) (for table use 150 ft. and divide by 2: 3/8 divide 2 is 3/16)
Add length of weld and total adjustment	2.129 in.	(0.48 +0.48 + 0.169+1) 1 weld is 1 in. (for table 1/2+1/2+3/16+1 = 2-3/16")

Cut rail at trailing end of turnout at 200ft away from turnout and remove anchors.

Cut 2.129" or 2-3/16" of the rail depending on calculation method used, and pull or heat to a 1 in. gap for final welding. Weld and re-anchor.

Cut rail at facing end of turnout at 200ft away from turnout and remove anchors.

Cut 2.129" or 2-3/16" of the rail depending on calculation method used, and pull or heat to a 1 in. gap for final welding. Weld and re-anchor.

13.4. Maintenance of Turnouts

1. The Signal Maintainer shall be notified when any planned work, which may interfere with the functioning of the signals system, is being performed. This work includes, but is not limited to:
    a. Surfacing the switch.
    b. Switch tie replacement.
    c. Switch point welding.
    d. Switch point and stock rail grinding.
    e. Switch stand or rod replacement.
2. Switch stands, switch plates, connecting rod bolts, and spring frogs shall be kept properly lubricated to provide easy movement and to protect against excessive wear.
3. Switch stands, targets, masts, connecting rods and all other component parts must be kept in good operating condition and must have defective parts repaired or replaced immediately.
4. The application of heat or mechanical methods to repair bent or twisted switch stand masts is not permitted.
5. Adjustment of semi-automatic switch stands shall be performed in accordance with Recommended Method 3500-6: Adjustment of #22 Switch Stands. Where inspection/adjustment reveals excessive wear or other internal problems with the stand, it must be removed from track and tagged for repair or scrap.
6. Insulation in switch rods, pipe connected derails and gauge plates shall be maintained in good condition at all times.
7. Metal flow on switch points and stock rails **shall be kept ground** off to maintain proper gauge and to prevent chipping of these parts. Flow should not exceed 1/16” (1.5 mm) on switch point or gauge side of stock rail. If flow exceeds this value, it shall be documented and planned for grinding. The flow MUST be ground off as per the requirements of Track Standards section 17.5.8.

8. **Welding of switch points or stock rails is NOT permitted on any main line track** except as permitted through Track Standards section 8.1.14**.**

9. Welding of switch rod or switch clips is prohibited.

10. Gaps in switch points, regardless of size, are unacceptable. The points must fit tightly against the stock rail.

11. Switch rods and switch clips should have sufficient clearance so as not to contact the side of the tie or the slide plate.

12. Good turnout tie conditions must be maintained under the heel assembly.

13. Gauge must be maintained ahead of the turnout.

14. Ensure that the switch point does not rest on an adjustable switch point roller when the point is closed against the stock rail.

15. Rollers shall be adjusted and cleaned to ensure that they spin freely and do not cause the switch point to drag or bind.

16. Self-guarded manganese frogs must not be used in track where speeds exceed 15 mph.

17. Once a frog has been installed, the manganese inserts **shall be ground** at the following suggested minimum intervals to remove flow and lip:

    a. After the passage of approximately 0.5 Million Gross Tons (MGT) of traffic (approx. 725 10-car GO Trains);

    b. After the passage of approximately 1.5 MGT of traffic (approx. 2,174 10-car GO Trains);

    c. After the passage of approximately 4 MGT of traffic (approx. 5,800 10-car GO Trains); and

    d. After every subsequent 12 MGT (approx. 17,400 10-car GO Trains) or as required to remove flow and lip.

18. Bolts for special track work components will be:

    a. Grade 5 for 100 ARA or smaller rail sections. Grade 5 bolts can be identified by three (3) radial lines on the head of the bolt. The use of 100 ARA special track work MUST be approved by the CM Senior Manager of Track and Structures.

b. Grade 8 for 115 RE or heavier rail sections. Grade 8 bolts have six (6) radial lines on the head of the bolt. Whenever grade 8 bolts are used, each bolt must be equipped with a hardened steel washer. 136 RE special track work is recommended in all new construction on GO Transit owned territory. All other weights of track shall be approved in writing by the CM Manager of Track.

c. Of the proper length and diameter for the application.

i. Only one lock washer or flat washer shall be installed on a bolt.

ii. The bolts shall have approximately ¾ in. (19 mm) of thread extending beyond the nut.

iii. Bolts will be lubricated using graphite lubricant and tightened to torque values specified in Table 27 and Table 28.

Table 27 - Torque to be applied to Grade 5 Bolts for Special Track Work

Size of Bolt	1“ (25 mm)	1-1/16” (27 mm)	1-1/8” (29 mm)	1¼” (32 mm)
Torque (ft.-lbs)	670	850	1200	1600
Torque (N-m)	910	1150	1630	2170

Table 28 – Torque to be Applied to Grade 8 Bolts for Special Track Work

Size of Bolt	1“ (25 mm)	1¼” (32 mm)	1-3/8” (35 mm)
Torque (ft.-lbs)	840	1675	2500
Torque (N-m)	1140	2270	3390

19. See Recommended Method 3500-7: Switch Point Guard Adjustment for instructions on how to adjust switch point guard bars.

20. Adjustable switch point guard bars will be set to ensure that the distance from the gauge side of the stock rail to the wear face of the switch point guard is never less than the initial installation dimension given for each type of switch point guard. Switch point guard bar adjustment will be accomplished by:

    a. Measuring the adjustment required to move the switch point guard bar to the appropriate guard length

    b. Adjustment of the switch point guard bar will be for the entire length of the point guard.

    c. Removing clips or loosening mounting bolts and removing the required thickness of shims from behind the switch point guard bar housing block

    d. Inserting the required shims between the switch point guard bar and the switch point guard bar housing block.

    e. Ensuring all shims have the retaining tabs under the switch point guard bar to prevent them from moving out under traffic.

    f. Ensuring all of the original shims are reinstalled either behind the switch point guard bar or behind the switch point guard bar housing block.

    g. Reapplying the clips or tightening bolts.

21. The maximum allowable switch point guard bar wear is 5/8 in. (15 mm). No more than four shims can be used to adjust the guard bar.

22. Weld repairs of switch point guard bars or any type of guard rail is prohibited.

23. Adjustable switch point guard bars used with jump frogs should have shims placed under the guard rail base plate through the area of frog ramping. The shims must match the size and hole punching of the guard rail plate.

24. When switches are removed from service:
    a. An Engineering or private lock must be secured in the hasp of the switch stand.
        i. On main line track this lock shall be high security equal to the lock on the stand.
    b. A yellow 3 in. x 5 in. (75 mm x 125 mm) plastic tag must be placed on the shackle of the lock.
        i. On the tag include the company, name, date, and contact information of the qualified employee who placed the switch out of service. If possible include the contact information for the supervisor.
    c. Two switch point clamps must be tightened and locked with a private lock to secure the switch point to the stock rail.
        i. Three switch point clamps must be used for a #20 or bigger turnout.
    d. The RTC, Yardmaster, or Control Operator, and the CM Manager of Track must be notified.

13.5. Maintenance of Spring Frogs

1. New spring frogs are not allowed on GO Transit / Metrolinx owned territory unless so authorized by the CM Senior Manager of Track and Structures in writing.

2. Do not put any part of your body between the spring wing rail and the point rail unless the spring is securely blocked open.

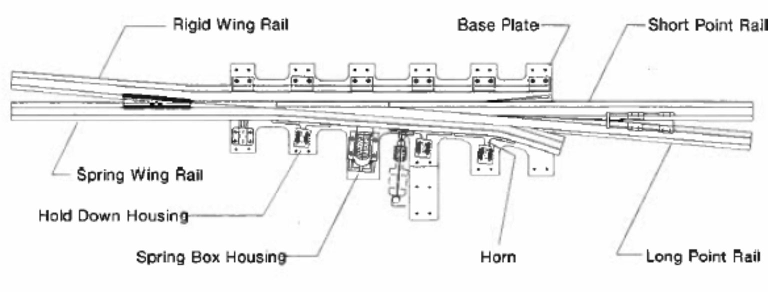


Figure 23. Spring Frog

3. Make sure the spike holes are plugged and the frog base plate is resting flat and solid. If not, adze or replace ties as necessary to provide a flat solid support under the entire frog. Make sure tie spacing is correct for the size of frog being installed.

4. Guard rails are extremely important. They provide protection and ensure the proper operation of the spring wing rail. Make sure the frog is properly gauged (56 ½ inches), and that the guard check gauge and the guard face gauge measurements are greater than or equal to the minimums shown by the class of track in the Transport Canada Rules Respecting Track Safety.

5. Care must be taken when lifting the frog with a tamper as the rail base hooks may bend the frog base plate. Hand jacks **MUST** be utilized on the outside rails of the turnout to assist in lifting the frog

6. Where hand tamping of ties is performed, only 16” on either side of the rail is to be tamped; the centre of the tie must not be tamped except on steel tie turnouts.

7. Before leaving the work site, clean the spring wing rail plates. Apply a lubricant to the base plates. Check the operation of the wing rail to ensure that the base plate has not restricted the horn clearance. Check to make sure the wing rail closes without sticking.

8. Maintenance of spring frogs includes:

   a. Good tie condition and surface under the frog toe to keep the horns from impacting the housings.

b. Having a 3/8 in. (10 mm) gap between the frog point (½ in. - 12 mm) and the wing rail. Beyond the tip, the wing rail and frog body shall be a tight fit.

c. When the wing is fully open the flange-way opening is at least 1 ¾”.

d. The retarder shall hold the wing open for 1 to 3 minutes.

Recommended Method 3500-6: Adjustment of #22 Switch Stands

Switch stands can become "out of adjustment" for a variety of reasons. Wear of the switch components and internal wear of the switch stand are the main two reasons. The purpose of this RM is to give guidance on how to test and return a switch stand to proper adjustment. This RM covers the Racor 22B (base), 22P (pedestal), 22E (ergonomic) stands. The internal workings of these stands are identical, and only the pedestals, latches and handles differ.

1. Check the condition of the head block ties. If there is evidence of loose spikes or stand is moving, the ties may be spike killed and it may be necessary to change the ties.
2. Adjust the throw of the switch points to the dimension specified on standard plans.
3. It is likely you will not be able to get the throw of the switch points to be exactly as in the standard plan because the teeth of the adjustment on the switch rods are fairly coarse. The throw must never be more than 5 1/32" (128mm) or less than 4 ½" (114mm).
4. When you are satisfied with the throw of the switch points, adjust the crank eye bolt setting in accordance with the 13.5.8.d.Table 29. These settings are critical to insure the stand will lock into place.

Table 29 – Crank Eye Bolt Settings

Throw ±1/32" (±0.8mm)	**Crank Eye Adjustment ±1/16" (1.6mm)**
4 ½" (114mm)	2 1/16" (52mm)
4 5/8" (117mm)	2 3/16" (55mm)
4 ¾" (121mm)	2 ¼" (57mm)
4 7/8" (124mm)	2 5/16" (59mm)
5" (127mm)	2 7/16" (62mm)

5. The crank eye adjustment is fairly coarse because the crank eye can only be adjusted half a turn at a time. Do not set the crank eye bolt setting over 2-3/4" under any circumstances as the bolt will strike the housing of the

stand and damage it. If you find the setting is over 2-3/4", shorten it. If the switch point throw cannot be adjusted, then the switch stand must be removed from service and tagged for repair or scrap.

6. When you are satisfied that the crank eye bolt is set per the table, leave it alone. Also do not try to compensate for the inexactitude in the crank eye bolt setting by going back and changing the switch point throw. The throw is the master number to which everything else is adjusted.

7. Balance the throws left and right.

    a. The technique for adjustment is given in the manufacturer's instructions. Sections for the Racor 22 Safety Switch Stand are quoted below:

        i. Temporarily connect the connecting rod to the switch stand and #1 switch rod (clevis end of rod to crank eye), lift handle of stand to centre position; ensure the connecting rod is straight. Install the stand firmly to the ties using lag screws.

        ii. Hand throw switch to both positions several times observing position of hand lever when points contact stock rail. Hand lever should not be more than 1-1/2" to 2" above the final position on top of foot latch rest for both positions.

        iii. When the near point fits properly and the far point is too tight, shorten the crank-eye, and shorten the connecting rod clevis.

        iv. When the near point fits properly and the far point is too loose, lengthen the crank-eye setting and lengthen the connecting rod clevis.

        v. When the far point fits properly and the near point is too tight, shorten the crank-eye settings and lengthen the connecting rod clevis.

        vi. When the far point fits properly and the near point is too loose, lengthen crank-eye setting and shorten the connecting rod clevis.

8. If all the foregoing adjustments were made as specified, see Track Standard Section 17.5, 17.6, and 17.6.8 for further details.

Recommended Method 3500-7: Switch Point Guard Adjustments

Switch point guards periodically require adjustment due to wear on the guard bar. The following procedures should be followed as to when and how to make the adjustments.

Note: When making adjustments, ensure that the distance from the gauge side of the stock rail to the wear face of the switch point guard is never less than the initial installation dimension given for each type of switch point guard. Dimensions that are less than those mentioned above could cause a wheel-climb derailment.

There are three types of point guards. The following describes the method to follow for adjustment:

1. Western Cullen Hayes FM series II Switch Point Guards:

   a. When to Adjust:

      On a new installation the distance from the gauge side of the stock rail to the face of the wear bar is 3-15/16”. When this dimension measures between 4-3/16 to 4-1/4” the guard bar must be adjusted inwards.

   b. How to Adjust:

      To adjust the guard bar, unbolt the 6 bolts that hold the adjustment inserts in place. Rotate the adjustment inserts so that the thicker side of the adjustment insert is closest to the stock rail and the narrower side of the adjustment insert is furthest away from the stock rail. Check that the distance from the gauge face of the stock rail is between 3-15/16” to 4-1/8”. If so re-bolt the 6 bolts that hold the guard bar in place and recheck the stock rail to guard face dimension.

   c. Note:

      The Western Cullen Hayes switch point guard only has 1 adjustment of 1/4” after the initial installation.

Adjustment beyond that is not possible and a new wear bar will be required.

2. Nortrak Switch Point Guards

a. When to Adjust:

On a new installation the distance from the gauge side of the stock rail to the face of the wear bar is 4”. When this dimension measures between 4-1/4” to 4-5/16” the guard bar must be adjusted inwards.

b. How to Adjust:

To adjust the guard bar, unbolt the 3 bolts that hold the guard bar in place. There are adjustment holes offset¼” from the initial (centre) hole. Move the guard bar to the left or right depending on which adjustment is being made. Check that the distance from the gauge face of the stock rail is between 4” to 4-1/8”. If so re-bolt the 3 bolts that hold the guard bar in place and recheck the stock rail to guard face dimension.

c. Note:

The older Nortrak switch point guards have 2 adjustments of 1/4” each after the initial installation. Adjustment beyond that is not possible and a new wear bar will be required. The newer switch point guards have a wear face on both sides of the wear plate and can be flipped to give a total of 6 positions of wear (e.g. 6 – 1/4” adjustments).

3. Abex or ABC Rail Switch Point Guards

a. When to Adjust:

On a new installation the distance from the gauge side of the stock rail to the face of the wear bar is 4”. When this dimension measures between 4-1/4” to 4-5/16” the guard bar must be adjusted inwards.

b. How to Adjust:

To adjust the guard bar, unbolt the 2 nuts and washers that hold the guard bar in place (The bolts are welded to the top of the wear plate, so the nuts must be removed from the underside). There are adjustment holes offset ¼” from the initial (centre) hole. Lift and move the guard bar to the left or right depending on which adjustment is being made and insert bolts into these holes. Check that the distance from the gauge face of the stock rail is between 4” to 4-1/8”. If so re-bolt the 2 bolts that hold the guard bar in place and recheck the stock rail to guard face dimension.

c. Note:

The Abex or (ABR rail) switch point guards have 2 adjustments of 1/4” each after the initial installation. Adjustment beyond that is not possible and a new wear bar will be required.

Section 14 Crossings

14.1. At-Grade Rail-to-Rail Crossings

1. For railway diamonds, follow the same procedure for turnouts in Track Standards Section 13
2. Crossings will be installed according to the plans supplied for each crossing.
3. Install continuously insulating joints at all diamond crossings.
4. Jack and lifting slings should be used under the diamond insert, not under the legs.
5. Avoid damage to the diamond insert when handling, placing and lifting.
6. Installation of guard rails in advance of the rail crossing will be at the discretion of the CM Senior Manager of Track and Structures.
7. Subgrade under rail crossings must be well drained. Clean crushed rock ballast will be kept well tamped so that the surface of the frog is maintained at a uniform grade with the approaches. Only approved ballast shall be used.
8. Rail crossings must be fully bolted. All bolts will be provided with spring or hardened flat steel washers and will be kept tightened to the torque shown in Table 27 and Table 28 of Track Standard Section 13.4. Use the correct diameter and bolt length. See Track Standards Sections 13.2 and 13.3 for further details.
9. Manganese castings will:
    a. Be ground and slotted as per Track Standard Section 13.4.17. Product warranty requires that this be documented.
    b. Be welded if the tread is worn down 3/8 in. (10 mm) or more below the original contour

i. 3/8 in. below the level corners where the raised diamond crossing corner pads have been ground off

ii. If worn more than 3/8 in. below this level, limit operating speed to 10mph

c. If of a reversible type, be reversed or transferred between corners as needed, to equalize wear.

10. Flange-ways will be maintained:

a. With a width no less than 1½ in. (38mm).

b. With a depth no less than 1-3/8 in. deep (35 mm) in Class 1 and 1½ in. in Class 2 and above track, unless designed specifically as a flange bearing frog.

11. Movable point crossings will be adequately lubricated with an approved lubricant.

12. Rail crossings will be kept free of snow, ice and other obstructions.

13. Rail crossings ties will be sound and firmly tamped for the entire length of the tie on both routes of the crossing.

14. All rail crossings will be adequately protected at all times with spare components to ensure continued operation. One full rail crossing will be available as a spare.

14.2. At-Grade Road Crossings

1. Before any maintenance or construction work that can affect signals can begin within a road crossing or crossing approach protected by an automated crossing warning system, the responsible S&C employee will be contacted and will protect the crossing according to prescribed S&C procedures. See Track Standards section 22.3 for full details.

a. When the road crossing is deactivated, the employees must have a clear understanding of the means of protection utilized to ensure trains do not operate unprotected over the crossing.

b. In the event that this protection requires manual flagging, this protection shall not be removed until notified by the responsible S&C employee that the road crossing has been reactivated.

2. Before any maintenance or construction work can begin on a road crossing, advise road authorities and emergency services with as much advance notice as possible of anticipated traffic delays providing expected times and durations of closures. Plan for detours and other means to handle emergency situations if they should occur.

3. Road crossings must comply with the Transport Canada Grade Crossing Standards.

4. Applications from outside parties for road crossings should be directed to the Director of CM who will ensure that all legal, financial, and other Railway requirements are met before a crossing is approved or constructed.

5. Road crossing shall not be constructed, widened or relocated without prior approval of both the Director of CM and Transport Canada.

6. When an agreement has been signed and filed for the construction of a new road crossing, the track is to be prepared for the construction of the crossing and the installation of planking or road crossing surface material as directed by the CM Senior Manager of Track and Structures. Appendix U – Crossing Surfaces and Recommended Method 2700-0: Construction and Reconstruction of Grade Crossings in Wood and Concrete Tie Territories contains guidelines for the selection of crossing surface.

7. New private road crossings must be covered by the Railway’s standard form of contract or license agreement before the crossing is constructed and put into service, unless the requesting party can satisfactorily demonstrate that they are otherwise entitled to a crossing under an applicable statute, deed covenant or other prescriptive right. In addition, private road crossings must not be converted to public road crossings except in accordance with applicable laws and regulations, and not until a formal agreement between the Railroad and the Public Authority accepting responsibility for the roadway has been signed and filed with the Metrolinx Legal Department.

8. The railway is responsible for the physical maintenance of the surface of the traveled roadway between the rails and for a distance of 5 ft. (1,524 mm) outside of each rail for unrestricted/public road crossings. However costs may be recoverable or shared as per Regulatory Order, formal agreement, or License Agreement.

9. All applicable signage (cross-bucks, whistle signs, etc.) shall be installed in accordance with the Standard Plan and the Transport Canada Grade Crossing Standards. An emergency notification sign shall be affixed to all of the signposts or signal masts or signal bungalows at unrestricted/public road crossings and the signs shall also show the exact milepost.

10. When an unrestricted/public road crossing has been granted approval for the elimination of whistling, Prohibited Whistle (anti-whistling) Signs shall be installed in lieu of Whistle Signs and in accordance with the Standard Plan.

11. At-grade road crossings can be classified as either Unrestricted or Restricted crossings.

    a. An Unrestricted Crossing is any public grade crossing or a grade crossing whose road is one of the following:

        i. A recreation road or trail maintained by a club, association or other organization;

        ii. A road of a commercial or industrial establishment, including a business operated from a residential or farm property, that is used in connection with the establishment by persons other than the employees of the establishment;

        iii. A road that serves three or more principal residences;

        iv. A road that serves three or more seasonal residences access to which is not controlled by a gate equipped with a lock;

        v. A private road that connects two public roads; or

vi. A private road maintained by a natural resource company, such as a company involved in forestry or mining activities;

b. A Restricted Crossing is any crossing that is not included in the above definition of an Unrestricted Crossing.

12. Private Agreement Crossings are crossings established under license-agreement between the Railway and an outside party. These road crossings must be covered by the Railway's standard form of contract or agreement before the crossing is constructed and put into service.

13. The view in both directions for vehicles approaching the track shall be kept clear with vision clearance triangles in accordance with the Transport Canada Grade Crossing Standards

14. Rails, planking, spikes, etc. in crossings shall be checked periodically to make sure they do not present a hazard to the roadway or railway traffic. If a hazard exists, appropriate action must be taken to correct the condition.

15. Track surface, line and gauge at crossings shall be properly maintained.

16. Flange-ways at crossings shall be kept clear of dirt, sand and ice and other obstructions.

14.3. Construction of Roadway Crossings

1. Drainage is of primary importance to both the track and highway roadbed. The removal of water will aid in the stability of the subgrade and its ability to carry the applied loads. Culverts under road crossings and especially culverts running under the track at crossings will be kept clear and free flowing.

2. Surface ditches shall be installed (or the existing ones cleaned out) so that water is directed away from the track at each quadrant. If this is not possible, subsurface drainage connected to a storm drainage system should be installed.

3. If the grade line of the roadway slopes towards the crossing, surface water should be intercepted prior to reaching the crossing and discharged laterally from the roadway. This can best be accomplished by the introducing of a slight swale in the roadway, prior to the crossing, with a crown in the road surface to aide in runoff.

4. This crown must be run out prior to reaching the crossing. If the roadway has curbs, then catch basins connected to a storm water system should be installed.

    a. Liaising with the road authority will be required to achieve the above.

5. On side hills where the roadway slopes towards the track and the road surface is unimproved (not paved) it is often necessary to install a catch basin with metal grating for the full width of the roadway on the uphill side of the grade crossing in order to intercept runoff water which carries mud, silt, gravel, etc. Without such a basin this material will wash into the ballast and soon foul the track in and around the crossing.

6. The crossing shall be excavated to 5 ft. (1,524 mm) outward from the nearest rail and a minimum of 60 feet (18.3 m) either side of the crossing. This excavation should be such that 12 in. (305 mm) of clean, free draining ballast can be installed under the ties spaced at 18 in. (457mm) centres through the crossing or as recommended by the crossing surface manufacturer (when using concrete, rubber, or treated wood panels).

    a. For crossing rehabilitations, the excavation of the existing ballast shall only be to 9 in. (228 mm) below the bottom of tie.

7. The depth of excavation should not be below the depth of the sub-ballast as to do so would disturb the stability of the roadbed.

8. If site conditions require the over-excavation to the top of subgrade (e.g. excavate both the ballast and sub-ballast) clean, well graded granular sub-ballast material shall be placed to a minimum depth of 12 in. (305 mm), and compacted to a 98% modified Proctor compaction

density prior to the addition of the 9 -12 in. (228 - 305 mm) of ballast under the tie.

9. The ballast must conform to Track Standard Section 11

10. At the ends of crossings, care should be taken to limit the width of the ballast shoulder section to that of a standard section so as to prevent fouling and water retention.

11. Modification of the length and location of crossings must not be made without the written approval from the CM Senior Manager of Track and Structures.

12. Emergency Notification Signs will be affixed to all sign posts or signal masts of public crossings. The sign will show: subdivision name, mile post location, and contact phone number.

13. Ties must conform to Track Standard Section 9 .

    a. Standard length track ties are acceptable through restricted crossings only (farm and private).

14. Crossing ties must be fully tamped (including centre tamped), stabilized and the track lined and surfaced to the desired elevation.

15. During crossing construction and rehabilitation, new rail shall be installed.

    a. Fully Head Hardened rail shall be used for crossings located in curves unless otherwise authorised by the CM Senior Manager of Track and Structures.

16. The new rail to be installed through the crossing shall be joint free for sufficient length so as to extend either side of the crossing at least 25 ft. (7.6 m).

17. All joints through the crossing area shall be flash butt welded.

    a. Thermite welds are not permitted within a crossing.

18. Where insulated joints are required, they shall be installed as per Track Standard Section 5.3.

19. When preparing the rail for the crossing, ensure that the bonded insulated glued joints are welded to this rail in order to remove a joint from the vicinity of the crossing and prevent pumping per item 16.

20. The rail weight and section to be installed shall be the same as the rail section for that portion of the subdivision. However, in no case should the weight of rail installed in a crossing be less than 115 lb. RE.

21. Tie plates shall be forged type (such as MSR) for the full crossing surface and fully spiked and lagged.

    a. Approval from the CM Senior Manager of Track and Structures can be given to use 14-inch double shoulder plates.

        i. Plates shall be fully spiked as per Track Standard Section 10.4, spiking pattern number D (Appendix R – Spiking Patterns) for the full crossing panel length.

            - The gauge side pin track spike may be removed to accommodate the proper seating of the rail seal.

        ii. The track shall be anchored as per Track Standard Section 10.2 including through the crossing.

22. The appropriate rubber rail seal shall be used to accommodate the rail anchors. Tie plates shall conform to Track Standard Section 10.1 and 14.3.21.When using rail clips the appropriate rubber rail seal shall be used. The manufacturer's instructions should be followed for the installation of this flange-way (rail seal) material.

23. Where asphalt crossing surfaces are used, the rubber rail seal product shall be secured to the rail via an approved fastening device in every tie crib. Rail seal shall be ended in a crib area, clipped, and the ends sealed in with asphalt. Asphalt shall extend to the edge of the rail seal.

24. Where spikes are used they shall be six inches in length (152 mm).

25. Where timber tie screws are used they shall be as per Standard Plan GTS-1315, 6-1/2 in. (165 mm) in length and heat-treated.

26. Cellular confinement (sometimes called geowebs and geogrids) may be used where the subgrade of the crossing is particularly soft and is prone to pumping, such as swamp or muskeg locations. They may also be used in other locations where the bearing capacity of the soil is insufficient to sustain the applied highway and railway loading. This can be determined by indications of either excessive water in the soil or if a heel can be pressed into the subgrade. Consideration should then be given to using cellular confinement cells. The CM Senior Manager of Track and Structures should be contacted for advise on where and which type to use.

27. Filter fabrics are not recommended for grade crossings except in exceptional cases, as directed by the CM Senior Manager of Track and Structures. Research has shown than most fines in ballast are either air borne, washed in by water or simply the result of ballast degradation under load. Having a filter fabric under the ballast traps the fines in the ballast.

28. There are five categories of crossing surface length dimensions. The following are the minimum lengths of crossing surface, as measured at right angles to the centre line of the roadway. Note that the travelled portion of the roadway includes sidewalks.

    a. Where the traveled portion of the roadway has no shoulders then the crossing surface must extend 20 in. (0.5 m) beyond the traveled portion of the roadway on both ends of the crossing.

    b. Where there is a shoulder (paved or unpaved) beyond the traveled portion of the roadway then the crossing surface must extend 20 in (0.5 m) beyond the shoulder on both ends of the crossing

    c. Where there is sidewalk within 3 ft. (1 m) of the vehicular portion of the roadway (with or without curbs) then the crossing surface must extend 20 in. (0.5 m) beyond the sidewalk on both ends of the crossing.

d. Where there is a sidewalk within 3 ft. (1 m) of the shoulder of the vehicular portion of the roadway (with or without curbs) then the crossing surface must extend 20 in. (0.5 m) beyond the sidewalk on both ends of the crossing.

e. Where there is a sidewalk adjacent to either the vehicular portion of the roadway or the shoulder but separated by more than 3 ft. (1 m) then the roadway-crossing surface may be separate from the sidewalk- crossing surface, but the crossing surface must still extend 20 in. (0.5 m) beyond either the vehicular portion or shoulder portion of the roadway and sidewalk as per item a or b above.

   i. If a gap is to be left in the crossing surface this must be approved in writing prior to the work by the CM Sr. Manager of Track and Structures.

29. At newly constructed or reconstructed public or unrestricted crossings, the crossing surface shall:

   a. Meet the requirements of Transport Canada Grade Crossing Standards

   b. Have a minimum flange-way width of 2-5/8 in. (65 mm)

   c. Have a maximum flange-way width of:

      i. 3 in. (75 mm) for public sidewalks, paths, or trails designated by the Road Authority for use by persons using assistive devices; or,

      ii. 4 ¾ in. (120 mm) for all other crossings.

   d. Have a minimum flange-way depth of 1-7/8 in. (50 mm).

   e. Have a maximum flange-way depth of:

      i. 3 in. (75 mm) for public sidewalks, paths, or trails designated by the Road Authority for use by persons using assistive devices; or,

ii. No limit for all other crossings.

30. Outer flange-ways are not permitted, except at private and construction crossings not designated as a route for persons using assistive devices

31. The use of rail laid on its side, often called a 'mud rail', is NOT permitted.

32. The crossing surface shall be constructed and maintained at the same elevation as the rails for unrestricted crossings.

    a. At no time shall the top of rail be more than ½ in. (13 mm) above or ¼ in. (6 mm) below the crossing surface at crossings designated for use by persons using assistive devices

    b. For all other crossings, the top of rail shall never exceed 1 in. (25mm) above or below the crossing surface, and immediate road resurfacing is required if this condition is found.

33. Crossings other than planking or asphalt shall have deflectors for dragging equipment installed.

    a. Asphalt or poured in place concrete crossings shall be sloped down at 30° at the ends to the tie surface so as to create a natural deflector.

    b. Planked crossings shall have ends cut at 30° so as to form a bevel or taper that will act as a deflector

34. Concrete panel and rubber panel crossings shall have ballast in the cribs filled to ¼ in. (6 mm) below the top of tie to ensure that ballast in not dragged between the tie and the panels.

35. The following requirements shall be followed for the construction of all new unrestricted crossings:

    a. The planking and/or other road surface shall be centred on the traveled portion of the roadway and conform to the minimum guidelines outlined in Transport Canada Grade Crossing Standards

    b. Planking and/or other road surface will extend for a distance of at least 20 in. (0.5 m) from the outside of each rail.

c. Approaches to the track shall be on a smooth grade, with no abrupt breaks, so that low clearance vehicles pass over the crossing without impacting rails or the surface of the crossing.

d. Unless otherwise directed by the CM Sr. Manager of Track and Structures, unrestricted crossings shall have a road approach gradient not exceeding 2% for 26 ft. (8 m) extending from the outside rail of the crossing or crossing panel, and not greater than 5% for the 33 ft. (10 m) beyond.

e. Approaches to the track for sidewalks, trail or path shall have an approach gradient not exceeding 2% for 16 ft. (5 m) from the outside rail of the crossing or crossing panel, unless designated by the road authority for use by persons using assistive devices then the approach grade shall not exceed 1% within the same distance.

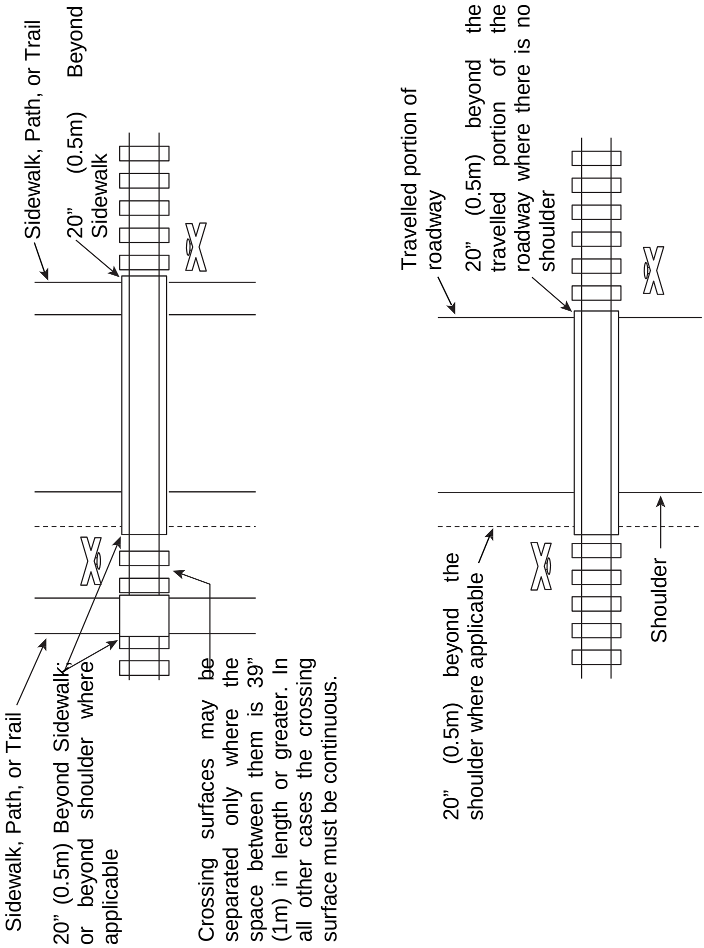
36. The crossing surface shall be chosen based on the requirements identified in Appendix U – Crossing Surfaces.

a. This appendix also identifies the estimated life span of each crossing surface type.

b. The selection of the crossing surface should be done in cooperation with the road authority. In many cases the road authority will be financially responsible for the cost of the crossing surface.

37. Where heavy vehicles operate on long descending approaches, increase stopping sight distances accordingly.

38. Refer to Transport Canada Grade Crossing Standards for further details on roadway grade crossings, stopping distances, and sightlines.



Notes:

1. The minimum width of grade crossing surface for public roads for vehicle use is 26 ft. (8 m) measured at a right angle to the centreline of the roadway.
2. The minimum width of the grade crossing surface for a sidewalk, path, trail, or any other route for a pedestrian, or for use by a pedestrian using an assistive device is 5 ft. (1.5 m) measured at right angles to the centreline of the sidewalk, path, trail, or route.

Figure 24. Transport Canada Grade Crossing Surface Requirements

14.4. Crossing Surfaces

1. The following are a few examples of grade crossing surfaces that are available and a brief description of each:

   a. Full Depth Planking

      A crossing surface consisting of 10 in. (254 mm) wide planking laid parallel to the rails over the ties. Planking is placed between the rails and on the outside of each rail over top of filter fabric. This is a very common type of crossing surface especially in rural areas. The centre plank must be cut to fit to accommodate flange-way material

   b. Sectional Treated Timber

      A crossing surface consisting of prefabricated treated timber panels approximately 8 ft. (2.44 m) long. Usually two panels form the surface between the rails placed on filter fabric. These are usually secured to the ties by lag screws. To be used only when approved by the CM Senior Manager of Track and Structures

   c. Bituminous (Asphalt)

      A crossing surface consisting of an asphalt surface over the entire crossing area. This asphalt (hot mix) is laid in three layers parallel to the crossing and roller compacted. The depth of asphalt shall be for the full depth of the rail. Asphalt must not be placed without an approved rubber rail seal product installed and properly attached on the gauge and flange side of both running rails.

   d. Steel Framed Concrete Panels

      A crossing surface consisting of precast concrete panels in a steel frame. The panels come in various widths such that one panel fits between the rails and one panel fits on the outside of each rail. A rubber rail seal product is installed on either side of each rail to form the flange-way. The panels are removable for maintenance purposes as they are secured in place by lag screws.

e. Full-Depth Rubber Crossing

This crossing surface consists of molded virgin rubber panels with / or without steel plate reinforcing. These panels are installed so that they extend from web of rail to web of rail creating their own watertight flange-way. There is an exterior panel of the same design that is installed on the outside of each rail. These panels are also removable for maintenance purposes. The panels are secured by lag screws. Where crossings include a sidewalk or pathway, the sidewalk / pathway shall be paved with asphalt.

2. If heavy salting is used, an alternate crossing surface to concrete should be considered. In any case, if concrete is selected, ensure that the concrete is coated with a sealer to prevent salt attack. This sealer may have to be reapplied annually or as required to increase the longevity of the crossing surface.

3. Dirt and/or gravel crossings shall not be used.

14.5. Destressing at Roadway Crossings

1. This standard applies only if at least one of the installed lengths of rail exceeds 60ft. (18m).

2. Prior to cutting the rail ensure that the rail anchors for 200 ft. (61 m) in each direction from the crossing are tight to the ties. If they are not, adjust the anchors so that they are tight against the ties.

3. Next, make reference marks on the field side of the rail on the web only where the cuts that are to be made. Starting at the reference marks and at approximately 50 ft. (15 m) intervals thereafter for 400 ft. (122 m), make match marks on the rail on one side of the crossing only. Ensure that the match marks start on the base and onto a tie plate of an unanchored tie. Ensure that the match marks are made with paint stick pen and are straight.

a. At the discretion of the CM Sr. Manager of Track and Structures, both sides of the crossing may require match marks and destressing. Prior to any work at a roadway crossing, this direction should be requested in writing.

4. Prior to cutting the rail, measure and record the distance between the reference marks on each individual rail (how much rail is cut out on each leg include the distance from rail ends to the reference marks).

5. After removing the old rail, measure and record on the rail and on paper the amount the remaining rail ends have contracted (pulled back). This is the amount of rail added (measure and record the distance between the reference marks). If the original distance is less, it is not necessary to include this number in your calculations.

   a. Note that this can also be found by measuring the difference between the match marks.

6. Make all welds at the crossing prior to de-stressing.

7. The following procedure shall be followed for destressing at crossings:

   a. Follow the requirements of Track Standard section 4.9.

   b. At the end(s) of the crossing with the match marks, measure out 400 ft. (121.9 m).

   c. Cut the rail in the middle approximately 200 ft. (60.9 m).

   d. Remove the rail anchors/rail clips for the 400 ft. (121.9 m).

   e. Calculate the amount of rail to be removed by using the CWR Rail Adjustment Chart. Add to this amount to any rail added when the panel was installed (see reference marks) and 1 in. (25 mm) for welding; this will be the amount of rail that will need to be removed. The distance to either heat or pull the rail at the end will be this amount less the one inch for welding. If heat is used, check match marks to insure expansion is present throughout the 400 ft. (121.9 m) unanchored section.

i. When destressing one side of the crossing only, use a rail length of 400 feet plus 100 ft. (30.48 m) or the crossing length, whichever is greater, for the crossing.

ii. When destressing both sides of the crossing, use 400 ft. (121.9 m) plus half the length of the crossing panel.

8. Make the thermite welds. After weld has cooled reapply the 400 ft. (122 m) of anchors as per Track Standards section 10.2.

9. Recommended Method 3205-2B: Destressing at Roadway Crossings provides an example of destressing at highway crossings.

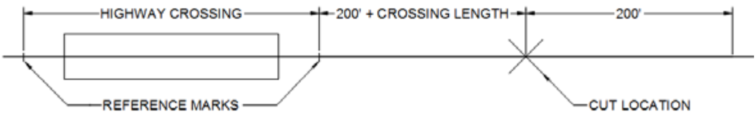


Figure 25. Destressing one side of the crossing only

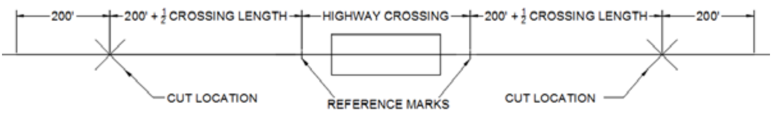


Figure 26. Destressing both sides of a crossing

10. Cut and pull halfway through the 400 ft. (122 m) section, at the x marks in the preceding figure, with all anchors removed on the main track; leave all anchors and clips on crossing.

Recommended Method 3205-2B: Destressing at Roadway Crossings

Example

A crossing is being rehabilitated and new rail panel installed through the crossing. 110 ft. of rail will be replaced, in a location where the CM Sr. Manager of Track and Structures has determined that only 1 side is required. The rail temperature at time of destressing the crossing rail was 60°F. The reference marks are now 1/4” further apart. What is the required rail expansion?

Temperature differential	40°F.	(PRLT – 60)
Length of rail removed	110 ft.	
Adjustment for 200 ft. gap	0.64 in.	(200*40*0.00008) (use 5/8 in. for tables)
Adjustment for crossing length	0.352 in.	110 ft. > 100 ft. therefore use 110 ft. (For table 3/8 in.)
Adjustment for crossing panel	1.632 in.	(0.64” + 0.64” + 0.352”) (for table 5/8” + 5/8” + 3/8” = 1-5/8”)
Additional adjustment for steel added	¼ in.	Reference marks were observed to be ¼ in. further apart.
Total adjustment	2.882 in.	(1.632+1/4+1) 1 weld is 1 in. (for table 1-5/8” + 1/4 + 1” = 2-7/8”)

Total adjustment required is 400 ft. for the unanchored zone (200 ft. + 200 ft.) plus add the greater of the length of the crossing or 100 ft. In this case the length of the crossing panel is 110 ft. therefore we use a total of 510 ft.

Cut 2.882 in. or 2-7/8 in. of the rail depending on calculation method used, and pull or heat to a 1 in. gap for final welding. Weld and re-anchor.

14.6. Construction/Temporary Crossings

1. All temporary construction crossings must be approved by the CM Senior Manager of Track and Structures.
2. The crossings shall be constructed per Track Standard Section 14.3 and Appendix V – Temporary Construction Crossings.
3. A condition assessment of the existing infrastructure must be completed by a qualified Track Inspector.
4. Filter fabric shall be placed under the crossing surface covering the entire ballast section.
5. Where a construction crossing is built in multi-track territory, the ballast in between the adjacent planked crossings shall be protected by filter fabric and covered with a compacted granular material to create a smooth running surface.
6. The crossing surface shall consist of:
    a. 7 x 10 in. planks for all rail sizes except for 100 lb rail where 6 x 10 in. planks shall be used.
        i. 8 x 10 in. planks may be used for 136RE rail.
    b. Planks on both sides of each rail with granular material placed in the centre. This type of crossing is to be used for low traffic temporary crossings only, at the discretion of the CM Senior Manager of Track and Structures.
    c. Planking shall be installed parallel to the rails over the ties. (7 planks are used per track) Planking is placed between the rails and on the outside of each rail. If a flange-way material is used then the centre plank must be cut to fit.
    d. 3 – 12 x ½ in. lag screws and washers shall be used per plank. Lag screws shall be staggered between each plank to avoid splitting the track tie.

e. Flange fillers shall be used on both the gauge and field sides.

7. Crossings shall have:

    a. Approach grades such that they are suitable for the intended use, and adequate sightlines are available;

    b. A crossing surface of suitable material extending at least 20 in. (0.5 m) beyond the travelled width on both sides measured at right angles to the temporary access; and,

    c. Be of an overall safe width suitable for the use intended.

8. Crossings shall be cut at the ends as to form a bevel or taper at 30° to the rail, that will act as a deflector.

9. Temporary crossings in concrete tie or steel tie territories shall be lagged into Grade #2 hardwood ties slid under the base of the rail and spiked to the rail, similar to that of a timber tie, at a regular spacing within the ballast profile, and pre-drilled.

    a. The crossing timbers must take into account the use of elastic clips and/or anchors.

    b. Upon removal of the crossing the steel ties must be fully surfaced with a mechanical tamper.

10. Heavy use construction crossings shall be replaced every 3 years or as required. During replacement, the rail, ballast, tie, and fastener condition will be inspected and replacement may be required.

11. Flange-ways shall be kept clear at all times.

12. Where anchors are removed to facilitate the installation of the construction crossing, the approaches to the crossing shall be box anchored at every tie in 200 ft. (60.9 m) in either direction.

13. All new construction and temporary crossings will be outfitted with lockable fence gates protecting the full width of the crossing.

14. Each gate shall include padlock fixing points in the closed position.

15. Fence gates shall be installed such that the swing cannot foul the tracks.
16. All locks to be used shall be approved by the CM Senior Manager of Track and Structures.
17. Barrier type gates must be approved by the CM Senior Manager of Track and Structures.

14.7. Temporary Planking of Tracks

1. All temporary planking of tracks must be approved by the CM Senior Manager of Track and Structures.
2. Tracks requiring planking for construction purposes shall be constructed as per Track Standard Section 14.6 and Appendix V – Temporary Construction Crossings.
3. A condition assessment of the existing infrastructure must be completed by a qualified Track Inspector.
4. Defective ties must be replaced prior to planking.
5. Filter cloth is required between Ties and planking.
6. Where planking of multiple parallel tracks in multi-track territory, the ballast in between the adjacent planked tracks shall be protected by filter fabric and covered with a compacted granular material to create a smooth surface.
7. It is the responsibility of the contractor that requested the planking to ensure that the flange-ways are clear of debris at all times.
8. It is the responsibility of the contractor that requested the planking to ensure that the surface of the planking is kept clear of snow and ice and other debris.
9. Tracks that have been planked must be inspected as per Track Standard Section 15 and at least monthly on foot measuring gauge and looking closely at the condition of all components.
10. **Planking MUST be removed at least annually**, for a thorough track inspection, and to complete any repairs required unless otherwise directed by the CM Manager of Track.

11. It is the responsibility of the contractor that requested the planking to ensure that the planks are removed once the crossing is no longer required.

12. Planked tracks must remain anchored as per Track Standards section 10.2.

14.8. Inspection and Testing of Railway Crossing Warning Devices (RCWS)

1. RCWS is defined as Railway Crossing Warning System that consists of:

    a. Flashing light signals with bell;

    b. Flashing lights; or

    c. Automatic bells and gates installed and/or maintained by the Railway.

2. The normal functioning of any rail crossing warning system shall not be interfered with in testing or otherwise, without first taking adequate measures to protect the safety of the public or highway traffic which depends upon the normal operation of such systems.

3. Where track is used less than once per week, testing of road crossing warning systems shall be as directed by the CM Manager of Signals.

4. The person assigned to undertake the test will, when road and railway traffic permits, manually operate the rail crossing warning system for one complete cycle, observing the proper functioning of all visible warning features such as lights, bells, movement of gates, etc. and check for any broken or damaged lenses or other defective parts of the system.

5. If the rail crossing warning system fails to operate or does not operate properly, traffic at the crossing must be protected by flagging immediately. In addition, arrangements must be made by any means available, to advise the Rail Traffic Controller (RTC), S&C Maintainer, and CM Manager of Signals as quickly as possible. If the warning device is for more than four tracks, two flagmen shall be used for flagging protection.

6. Observation of the power “off” or “on” light by the person assigned to make the test is required, and if the light is extinguished or the power is off, the RTC, the S&C Maintainer, and the CM Manager of Signals must be advised promptly and highway traffic protected.

Recommended Method 2700-0: Construction and Reconstruction of Grade Crossings in Wood and Concrete Tie Territories

Example:

Assume that a crossing on a line carrying 10 MGT annually requires rehabilitation. The road authority advises that the average daily vehicle count for this crossing is 10,000 vehicles per day of which 1,000 are trucks. Find the most appropriate crossing surface for this crossing.

First determine the number of car equivalents in thousands per day. There are 1,000 trucks per day and 9,000 cars per day (10,000 - 1,000). To find the daily car equivalents for this crossing take the number of trucks per day and multiply by 100 and add to this number the number of cars per day.

1,000 Trucks x 100 = 100,000

Daily car equivalents = 109,000

Now proceed to the chart in "Appendix U – Crossing Surfaces" and enter from the bottom at 109,000 car equivalents per day and from the right at 10 MGT. The two lines intersect in area 3. Now look under area 3 to determine the crossings best suited for this location. These are as follows:

- full depth (recycled) rubber
- concrete panels with rubber flange-ways

The crossing surface should then be selected from one of the two surfaces listed above. As per the notes in Appendix U – Crossing Surfaces, the concrete panel crossing is preferred unless otherwise specified in writing by the CM Sr. Manager of Track and Structures.

Should this crossing be located in a curve, the crossing surface shall be Asphalt.

Section 15 Track Inspection

15.1. Class of Track

1. The allowable train speed on a subdivision, or portion thereof, shall be used to determine the class of track as per Appendix A – Class of Track.

15.2. General Information

1. The Track Supervisor and the CM Manager of Track are responsible to ensure that any person designated to conduct track inspections is qualified and certified as per the requirements in Track Standards Section 1 and must ensure the quality of inspection.

    a. Track inspections must be carried out ONLY by employees who are qualified and certified under the Transport Canada Rules Respecting Track Safety and the GO Transit Track Standards, and under the direction and approval of the CM Senior Manager of Track and Structures.

2. The method chosen for the frequency of track inspections must ensure that the track is safe for operation at the currently authorized speeds. All unsafe conditions found during inspection that cannot be corrected must be properly protected and reported to the CM Manager of Track.

3. As a minimum, all tracks must be inspected in accordance with the schedules listed in the current Transport Canada Rules Respecting Track Safety and or as specified by GO Transit in the Track Standards Appendix B – Track Inspection Frequencies whichever is more restrictive.

4. Each inspection must be made on foot or by riding over the track in a vehicle at a speed that allows the person making the inspection to visually inspect the track structure for compliance with Transport Canada and GO

Transit requirements. The speed for track vehicles must not exceed the speed prescribed in the GO Transit Track Worker Safety Instructions.

5. Mechanical, electrical, and other inspection devices may be used to supplement visual inspection.

6. When riding over the track in a vehicle, the inspector(s) may inspect up to two tracks at one time provided that:

   a. Each main track is actually traversed by the vehicle or inspected on foot on alternate inspections at least once every two weeks, and each siding or crossover is actually traversed by the vehicle or inspected on foot at least once every month.

   b. One inspector cannot inspect more than two tracks at one time and cannot inspect any track centred more than 30 ft. (9.1 m) from the track on which the inspector is riding.

   c. Track inspection records must indicate all track(s) included in the inspection and indicate which track(s) was traversed by the vehicle or inspected on foot. Track inspection records must clearly specify to and from locations by means of identifiable locations.

   d. The inspectors view of the track(s) is unobstructed by tunnels, bridges, differences in ground level, station platforms or any other circumstances or conditions that would interfere with a clear view of all the tracks they are inspecting.

   e. The inspection is not being conducted at night.

   f. All sidings are traversed at least monthly.

7. When the track is occupied by equipment, the inspection will be made by a walking inspection on each side of the track.

8. For yard tracks, if a track is inspected from an adjacent roadway, the next required track inspection must be completed with the track traversed by the vehicle or inspected on foot.

9. Inactive tracks must be secured in a manner that must prevent use by movements and all assets must be inspected before being used to ensure the track is compliant and safe for all movements at the authorized speed.

10. An automated geometry inspection is required as per the requirements of Track Standards section 18.3 and 18.5.

11. The CM Manager of Track and the Track Evaluation Officer have the authority to order additional inspections if they are required for safe railway operation.

12. Additional track inspections are required under the following conditions:

    a. Strong winds, which may cause trees or other obstacles to fall on the track;

    b. Heavy rain, snow or repeated freeze-thaw cycles, which may cause high water, washouts, rock falls, or mud slides;

    c. Extreme hot or cold temperatures, which may cause track buckling or rail breaks

    d. Long dry period combined with track maintenance activities, or during any train operations that may cause fires

    e. After an earthquake

    f. Any other occurrence which may have damaged or disturbed the track structure

    g. Curve movement

        i. When curve movement is evident, the track inspector must continuously monitor signs of rail stress. Stakes shall be applied at the centreline of track at 200 ft. (60.9 m) intervals throughout the curve. Measurement between stakes and base of rail shall be documented on the web of the rail with paint marking the location of each stake.

13. For the purposes of forecasting or initiating extreme weather inspections and conversions of rail temperatures in relation to ambient temperatures:

a. In hot weather, rail temperature is equal to the ambient temperature plus 30ºF (16ºC); and

b. In cold weather, rail temperature is equal to ambient temperature.

14. Track inspectors, at a minimum, will be equipped with the following:

a. Level board and track gauge (capable of measuring point rise);

b. 62 ft. (18.9 m) string line and clamps;

c. 36 in. (914 mm) straight edge and taper gauge;

d. Rail wear gauge;

e. Tape measure;

f. Spray paint, high visibility ribbon, and paint stick marker;

g. Inspection mirror with telescoping handle;

h. Counter – clicker type;

i. Operable GPS unit;

j. The most recent track geometry car report, track chart and curve list; and

k. Semi-automatic pressure switch gauge (if required)

15.3. Frequency of Inspections

1. Minimum track inspection frequencies shall be as outlined in the Transport Canada Rules Respecting Track Safety and Appendix B – Track Inspection Frequencies, whichever is more restrictive.

2. A walking inspection must be completed on all tracks per the inspection frequency outlined in Appendix B – Track Inspection Frequencies, but not less than those in the Transport Canada Rules Respecting Track Safety.

3. Each turnout, railway crossing at grade, moveable bridge lift rail, derail, sliding joint, or other transition device must be inspected on foot as per the

requirements in Appendix B – Track Inspection Frequencies.

4. In the case of track that is used less than the inspection frequency identified in Appendix B – Track Inspection Frequencies, each turnout, railway crossing at grade, moveable bridge lift rail, derail, sliding joint, or other transition device must be inspected on foot before it is used.

5. Walking inspections of public crossings shall be undertaken at least annually, with no more than 12 calendar months between inspections.

6. Compromise bars shall be inspected monthly.

15.4. Methods of Inspection

1. Inspection methods include walking, or riding over the track in a vehicle in accordance with Track Standard section 15.5 and with the recommended inspection checklist tabulated in Recommended Method 3100-0: Track Inspection.

2. Hi-rail unit used for inspection must travel at a speed that allows the person making the inspection to visually inspect the track but not exceeding the speeds prescribed in the GO Transit Track Worker Safety Instructions.

3. Track shall be inspected by train, at least monthly, riding a forward facing unit when possible. Inspection by train will provide a view of the track and right-of-way and will give an indication of ride quality, but is not included in the count of required inspection by Transport Canada.

    a. The Track Supervisor or designate shall inspect their area of responsibility at least once every month from the engine of a GO Transit train. For tracks where GO Trains are not permitted (e.g. the Pearson Sub), the Track Supervisor should ride in the cab of the UP DMU.

4. Walking inspections on class 3, 4, and 5 main track, and on sidings, class 1, and 2 main tracks that carry more than 25 million gross tons (MGT) of traffic per year should be carried out in such a manner that priority

locations and areas of known problems, such as those outlined in Track Standard Section 15.5, are monitored.

5. Walking inspections on class 1 and 2 main track and sidings that carry less than 25 million gross tons of traffic will be performed as directed by the CM Senior Manager of Track and Structures.

6. In addition to the priority locations in Track Standard Section 15.5, Recommended Method 3100-0: Track Inspection provides a checklist that should be followed for walking, routine, and on-train inspections.

15.5. Areas for Inspections

1. The Areas for Inspection are included, but not limited to those found in Table 30.

Table 30 – Areas for Inspection

Rail	
a	Areas with high numbers of fatigue related rail defects
b	Rail defects protected by joint bars
c	Rail damage which has been alleviated by grinding
d	Areas approaching urgent limits for wear. Where rail wear is at the increased monitoring limit, the underside of the rail-head must be physically inspected.*
e	Locations prone to overstressed rail, such as: i. areas where rail repairs have been made (too little or too much rail installed) ii. curves iii. areas of severe rail corrugation iv. areas of heavy brake application (e.g. approaches to PSO locations) – moving rail. v. areas of buffer rails or any joints adjoining CWR vi. areas of steep grades and sags vii. areas of insufficient or damaged rail anchors, or significant rail movement viii. derailment sites or derailment damaged rail
f	Signs of rail moving through anchors
g	Short misalignment and kinks in tangent track.
Joints	
a	Cracked or broken joint bars, especially where this is a high occurrence of such
b	Gauge or top of rail mismatch between rails.

c	Pumping action of joint under traffic
d	Weak tie condition under or surrounding the joint
e	Tie plate movement on top of the tie
Bolts	
a	Loose, bent, frozen broken, and missing track bolts
Plates	
a	Rail base improperly seated in plates
b	Cracked, broken, or damaged tie plates
Fasteners	
a	High cut spikes and broken screw spikes
b	Broken / missing spikes
c	Spiking pattern
Wood Ties	
a	Cluster of defective ties
b	Gauge problem areas with 1/2 in (13mm) or greater
c	Excessive loss of cant (positive or negative)
d	Areas prone to hanging ties, such as insulated joints, road crossings, and bridge approaches
e	Areas of high, missing, or broken spikes or timber tie screws
f	Areas with high dynamic braking such as controlled locations, PSOs, or stations
Concrete Ties	
a	Loose or missing clips or insulators
b	Signs of rail movement
c	Loose or damaged embedded shoulder
d	Signs of rail seat abrasion – excessive cant or gauge, rail movement, insulators missing
e	Areas repaired by the use of Laird Clips
f	Areas with historical clip failure
g	Hanging ties
h	Ties damaged by derailment or cracks in the rail seat or through the embedded shoulders
i	Rail seat abrasion
j	Signs of end splitting
Ballast	
a	Sink holes
b	Mud pumping locations
c	Frost heave locations
d	Areas of weak ballast shoulders
e	Areas where recent program work has left ballast disturbed
f	Adequacy of the ballast section at sags, culverts, ballast deck bridges bridge abutments and locations where vehicles have been driven along the right-of-way or where foot paths may cross tracks

g	Signs of churning ballast.
Roadbed / Slope Stability	
a	Areas historically prone to track geometry problems (surface, line, cross-level)
b	Slope stability problems (slip, rock falls, or mud slides)
c	Slope of subgrade / excavation
Drainage	
a	Areas prone to ponding water (beaver dams, drainage ditches, blocked culverts, etc.)
b	Area of high or increased surface run-off (near forestry operations, industry development, high water tables, etc.)
c	Areas prone to ice build-up under the tie plate
d	Culverts
Transition Areas	
a	Bridge approaches
b	Concrete tie to wood tie transition areas
c	Signs of rail or tie movement
Derailment Areas	
a	Substandard conditions or temporary repairs
b	Monitor until permanent repairs have been completed.
c	Locations of square joints associated with panel installation
Direct Fixation Track	
a	Bolts are properly tightened.
b	Check clips are properly attached and secured; not rusted
c	Significant concrete cracking

* Under Head Inspection

a. It is acceptable to conduct under head inspections with an inspection mirror.

b. Look for cracks that cause head-web separation defects. The indications are:

   i. In the early stage a wavy, wrinkled line appearing in the fillet under the head.

   ii. In mid-stage a small crack will appear along the fillet on either side of the rail head, indicating growth through the web. The crack will progress longitudinally.

c. If any of the above indications are found, the rail shall be replaced immediately.

d. If none of the above indications are found, but rail surface shelling, spalling, and/or corrugation are present, the location must be monitored, until the rail is removed from track.

15.6. Walking Curve Inspections

1. Walking curve inspections require:
    a. Knowledge of the correct superelevation for the curve;
    b. Review of geometry car reports for the locations of gauge, cant, and geometry conditions;
    c. Inspection of both the high and the low rail, noting:
        i. Excessive gauge corner wear, measuring periodically;
        ii. Excessive flattening of the low rail, measuring periodically;
        iii. Adequacy of lubrication on the rail; and
        iv. Proper ballast shoulder and roadbed slope on each side.
    d. Line or surface deviations in the track; and
    e. Signs of gauge widening from rail wear, plate movement or insulator crushing.
2. For walking curve inspections on wood tie territory:
    a. Observe screw spikes and cut spikes for signs of lift, breakage, or rotation;
    b. Tap plates, spikes, and screw spikes with a lining bar for signs of loose or broken fasteners;
    c. When a broken screw or spike is found, perform a detailed inspection of the surrounding area to determine the extent of the broken fasteners;
    d. Note any cracked, broken, or damaged tie plates; and
    e. Note plate pushing or plate cutting with excessive rail cant – both inward and outward.
3. For walking curve inspections on concrete ties:
    a. Inspect when ties are not covered with snow or ice.

b. Walking along the field side noting the condition of the clips, pads, insulators, and cast shoulder.

c. Note any outward rail movement or other signs of rail seat abrasion.

15.7. Joint and Joint Bars

1. Each joint bar in CWR shall be inspected on foot each calendar year at the frequency indicated by class of track and annual tonnage in Appendix B – Track Inspection Frequencies in Table 45 and its footnotes. This includes:

   a. Insulated joints in CWR track

   b. Jointed rail track less than 200 ft. (61m) in length between strings of CWR.

   c. Jointed rail track greater than 200 ft. (61m) with joints adjoining CWR

   d. Joints within or adjacent to switches, rail crossings and lift / expansion rails are exempt from periodic joint inspection provided that they are inspected in the monthly walking inspections for these devices.

2. Joints requiring on foot inspection are any joints located in a CWR string or any joint in a segment of rail between CWR strings that is less than 200 feet (61 m) apart. When there is a segment of jointed rail greater than 200 feet (61 m) between CWR strings only the joints adjacent to the CWR must be inspected.

3. Walking inspections must be completed on all jointed tracks and all concrete tie curves 4 degrees or greater per frequencies outlined in Appendix B – Track Inspection Frequencies.

4. If any of the following conditions contained in Table 31 are found at a joint in CWR and are not a regulatory defect and cannot be corrected immediately, on-foot follow up inspections will be required until such time as the condition is corrected.

Table 31 Rail Joint Conditions and Remedial or Corrective Actions

Rail Joint Condition	Action[1]
Visible cracks in joint bar	Replace bar
Loose bolts	Tighten bolts
Bent bolts	Replace bolts*
Missing bolts[2]	Replace bolts
Tie(s) not effectively supporting joint	Tamp tie(s) Replace or repair tie(s)*
Broken or missing tie plate(s)	Replace tie plate(s)
Deteriorated insulated joint	Replace/repair joint*
Rail end batter (greater than 5/16 in. (8 mm) in depth and more than 6 in. (152 mm) in length measured with a 36 in. (914 mm) straight-edge)	Repair by welding joint or removing rail*
Rail end mismatch reaches limits specified by TC Rules Respecting Track Safety, Part II, Subpart D, IV (see table below)	Replace rail weld or grind
Longitudinal rail movement greater than 2 inches (51 mm)	Adjust rail anchors, tighten bolts, add or remove rail at appropriate time
Wide rail gap greater than ½ in. (13 mm)	Adjust rail gap and secure joint*
Joint vertical movement (profile) that exceeds 75% of the allowable threshold for the designated class of track[3]	Surface joint*
Fouled[4] ballast present in conjunction with joint vertical movement (profile) that exceeds 75% of the allowable threshold for the designated class of track	Surface joint and provide drainage*

[1] Action may also consist of placing a speed restriction or removing the track from service.
[2] A minimum of 2 bolts per rail must be in place at each joint.
[3] Joint vertical movement is the apparent visible movement measured at the joint.
[4] Fouled ballast is defined as ballast that is so contaminated with fines that it contains standing water within the track structure at joints
* Or conduct follow-up inspections every other week until the defects are repaired or removed

5. Jointed and CWR main line track requires on foot inspection of all rail joints on bridges be undertaken at the following frequencies:

    a. Track with less than 10 MGT annually - once per year.

    b. Track with 10 MGT or greater annually - twice per year.

6. Joints can be permanently embedded or temporarily buried:

    a. Permanently embedded joints do not require disassembly or removal of the obstruction to inspect the joint, however, every effort practicable must be made to inspect the visible portion of these joints.

        i. Permanently embedded joints may need to be exposed in order to repair signals defects.

    b. Temporarily embedded or buried locations are locations where ballast, planking or similar material has been placed in the middle or along the tracks. Where CWR joints are buried, wait for the completion of track work before conducting the joint bar inspection. All temporarily embedded joints must be inspected at least annually regardless of track work.

15.8. Ballast Inspections.

1. When performing inspections, be aware of line or surface deviations possibly due to insufficient ballast

    a. Either end of the tie fully exposed or 50% empty cribs of 6 or more consecutive ties coupled with track surface; or,

    b. Alignment deviations that exceed 75% of allowable threshold for designated class of track.

    c. This requirement applies when the ambient temperature exceeds 85º F (29 ºC) or is expected to exceed 85º F (29 ºC) within the next 24 hours. When this combination exists, reduce the speed to the next lower class of track and continue to monitor until repaired. Speed restriction may be removed and monitoring will not be necessary when the ambient temperature drops below 85ºF (29ºC).

2. Ballast must conform to the Track Standards Section 11

15.9. Direct Fixation Track

1. Direct Fixation Track (DFT) is an “open” track-form with nearly all of the major components easily visible and accessible for inspection and maintenance. As compared to traditional ballasted track, DFT is fixed directly to a concrete slab or plinth which eliminates the requirement for ballast and ties.
2. All bolts must be checked that they are tight, as bolts are subject to loosening.
   a. Note that bolts on new construction are particularly prone to loosening, until such time as mating parts wear in and seat to each other.
   b. Bolts are located at rail fastener locations (plates), guard rails, and numerous nuts and bolts in special track work.
3. Elastic rail clips must be regularly checked.
4. Heavily corroded clips must be replaced to avoid the clips from “rusting together” with the rail fasteners (plates).
5. Missing clips must be replaced immediately.
6. Clips subject to constant damp conditions (e.g. in tunnels) or to heavy salting (e.g. through station platforms, rail crossings), must be galvanised.
7. DFT track must be kept clean at all times, in particular in locations of heavy salting.
8. Each Spring DFT track covered track areas near heavy salting locations must be washed off with water to remove any excess salt. This can be done with a firehose and water or other approved method.

9. In heavy sanding locations, the DFT track bed must be cleaned at least annually.

10. When rail begins to wear in the curves, the gauge of the track needs to be adjusted to meet the requirements of the class of track as per Appendix C – Priority Defects and Appendix D – Urgent Defects. Use the provided DFT Fastening Plates to adjust gauge as required.

11. Cracks in concrete are a normal occurrence. Any cracks greater than 1/64 in. (0.4 mm) must be reported to the CM Manager of Bridges and Structures.

12. All rail breaks in DFT must be documented and forwarded immediately to the CM Manager of Track.

13. When a DFT fastener plate is required to be replaced, prior to a new plate being installed, the concrete base must be inspected to determine the cause of the fastener failure.

    a. Any voids found under the fastener plate must be repaired before installing the new fastener plate.

    b. If the anchor insert for the bolts sits above the plane of the concrete, the anchor insert must be ground flush to the concrete surface and then epoxy paint applied to the bare steel.

14. If the anchor insert is found to be defective, it must be replaced.

    a. This is done by core drilling and grouting a new insert in its place.

    b. The new insert must be perpendicular to the bottom plate of the fastener, flush or slightly below the surface of the concrete, and not in contact with the sides of the cored hole.

    c. Any grout to be used must be approved by the CM Manager of Bridges and Structures. It is recommended to use a two component Epoxy grout.

    d. A template must be used as a guide for positioning the new insert.

15.10. Derails

1. Derails shall be inspected on foot and operated and must conform to the requirements in Track Standards Section 10.3.
2. Derail inspection frequency is dictated by Table 46 in Appendix B – Track Inspection Frequencies.
3. When conducting an inspection of a derail the following should be noted:
    a. Derail is of the proper size, type, and fit;
    b. The ties under the derail are sound, fasteners intact, and the tie fully supports the derail;
    c. Lock is present and applied to the derail;
    d. Derail is painted yellow, and clearly visible; and
    e. Derail signs, where required are in place and visible.

15.11. Bumping Posts

1. Bumping posts shall be inspected on foot and must conform to the requirements of Track Standards section 10.7.
2. Bumping posts shall be inspected at the same frequency as derails.
    a. Bumping posts on main track shall be inspected at the same frequency and time as routine track inspections.
3. When conducting an inspection of a bumping post, the following should be noted:
    a. The ties under the bumping are sound and the rails fully supports the derail;
    b. All fasteners are in place and tight.
    c. All supports are in good condition. Bent or damaged elements shall be reported to the CM Sr. Manager of Track and Structures

15.12. Culverts and Drainage

1. General inspections of all culverts and surface drainage conditions will be conducted by track Inspectors in conjunction with track inspections.
2. Culvert inspections are for the purpose of ensuring:
   a. Hydraulic flow can be observed without obstruction upstream and downstream of the inlet and outlet;
   b. Site conditions have not changed in a manner that impacts drainage through assessment of land use and ditch conditions;
   c. The structural integrity of the culvert is sufficient to support track, ballast, and embankment material, and no voids are observed in the ballast or embankment; and
   d. Identification of maintenance that may be required prior to the next inspection.
3. Culverts with a diameter of 10 ft. (3.05 m) or less must be inspected on foot every 5 years.
   a. Increase frequency of inspection upon discovery of issue up to annually.
   b. The CM Manager of Bridges and Structures may specify additional inspection requirements.
4. Underpass pedestrian tunnels or culverts over 10 ft. (3.05 m) require annual inspection with no more than 540 days between inspections.
   a. The CM Manager of Bridges and Structures may specify additional inspection requirements.
5. In the cases where defects are observed, the Manager of Bridges and Structures must be notified promptly, to determine remedial action required.
6. Beaver dams located upstream from the track in streams that flow under or near the track represent a potential hazard. The Track Supervisor must arrange for regular inspections of beaver dams on their territory and take the necessary protective action if conditions are hazardous. On certain territories, an aerial inspection of

dams may also be required in the spring and fall of each year to support ground inspections.

7. An up-to-date list of beaver dams will be maintained on each Track Supervisors territory. The list should include:
   a. The subdivision mileage;
   b. The side of the track on which the dams are located;
   c. The number of dams;
   d. Whether the dams are upstream or downstream;
   e. The distance to each dam from the track;
   f. Remarks regarding the dams;
   g. Water fluctuation; and
   h. The date of the inspection.
8. If it is determined that there is a head of water upstream of the beaver dam that poses a concern to the safety of the railway crossing(s) downstream of the dam, then remove the end portion(s) of dam to draw down water to a safe level. Report all beaver dam locations to the Manager of Bridges & Structures.
9. Additional information is located in Track Standards Section 21.3.

15.13. High Water and Spring Run-Off Inspections

1. Joint inspections between the CM Bridges and Structures group and the Track Supervisor must be completed every Spring, and as required.
2. With the onset of Spring flooding conditions, snowmelt runoff, ice movements and precipitation, the following steps need to be taken to prevent bridge and culvert washouts:
   a. All railroad employees should be on the lookout for water related problems as a component of their regular duties. Concerns should be reported to the CM Manager of Bridges and Structures

b. All employees must report:

i. Inlet conditions:

- Watercourses with lower or higher than normal spring flow discharges. If creek discharges are less than usual or if debris and mud are evident in the flow, an upstream watercourse blockage may exist
- Flow constraints, such as debris building up at the culvert inlet should be removed to restore normal flow through the culvert
- Water ponding at the inlet to a culvert
- Water levels higher on one side of the track than the other side.

c. Track and bridge inspectors must inspect bridges for track alignment and level during the Spring runoff

d. Typical problems experienced by bridges in spring conditions of snowmelt and ice movement are:

i. Scour conditions at substructures (piers and abutments). Eddying or dirty water around the substructure base may be a sign of scouring

ii. Failure of supports (particularly for trestle type bridges) due to ice loads or debris

iii. Loss of substructure support causing subsidence or sway of bridges

iv. Inadequate bank protection during Spring Runoff conditions

v. Failure or poor condition of ice protection measures such as noses on piers or upstream protection structures.

15.14. Gas Welded Rail Inspection Policy

1. This policy shall be in effect from October 1 to March 1 and other times when the ambient temperature is expected to fall below 25°F (-4°C).
2. For main track that contains gas welded continuous welded rail, the minimum inspection frequency is amended as follows:
   a. Three times weekly with at least 1 calendar day between inspections.
   b. The Track Supervisor must make every effort to personally perform at least one inspection per week.
   c. Additional inspections on secondary main tracks and other tracks shall be as directed by the CM Senior Manager of Track and Structures.

15.15. Record of Track Inspections

1. All persons engaged in making inspections will prepare and sign a record of each inspection on the day the inspection is made in accordance with Transport Canada Rules Respecting Track Safety and the GO Transit Track Standards. The report shall be retained for at least one year after the date of the inspection. After this time period, all documentation shall be submitted to CM through GO Transit's document management system.
2. Records must include the following:
   a. The track inspected, including the from and to mileages of the main track and siding inspected
   b. The date of the inspection
   c. Name and employee ID of the qualified and certified inspector
   d. Signature of the qualified inspector
   e. The method of inspection and whether the track was observed walking or traversed by a vehicle
   f. The type of inspection (e.g. regulatory, special, joint bar inspection, etc.)

g. The location and nature of any rail or track defects found including any differences from the requirements of the Transport Canada Rules Respecting Track Safety.

h. The remedial action taken, the date of the action, and signed off by the supervisor who completed the work.

3. The following inspection forms should be used for inspections:

a. Track inspection form for regulatory defects

b. Track inspection form for non-regulatory defects

c. Monthly Yard and Other Track inspection form

d. Monthly Turnout inspection form

e. Detailed Turnout Inspection Form

f. Track Crossing Inspection report

g. Annual Derail inspection form

h. Joint Bar inspection form (jointed track)

i. Joint bar inspection form (CWR track)

15.16. Extreme Cold Weather Inspections

1. Daily cold weather track inspections will be under taken on core lines under the conditions in Table 32.

Table 32 Conditions for Cold Weather Inspections

Track Conditions	**Either Condition Met**	
	Extreme Cold Ambient Temperature	**Rapid Drop in Ambient Temperature**
Susceptible to Cold	< -13ºF (< -25ºC)	>45ºF (>25ºC) in 24 hrs
All Tracks	< -22 ºF (< -30ºC)	

2. Lines shall be considered susceptible to cold weather related rail failure if any one of the following conditions applies:

a. Non-signalled territory.

b. Jointed and/or gas welded rail.

c. Rail of 115 RE weight or lighter subject to rail car gross weight of 286,000 lbs.

d. Rail with a history of frequent defects.

3. Additional track inspections should also be considered during the first “cold snap” of the season.

4. During winter, at times of snow accumulations, watch for signs of screw spike / cut spike failure on curves equipped with rolled plates and 16 inch modified eccentric plates with welded e-clip shoulders. Disturbance of the snow may be evidence of lateral movement of the tie plates due to weaken fasteners and may be accompanied by lifting/canting of the plate.

15.17. Cold Weather Speed Restrictions

1. In areas identified by the CM Sr. Manager of Track and Structures as having rail with a history of frequent defects the following cold weather temporary speed restrictions will be put in place:

   a. When temperature is below -13ºF (-25ºC), all passenger trains shall be restricted to a speed of 60mph or track speed, whichever is more restrictive.

   b. When temperature is below -13ºF (-25ºC), all freight trains shall be restricted to a speed of 40mph or track speed, whichever is more restrictive.

2. Track protected by a ‘cold weather slow order’ must be inspected daily.

15.18. Icing Conditions under Rail

1. During the winter months under snow conditions, inspectors must look for icing between the tie plates and the base of the rail. Progressive ice build-up may cause the rail base to clear the shoulders of the tie plate resulting in wide gauge under loaded conditions. The

condition can be discovered to some extent by looking for a disturbance in the snow along the field side of the high or low rail of a curve. A fresh snowfall may hide this disturbance, making additional checks essential.

2. In locations where ice build-up is likely to occur, snow must be removed and tie plates examined for ice build-up.

3. Icing is most likely to occur where one or more of the following conditions exist:

   a. Hanging ties;

   b. Centre bound track;

   c. High spikes;

   d. Corrugated rail;

   e. High ballast or build-up of engine sand in the tie cribs directly under the rail;

   f. Where CWR was laid above the desired rail laying temperature, which causes CWR strings to cant inward creating space for ice formation between the base of the rail and the top of the tie plate; and/or

   g. Where poor drainage conditions are known to cause ice build-up.

15.19. Hot Weather Inspections

1. Whenever ambient (air) temperature **exceeds 86ºF (30ºC)** or during periods of significant seasonal increase in temperature (i.e. Spring), hot weather track patrols must be undertaken between the hours of 11:00 and 22:00.

2. Hot weather patrols may be suspended if temperatures have stabilized and previous inspections have shown that the track structure is stable and complies with standards.

15.20. Hot Weather Speed Restrictions

1. Hot weather TSOs must be applied on portions of Subdivisions where the temperature threshold exceeds **90ºF (32ºC)** or any one of the following track conditions are known to exist:

    a. Lateral or vertical movement of rail (e.g. “wavy” or improperly seated rail);

    b. Kinky rail that is riding up or out of the tie plates or is crowding the shoulder of the tie plates on curves;

    c. Deviations in alignment;

    d. Movement of ties (e.g. gaps or voids in ballast at tie ends or in cribs);

    e. Rail base not properly seated in the plates;

    f. Insufficient ballast section (e.g. weak shoulders, empty cribs) especially at approaches to bridges, road crossings turnouts, interlockings, sliding joints, and other fixed locations;

    g. Rail running through anchors or spikes;

    h. Churning of ballast caused by tie movement resulting in gauge and line kinks;

    i. “Tight steel” (e.g. areas of frequent dynamic brake application, approaches to PSO’s, bottoms of grades, etc.);

    j. Areas where joints adjoin CWR. Bolts must be inspected for straightness when rail gaps are closed;

    k. Recently completed track work;

    l. Cluster of high spikes and poor ties;

    m. Hanging ties on bridge approaches;

    n. Longitudinal movement of a switch point in relation to stock rail, resulting in improper switch adjustment;

    o. New installations of culverts, turnouts, and road crossings;

p. Rail gaps that are not closed when the rail temperature is 22ºC or 40ºF above the PRLT must be reported to the CM Manager of Track and the Track Supervisor;

q. Spike lining is not permitted in CWR territory except when it is not possible to line the track;

r. Shimming areas must be inspected closely for high spikes and spike killed ties. Anchors must be removed from shimmed track;

s. Particular attention must be paid to curves in CWR territory. When 11" and single shoulder tie plates are used, watch for rail canting to the outside of the curve. The high rail will lift off the tie plate on the gauge side, the low rail on the field side;

t. Particular attention should be paid to welds in curves. Poor alignment of welds will result in heavy, unusual rail wear. Additional excessive forces will be placed on the high rail, causing inside spikes to lift, and track to go out of line;

u. Particular attention should be paid to compromise rail joints and to locations where rail repairs were performed during winter to replace service failed or defective rails;

v. In areas of severe corrugation in curves, attention should be paid to rail creep;

w. Grade instability; or

x. Any other areas having a history of lateral instability, site of derailment, washout, etc., or where Track Supervisors have a concern.

2. When the temperature exceeds the threshold level, a speed restriction of 15MPH below the zone speed/PSO speed or 60 MPH (Passenger) 40 MPH (Freight) whichever is greater must be placed.

3. When deterioration of these conditions are present as listed in this section, a speed restriction of 30MPH (Passenger) 25 MPH (Freight) or less must be placed or track removed from service until repair or adjustment is made.

4. When there are indications that a track buckle may be about to occur, immediately take the following steps to protect train traffic until the condition is corrected:

   a. Place a 10 mph speed restriction; or

   b. Stop traffic, if the situation warrants.

5. This policy does not supersede timetable instructions governing either the operation of unit trains over specified branch lines or the movement of trains on subdivisions equipped with Hot Box Detector talkers broadcasting the ambient temperature.

Recommended Method 3100-0: Track Inspection Recommended Checklist

ITEM TO CHECK	WHAT TO LOOK FOR		
	HI-RAIL	WALKING	TRAIN
Rail	Broken, vertical split heads, crushed heads, engine burns, discoloration, wear.	Broken, vertical or horizontal split heads, rail head surface collapse, crushed heads, corrugation, wear, spalls, shelling, engine burns, rail end batter, discoloration, rust streaks, rail wear, underside of rail head, damage by equipment.	Broken, rough
Bars	Broken	Broken, bent, cracked	-
Bolts	Loose, missing	Loose, missing, bent	-
Washers	-	Missing	-
Tie Plates	Broken, missing	Broken, bent, badly corroded, missing, skewed, installed backwards, improper cant	-
Track Spikes	High, missing	High, missing, bent, loose	-
Rail Anchors	Off, damaged, insufficient	Off, loose, away from tie or plate, damaged, insufficient	-
Hardwood Track Ties	Broken, damaged by equipment	Broken, split, spike killed, plate cut, damaged by equipment, clusters	-
Concrete Track Ties	broken, damaged by equipment	Broken, cracked, centre-bound, loose, worn, or damaged shoulders, skewed, abraded rail seat, damaged by equipment Walk along the field side noting the condition of clips, pads, insulators, and cast shoulder or outward rail movement or other signs of Rail seat abrasion	-

GO TRANSIT RECOMMENDED METHODS

Steel Track Ties	Broken, damaged by equipment	Broken, cracked, bent, loose or damaged clips, heavy corrosion, worn shoulders, skewed, damaged by equipment. Check inspection holes for sufficient ballast.	
Rail Clips	Missing, damaged	Missing, damaged, loose, corroded	-
Insulators	Missing	Missing, worn, damaged, out of position	-
Pads	-	Missing, worn, out of position	-
Ballast Section	Ballast low in cribs or shoulder	Cribs not full, low shoulder, narrow shoulder.	-
Ballast	Pumping, fouled	Pumping, fouled, hanging ties	-
Line	Misalignment	Misalignment	Misalignment, ride quality
Icing Conditions	Ice build-up between base of rail and tie plate, raised spikes, churned ice	Ice build-up between base of rail and tie plate, raised spikes, churned ice chunks , wide gauge	Churned Ice, rough ride-
Surface	Poor surface	Poor surface	Poor surface, ride quality
Cross Level	Poor cross level	Poor cross level	Ride quality
Gauge	Wide / Irregularities, wheel flange marks, raised or tipped spikes, plate cutting or movement Irregularities Change in location of running band on the rail.	Wide / Irregularities, wheel flange marks, raised or tipped spikes, plate cutting or movement Change in location of running band on the rail.	Irregularities, ride quality
Turnouts	Misalignment, components damaged, loose, missing, worn	As per Track Standard Section 17	Ride quality
Railway Crossings (Diamonds)	Misalignment, components damaged, loose, missing, worn	As per Track Standard 17.8	Ride quality
Vegetation	Contacting equipment, restricting visibility, fire hazard, Restricting drainage, contacting wires, fouling ballast, Impeding inspection of fasteners	Contacting equipment, restricting visibility, fire hazard, Restricting drainage, contacting wires, fouling ballast, Impeding inspection of fasteners	Contacting equipment, restricting visibility, fire hazard, Restricting drainage, contacting wires, fouling ballast

GO TRANSIT RECOMMENDED METHODS

Drainage	Ditches or culverts blocked, beaver activity, high water	Ditches or culverts blocked, beaver activity, high water	High water
Slides	Slides, rock falls	Slides, rock falls	Slides, rock falls
Fencing	Damaged, open gates, livestock on R.O.W.	Damaged, open gates, livestock on R.O.W.	Damaged, open gates, livestock on R.O.W.
Clearances	Restricted clearances	Vertical & horizontal restricted clearances	-
Highway and Farm Crossings	Missing or high planks or other surface material, high spikes, obstructed flange-ways, restricted sight lines Warning devices - damaged or missing gates, lenses, bulbs, signs, masts, 1-800 number label Power light.	Loose, missing or high planks or other surface material, high spikes, obstructed flange-ways, restricted sight lines Warning devices - damaged or missing gates, lenses, bulbs, signs, masts, 1-800 number label, power “off” or “on” lights	Ride quality, restricted visibility Warning devices - damaged or missing gates, inoperable
Track Signs	Defective, missing, obstructed, loss of reflectivity	Defective, missing, obstructed, loss of reflectivity	Defective, missing, obstructed, loss of reflectivity

Section 16 Track Geometry

16.1. Track Geometry Maintenance Standards

1. All tracks must meet or exceed the track geometry standards defined in the GO Transit Track Standards and the Transport Canada Rules Respecting Track Safety.
2. Track geometry standards are defined for seven classes of track based on maximum operating speeds for passenger and freight trains.
3. Track Geometry can be measured by IRIS, the Andian car, Light Geometry Inspection Vehicle (LGIV), Heavy Geometry Inspection Vehicle (HGIV), or by hand measurements.
4. Deviations exceeding the minimum safety requirements for track geometry are defined as “URGENT” defects.
    a. When an URGENT defect is discovered, action must be taken immediately to protect the track. Action shall include in order:
        i. repair the defect;
        ii. reduce the speed based on the defect severity; or
        iii. remove track from service.
    b. URGENT defects are to be corrected and signed off within 48 hours of discovery.
        i. Where an URGENT defect reduces speed of track by 3 or more classes, the defect must be corrected and signed off within 24 hours of discovery.
    c. Urgent defect limits are found in Appendix D – Urgent Defects.
5. Deviations approaching Transport Canada Rules Respecting Track Safety minimum safety requirements for track geometry are defined as “NEAR URGENT”

conditions. These are typical 90% of the Transport Canada Urgent defect values.

a. NEAR URGENT conditions are to be corrected and signed off within 30 days of discovery.

6. Deviations exceeding GO Transit's maintenance tolerances are defined as "PRIORITY" conditions.

a. PRIORITY defects are to be monitored for escalation, planned and scheduled for correction. This plan and schedule shall be submitted within 30 days of discovery. Priority defects should be corrected within 90 days or as directed by the CM Sr. Manager of Track and Structures.

b. Priority defect limits are found in Appendix C – Priority Defects.

7. Where a portion of track exceeds the limits defined as "PRIORITY", the condition **must be monitored** until it is repaired within the time period specified in these standards to ensure it does not escalate to an "URGENT" defect.

8. Multiple "PRIORITY" surface or alignment defects shall be considered "URGENT" when:

a. Three or more non-overlapping surface or alignment defects occurring within a distance equal to five times a specified cord length shall be considered URGENT and their limits are defined in Appendix D – Urgent Defects.

9. The following approach is to be used in responding to PRIORITY defects and combinations of PRIORITY defects:

a. Address combinations of PRIORITY defects (defects within 100 ft. (30.5m) of each other) in the following order:

i. Combination defects on curve spirals.

ii. Combination defects on curve body.

iii. Combination defects near changes in track modulus (e.g. near bridges, crossings, turnouts, etc.).

b. address all other PRIORITY defects

10. When unloaded track is measured to determine compliance with this Track Standard the amount of rail movement, if any, which occurs when the track is loaded must be added to the measurement of the unloaded track.

11. Where speed related track geometry defects are detected during track geometry (I.R.I.S.) truck inspections, Appendix E – Allowable TSO for IRIS Truck Defects – Passenger and Appendix F – Allowable TSO for IRIS Truck Defects – Freight may be used to determine the maximum Temporary Slow Order speed to be applied for the seventy-two (72) hour period immediately following the inspection.

    a. If the track defect has not been repaired upon the expiration of the seventy-two (72) hour period, the temporary slow order speed must be revised, restricting trains to a maximum speed that is within the track class allowed by the severity of the defect(s). (See Appendix C – Priority Defects and Appendix D – Urgent Defects).

12. Details of remedial action or temporary slow orders applied **MUST** be recorded on the exception reports, initialled and dated for all URGENT, NEAR URGENT, and PRIORITY defects.

16.2. Track Geometry Conditions

1. Gauge

    a. The maximum allowable deviations for gauge related defects are listed in Appendix D – Urgent Defects.

    b. Standard gauge is 56½ in. (1435 mm) on tangents and curves up to 14°. Refer to Track Standard Section 4.5 for standard gauge of curves over 14°.

    c. The gauge at hotbox detectors and for a minimum of 50 ft. (15 m) in either direction must be maintained between 56½ in. (1435 mm) and 56¾ in. (1441 mm).

d. Gauge shall not be allowed to become greater than 57¾ in. (1,466 mm). If loaded or unloaded gauge has been found to exceed this limit, the track shall be removed from service immediately.

e. Gauge should not be allowed to become tighter (less) than 56¼ in. (1,429mm). *Where gauge is found to be less than 56¼ in. (1429mm):*

i. A Class 5 speed restriction must be placed;

f. A track must be removed from service if the gauge is found to be less than 56 in. (1,422 mm)

2. Change in Gauge

a. If the change in gauge over a distance of 31 ft. (9.5 m) or less on either side of the defect exceeds 1/2 in. (13 mm) a class 3 speed must be placed.

b. If the change in gauge over a distance of 20ft (6.1 m) or less on either side of the defect exceeds 1½ in. (38 mm), operating speed must be reduced to Class 1.

3. Cant

a. Gauge variations can be caused by tipped or canted rail.

i. Inward cant results in tight gauge.

ii. Outward cant results in gauge widening.

b. Near base to near base measurement for standard gauge for various rail sections is defined in Table 33.

Table 33 Inside Base to Inside Base Gauge

Rail Section	Base Gauge	Height of Section	Δ_{Design}
136 RE	53¾" (1,365 mm)	7 5/16" (185.75 mm)	2¾" (70 mm)
132 RE	53 7/8" (1,368.5 mm)	7 1/8" (181 mm)	2 5/8" (66.7 mm)
115 RE	54" (1,371.5 mm)	6 5/8" (168.25 mm)	2½" (63.5 mm)

c. A 1 degree rail cant causes a change in gauge of approximately 1/8 in. (3 mm) in all rail sections.

i. Cant can also be determined by measuring the rail base gauge and comparing it to the gauge measurement and the height of the rail section and the flange wear.

$$Cant \approx \tan^{-1}\left(\frac{(Gauge_m - base_m) - (\Delta_{Design}) - Wear_{flange}}{Height\ of\ Rail}\right)$$

4. Alignment

a. The maximum allowable deviations for alignment related defects are listed in Appendix D – Urgent Defects.

b. The measurement for alignment shall be the maximum mid-ordinate (positive or negative) in inches, of a 62 ft. (18.9 m) or 31 ft. (9.5 m) chord measured at the gauge point.

i. On curved track, the high (outside) rail shall be used as the line rail. On tangent track, either rail may be used as the line rail but the same rail must be used throughout the tangent.

ii. The line rail for a turnout for the diverging route is the curved closure rail between the switch point and the frog.

The line rail for the straight route shall be the straight closure rail.

c. The maximum mid-ordinate shall be established by centring visible misalignments on the chord.

d. If 62 ft. (18.9 m) chords are used, the mid-ordinate (in inches) is in a 1 to 1 relation with the degree of curve. If 31 ft. (9.5 m) chords are used, the mid-ordinate (in inches) must be multiplied by 4 to obtain the degree of curve.

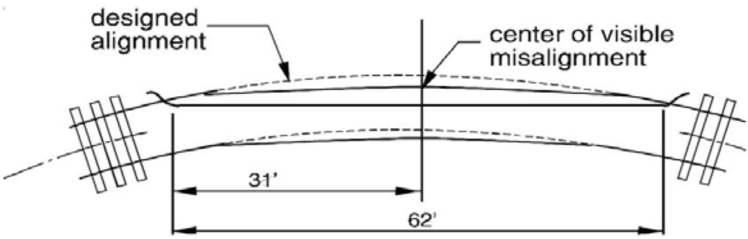


Figure 27. Alignment

e. The degree of curve is determined by averaging the degree of curvature of 11 points (the point of concern plus 5 points on either side) over a 155 ft. (47.2 m) track segment at 15 ft. 6 in. (4.72 m) spacing. If the curve is less than 155 feet (47.2m), then the average is taken throughout the full length of the body of the curve.

f. To determine the alignment variation in a curve:

i. If using a 62 ft. (18.9 m) chord, place stations every 15 ft. 6 in. (4724 mm) for 4 stations either side of the centre of the point of misalignment for a total of 9 stations.

ii. Average the midpoint measurements at the stations either side of the point of misalignment. This average is the uniformity of the curve.

iii. The difference between the midpoint measurement at the point of misalignment and the uniformity is the variation from uniformity.

iv. If the 31 ft. (9.45 m) chord is used, place 8 stations either side of the centre of the point of misalignment.

5. Superelevation

a. Except as provided in Section 13 for limits of Cross level from Design, the outside rail of a curve shall not be lower than the inside rail.

b. Superelevation in a curve shall not exceed 6” (152mm). Curves exceeding 6” of elevation require a plan to reduce elevation.

c. Design superelevation should not exceed requirements identified in Track Standard Section 19.4.9 and 19.4.10.

d. Minimum superelevation are defined in Track Standard Section 19.4.10

e. When superelevation on a curve is less than the amount required, the curve must be checked for V-max. See Track Standards Section 19.4.8.

f. The designated elevation at any point on a curve is determined by averaging the elevation over the same track segment as used in Track Standard Section 16.2.4.e above.

g. Where superelevation is runout onto tangent track per the conditions in Track Standard Section 19.4 and Recommended Method 1305-0: Determining Superelevation, Spiral Length and Maximum Train Speed on Curves, designated elevation in the spiral and tangent shall be based on the maximum allowable runout permitted.

i. Where the runout requirements cannot be met, speed must be restricted accordingly.

6. Surface

a. The maximum allowable deviations for surface related defects are listed in Appendix D – Urgent Defects.

b. The measurement for SURFACE shall be the maximum positive or negative mid-ordinate, in inches or mm, of a 62 ft. (18.9m) chord measured along the top surface of the rail.

c. The maximum mid-ordinate shall be established by centring visible peaks or sags on the chord.

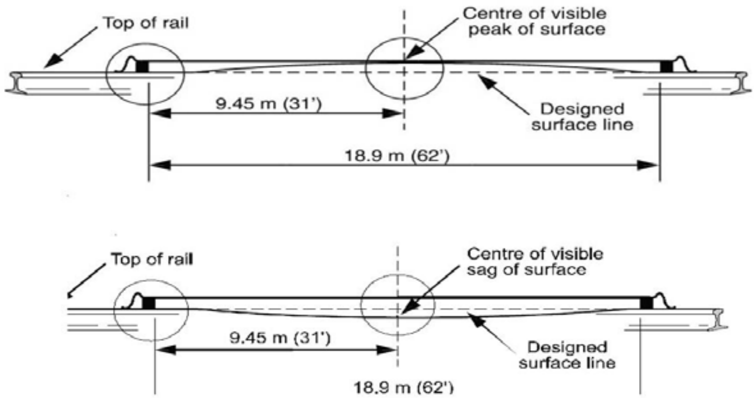


Figure 28. Surface Defect Measurement

7. Cross Level

a. The maximum allowable deviations for cross level related defects are listed in Appendix D – Urgent Defects.

b. The measurement for cross-level shall be the difference in elevation, in inches or mm, between the grade rail and the adjacent rail, measured at right angles with a level board or approved track gauge.

c. Designated elevation at any point on a curve is determined by averaging the elevation of 11 points (the point of concern plus 5-points on either side) over a 155 ft. (47.2 m) track segment at 15 ft. 6 in. (4.72 m) spacing. If the curve is less than 155 ft. (47.2 m), then the average is taken through the full length of the body of the curve. The degree of curve is determined by averaging the degree of curvature over the same track segment as the elevation.

d. On curved track, the grade rail is the low (inside) rail. On tangent track, either rail may be used as the grade rail, but the same rail must be used throughout the tangent.

e. The difference in cross-level readings shall be used to calculate WARP 31 and WARP 62. Measurement for cross level shall be taken so as to ensure that the maximum deviations are recorded. Both of these terms describe variations in cross level which contribute to the wheel lift and harmonic rocking action of equipment that can result in a derailment.

i. NOTE: It is possible to have several combinations of differences in cross level within any 31 ft. (9.5 m) or 62 ft. (18.9 m) It. is essential that the inspector determine the maximum difference.

ii. WARP 31 is defined as the difference in cross level between any two points within 31 ft. (9.5 m) apart in spirals.

iii. Warp in tangents, spirals and curves (WARP 62) are defined as the difference in cross level between any two points within 62 ft. (18.9 m) apart.

iv. WARP 31 and WARP 62 conditions can occur in the same section of track.

8. Runoff

a. The runoff at the end of the raise, when surfacing track, or when surfacing into any fixed structure, in any 31 ft. (9.5 m) of track cannot exceed the URGENT limits for the Class of track found in Appendix D – Urgent Defects.

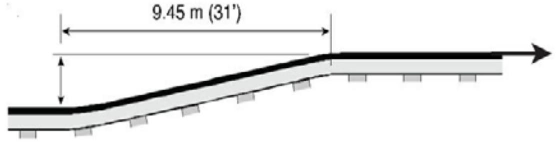


Figure 29. Runoff

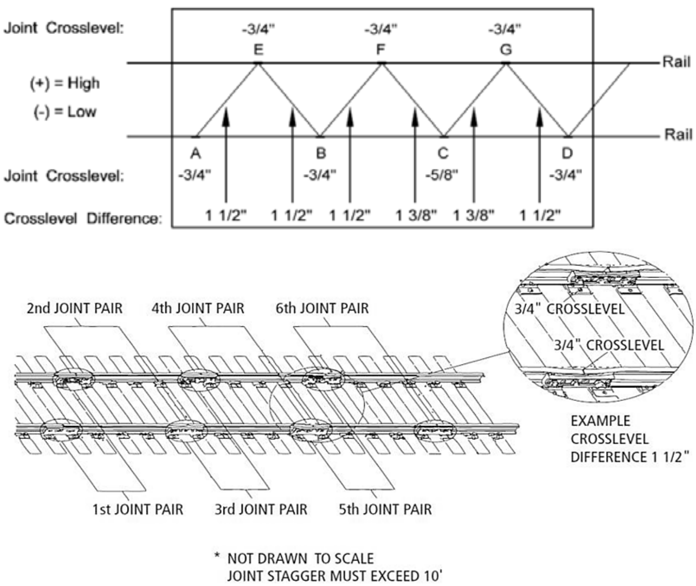


Figure 30. Harmonics

9. Harmonics (Rock and Roll)

   a. To control harmonics (Rock and Roll) on Class 2 through 5 jointed tracks with staggered joints the cross level differences shall not exceed 1¼ in. (32 mm) in all of six consecutive pairs of joints, as created by 7 low joints.

   b. Jointed track with joint stagger less than 10 ft. (3048 mm) shall not be considered as having staggered joints.

c. Joints within the 7 low joints, but outside of the regular joint spacing shall not be considered as joints with respect to harmonic.

10. Combination Defects Including Cant

a. When measurements of rail cant, flange wear, and wide gauge exceed the values in Table 34 and/or Table 35 below, then the appropriate remedial action as indicated in the tables must be taken, whichever is more restrictive.

Table 34 – Urgent Defect for Combination Cant

Combination Cant URGENT Defect				
Combination Cant Defect Threshold			**Remedial Action Required**	
Flange Wear	Rail Cant	Rail Gauge	Class 1&2 Track	Class 3, 4, & 5 Track
13/32 in. (10 mm)	4°	57 1/8" (1451 mm)	Repair Immediately or place a 10mph speed restriction until repaired.	Repair immediately or place 25 mph speed restriction until repaired

Table 35 - Near Urgent Defect for Combination Cant

Combination Cant PRIORITY Defect			
Combination Cant Defect Threshold			**Remedial Action Required**
Flange Wear	Rail Cant	Rail Gauge	Class 1 to 5 Track
3/8 in. (9 mm)	3.5°	57 in (1448 mm)	Inspect within 72 hours and repair within 30 days. If not repaired within 30 days, apply speed restrictions per Table 34 until repaired.

b. To repair combination cant defects, address the cant first.

i. Remove rail, plates, and fasteners and adze ties to restore proper plate surface, then tamp ties;

ii. Remove plates and fasteners, and then pull track ties to expose the tie plate seating area. Adze ties to restore proper tie plate seating surface and reinstall tie and fasteners and then tamp the track ties; or

iii. Replace existing track ties.

16.3. Application of Slow Orders for Defective Track

1. Where a portion of track exceeds the limits defined as “URGENT”, one of the following actions must be immediately taken before the operation of the next train over the defect(s):

   a. The defect(s) must be repaired to within the allowable tolerance;

   b. Except as prescribed in Track Standard Section 16.1 for PRIORITY defects, if the defect is a speed-related type, a temporary slow order (TSO) must be placed restricting trains to a maximum speed which is within the track class allowed for the severity of the defect(s), (refer to Appendix D – Urgent Defects); or

   c. Track must be removed from service if defects exceed Class 1 limits

16.4. Responsibility

1. The Track Supervisor or designate is responsible for:

   a. Checking the deterioration in track geometry between IRIS tests;

   b. Ensuring that track geometry is maintained with the track geometry standards, or providing appropriate track protection; and,

   c. Accompanying the IRIS testing vehicle when it is testing primary and secondary main lines in their respective territory.

2. All tracks **MUST** meet or exceed the track geometry standards defined in the GO Transit Track Standards and the Transport Canada Rules Respecting Track Safety.

Section 17 Turnout, Crossing and Special Track Work Inspection

17.1. General Information

1. All unsafe conditions found during the inspection must be reported to the CM Manager of Track and corrected immediately or properly protected.
2. The inspections must be carried out by employees who are qualified and certified in accordance with Transport Canada Rules Respecting Track Safety, and GO Transit Track Standards, and must be under the direction of the CM Senior Manager of Track and Structures.
3. All turnouts must be operated in all of its positions during the detailed inspection at the prescribed frequency for detailed inspections.
    a. Power or dual control turnouts, will be jointly inspected annually by a qualified Track and S&C Inspector.

17.2. Types of Inspections

1. There are three types of turnout inspections:
    a. Routine Inspection
    b. Walking Inspection
    c. Detailed Inspection

17.3. Frequency of Inspections

1. The frequency of inspections must ensure that the track is safe for operation at currently authorized speeds.
2. Turnouts, crossings, and special track work must be inspected at the minimum frequencies specified by the Transport Canada Rules Respecting Track Safety or the GO Transit Track Standards, whichever is more

restrictive. These frequencies can be found in Appendix B – Track Inspection Frequencies in Table 47.

3. The CM Manager of Track and the Track Evaluation Officer have the authority to order additional inspections at their discretion.

17.4. Record of Inspection

1. A report of each Walking Inspection and Detailed Inspection must be prepared on a prescribed turnout inspection form on the same day that the inspection is performed. The inspection report must be signed by the person making the inspection, and retained at the designated location for at least one year.

17.5. Walking Turnout Inspection

1. Walking turnout inspections must include the following procedures:
    a. On power and dual control operated switches, arrange with the RTC to have the switch taken off power. Observe if the points are closing properly. Advise the Signal Maintainer accordingly.
    b. Check the throw and adjustment for any lost motion (check that the eyebolt is adjusted to compensate for any lost motion).
    c. Check the condition of the eyebolts, its position in the mast barrel, and the condition of the connecting rod, and all switch rods. The wear of these components also needs to be checked.
    d. Check the rail flow and switch points for wear, for fit against, and for proper height above the stock rail. Gaps in switch points, regardless of size, are unacceptable. The switch points must fit tightly against the stock rail.
    e. Check the switch points are properly adjusted and secured.

f. Check to see that the switch points are not skewed. They must be installed directly opposite each other. If skewing should develop, adequate rail anchors must be installed to resist rail movement.

g. Check the riser slide plates and rail braces.

h. Check that all cotter pins are in place.

i. Check the frog to determine if it is being struck at the point of the wheel flange.

j. Check the frog for fit and firm attachment to the ties or gauge plates, and for any lateral movement.

k. Check the general condition of the frog. On a spring frog, check the location of the wheel contact on the wing rail. Also, check for loose bolts and rivets, and measure the clearance between the horn and the hold down housing.

l. Check frogs to determine if bolts are of the correct size, length, and grade.

m. Check all bolts and joint bars throughout the turnout are installed and tight.

n. Check the gauge ahead of the switch point and at the heel of the switch point.

o. Check the actual gauge throughout the turnout on the main track and the turnout track and the return curve.

p. Check the guard check gauge and guard face gauge on the main track and on the turnout track. See Figure 31.

q. Check the line and surface throughout the complete turnout on both the main and turnout track.

r. Check the foot guards where applicable.

s. Check the derail (if so equipped) to ensure it is functioning and properly secured.

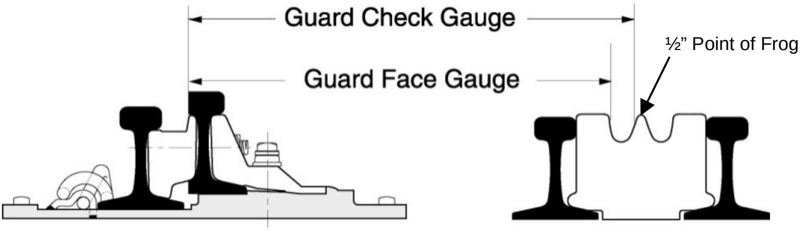


Figure 31. – Guard Check Gauge and Guard Face Gauge Measurement locations.

t. Check the top surface of switch points to ensure that the outer edge of the wheel tread cannot contact the gauge side of the stock rail. See Figure 32.

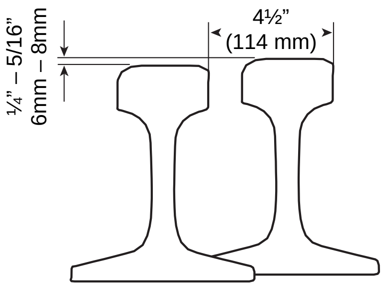


Figure 32. - Switch Point and Stock Rail Minimum Clearance

u. Check the switch lock or keeper.

v. Check the condition of the reflectorized targets (if applicable).

w. Check the heel block assembly to ensure that the bearing of the switch point is correct in relation to the heel block, and to the bent joint bar.

x. Check the heel block assembly for broken bolts, and replace anywhere required.

y. Check that guard rails are properly located in their longitudinal position in relation to the frog point.

z. Check that the turnout ties are square to the through track in lateral turnouts, and square to the centreline in equilateral turnouts.

aa. Check that the turnout ties are well tamped throughout the turnout.

bb. Check the surface through the turnout.

2. There must be no broken or bent clips or stop blocks. Switch rods or connecting rods must not be excessively bent, broken or corroded to a depth exceeding 1/8 inch (3 mm).

3. Welding on connecting rods is not allowed.

4. Gauge at the point of the switch, heel of the switch, and in the frog area is to be with ± ¼ in. (6 mm) of standard gauge. Maintain the gauge in the remainder of the turnout per Priority Defect geometry limits.

5. Switch points are manufactured such that the running surface is ¼ in. to 5/16 in. (6 to 8 mm) higher than the stock rail, as measured at the location where the distance between gauge face of stock rail and gauge face of switch point when tight against the stock rail is 4-1/2 in. (115 mm). When this vertical dimension is reduced by wear to 3/16 in. (5 mm), the location must be monitored for signs of wheel contact on the stock rail. Where contact is evident, the switch point must be renewed or the stock rail ground to restore the ¼ in. to 5/16 in. (6 to 8 mm) dimension.

6. Stock rails can be worn more than ¼ in. (6 mm) providing that the switch point is 3/16 in. (5 mm) below the top of the stock rail as measured at the top of the radius at the end of the switch point.

7. On switch point ends which are chipped or broken the thickness must not exceed 3/16 inch (5 mm).

8. When the switch point or stock rail has sustained flow of more than 1/8 in. (3 mm) causing the point to stand out from the stock rail, excess metal must be ground off to obtain proper fit.

9. Switch points and stock rails must be of the same size rail sections unless approved otherwise by the CM Senior Manager of Track and Structures.

10. Gaps in switch points, regardless of size, are unacceptable. The points must fit tightly against the entire planed portion of the stock rail.

    a. Gaps between 1/16 in. and 1/8 in. (1.5 mm and 3 mm) must be repaired within 24 hours. The switch must be removed from service if one of the following conditions is also present:

        i. Locations with spiked rail braces;

        ii. Locations with bolted braces where brace plate is spiked and there is evidence of plate movement;

        iii. Locations in curves where the gap is on the diverging point;

        iv. Locations where there is evidence of hanging or pumping ties;

        v. Locations where the switch stand is not secure;

        vi. Locations with Jackson switch stands;

        vii. Locations with gauge movement ahead of the switch point; or

        viii. Locations with chipped points.

    b. Gaps greater than 1/8 in. (3 mm) must be removed from service immediately.

    c. Note: Locations where there is flange wear ahead of the switch points indicate that wheels are tracking outward and consequently, it will be easier for a wheel to climb or pick a switch point.

11. Where a different rail size is authorized, measure the switch point guards for wear as shown on the Standard Plan for the different new rail size. If the wear is more than the wear limit allowed, the guard must be replaced.

12. Guard rail bolts and fasteners must be intact and tight. Guard rail wear surfaces must not be worn more than 5/8 in. (16 mm).

13. Guard Check Gauge and the Guard Face Gauge shall be within the limits shown in Table 36.

Table 36 – Guard Check Gauge and Guard Face Gauge

Class of Track	Minimum Guard Check Gauge[a]	Maximum Guard Face Gauge[b]
1	54-1/8" (1375 mm)	53¼" (1352 mm)
2	54¼" (1378 mm)	53-1/8" (1349 mm)
3,4	54-3/8" (1381 mm)	53-1/8" (1349 mm)
5	54½" (1384 mm) [c]	53" (1346 mm)

[a] The distance from the gauge line of a frog to the guard line of its guard rail or guarding face, as measured across the track at right angles to the gauge line. See Figure 31.
[b] The distance between guard lines as measured across the track at right angles to the gauge line. See Figure 31.
[c] At points of heavy point frogs equipped with through gauge plates, use 54 3/8 in (1381 mm)

14. Any loose or missing bolts must be replaced.
15. Lateral wear on a frog should not exceed 1/8 in. (3 mm).
16. The depth of the flange-ways of a frog:
    a. On Class 1 track may not be less than 1 3/8 in. (35 mm); or
    b. On Class 2 through 5 track, may not be less than 1½ in. (38 mm).
17. If a frog point is chipped, broken or worn more than 5/8 in. (16 mm) down and 6 in. (152 mm) back, operating speed over that frog may not be more than 10 mph.
18. If the tread portion of a frog casting is worn down more than 3/8 in. (10 mm) below the original contour, operating speed over that frog may not be more than 10 mph.
19. Spring Frogs
    a. Clearance between the horn and hold-down housing on spring frogs must not exceed ¼ in. (6 mm), and the horn must not bind on the hold down housing.
    b. Clearance between the bottom of the horn to the wear plate must not exceed 1/8 in. (3mm).

c. Each spring must have a compressive force sufficient to hold the wing rail against the point rail.

i. Note: the wing on 115 RE, 132 RE, and 136 RE spring frogs is designed to be open 3/8 in. (10 mm) at the half inch point (13mm). The maximum opening is ¾ in. (19 mm).

d. The wing rail must bear evenly on all base plates (check wear marks on the plates).

e. Check to ensure the outer edge of a wheel tread is not contacting the gauge side of the spring wing rail.

f. Similarly to the stock rail, if the outer edge of a wheel makes contact in a trailing movement, it can roll out the wing and derail a train. If the horns are doing their job significant wear would have to be present before a train wheel can make contact.

i. There have been incidents caused by tampers surfacing a turnout and bending the base plate enough to raise up the wing rail and cause a derailment. Always watch for evidence of a bent base plate especially if the wing rail stays open after a turnout is tamped.

g. The retarder, on frogs so equipped, must close completely with a cycle time from 1 minute to 3 minutes after opening.

20. On self-guarded frogs, check the wear on the raised guard. If the measurement from the raised guard on a self-guarded frog to the 5/8 in. (16 mm) point on the gauge side of the frog point is more than 4 3/8 in. (111 mm) restrict operating speed to not more than 10mph.

21. Bolts shall be retightened to the required torque approximately 6 weeks after initial installation.

22. Ties that are plate cut more than 2¾ in. (70mm) or where the tie plate or rail can move laterally ½ in. (13mm) or more the tie will be considered defective. For

further definition of defective ties see Track Standard Section 9 .

23. Ballast and proper drainage are necessary in order to maintain good surface and line through the turnout.

24. Make sure there is sufficient ballast and that the tie cribs are full.

25. Ensure that a good drainage ditch or structure is available on both sides of the track.

26. During winter months, tie cribs in the switch point area should be dug out.

27. Pay particular attention to the surface at the frog.

28. For more information on Turnout inspections see Recommended Method 3500-1: Turnout Inspection

29. For more information on joint Track and S&C inspections of power operated turnouts see Recommended Method 3500-0: Joint Inspection of Power Operated Turnouts.

17.6. Detailed Turnout Inspection

1. Detailed turnouts inspection shall also include all items found in Track Standards section 17.5.

2. A detailed turnout inspection must include the measuring and recording of the following specified items:

   a. Track gauge measurements 5 to 10 ft. (1.5 – 3 m) ahead of the switch points, at the heel block, at the mid-point of curved and straight closure rail, at 15 ft. 6 in. (4.7 m) intervals throughout the straight and diverging route behind the frog, and at the first and last throw rod.

   b. Guard check gauge measurements.

   c. Guard face gauge measurements.

   d. Switch Point Rise where contact is evident (Vertical clearance between the switch point and the stock rail). The turnout must be thrown to effectively measure point rise.

   e. Heel Block assembly for surface and check bolts to confirm they are tight

f. Cross level measurements at locations 15ft. 6 in. (4.7 m) apart on both routes throughout the turnout.

g. Measurements obtained at required locations with track geometry vehicles meet the requirements of part a and part f above. These measurements must be made through independent geometry inspections.

3. Each turnout and special track work must receive a detailed inspection at least annually, or per the minimum frequencies in Section 17.3.

4. The switch stand should be checked for the following:

   a. The stand is securely fastened to the head block ties. The stand should be securely fastened by proper head block bolts, track spikes, or lag screws.

   b. The head block ties are in good condition.

   c. The switch stand can be thrown with no excessive wear in the handle.

   d. The bushings to see that they are securely in place and not excessively worn

   e. The bushings and mast bearing areas are well lubricated

   f. The operating condition of the stand

5. The crank eyebolt should be inspected as follows:

   a. Check crank eyebolt extensions. For 1½ in. (38 mm) crank eyebolt extension of 3/8 in. (9.5 mm) must be showing beyond the rear of the mast barrel. For 1¾ in. (44.5 mm) crank eyebolts a minimum of 7/8 in. (22 mm) must be showing

   b. Check the relative movement between the handle and top casting, and between the top casting and mast. When relative movement becomes so great as to require excessive extension of the eyebolt from the mast barrel, the switch stand must be replaced.

   c. Check if the crank eyebolt has been changed according to the following schedule:

i. On main lines, replace once every 6 years

ii. On non-main lines, replace once every 9 years.

6. Inspect gauge plates, riser slide plates, turnout plates, hook-twin tie plates, frog plates, guard rail plates, switch point rollers, and tie plates as follows:

   a. Check for broken, bent, or missing plates

   b. Riser slide plates with the surface worn more than 1/8 in. (3 mm)

   c. Shoulder plates, or turnout plates with cut rail seats for excessive rail.

   d. Gauge plates with defective insulation. This must also be reported to the Signal Maintainer and the CM Manager of Signals.

   e. Rails are properly seated in the gauge and riser slide plates.

   f. Rail braces are tight and well driven, but not overdriven to the extent that the rail is canted inward.

   g. The riser side plates and spring frog plates are properly lubricated to permit free movement of switch points and spring wing rail.

   h. All other plates are properly seated with shoulders bearing firmly against the rail base.

7. In addition to those measurements and requirements above, all the conditions in Section 17.5 “Walking Turnout Inspection” also apply to a detailed inspection.

8. For semi-automatic switches, the clamping force must be tested in addition to all other requirements above. Follow the procedure below:

   a. A No. 22 switch stand in good condition will show a clamping force between 800 and 1400 pounds. If a switch stand reads a clamping force of 800 to 1000 lbs. consistently on one rail and 1200 to 1400 lbs consistently on the other that does not mean there is anything wrong with the stand. It just means that the connecting rod length is just a little different than ideal.

b. A stand that has had bad internal wear may show 1000 lbs. Clamping force on one rail, zero (0) on the other; then after being reversed a few more times may show zero (0) where it formerly showed 1000 lbs. and vice versa. The numbers will show no consistency from one trial to the next and no amount of adjustment of the connecting rod will make the clamping forces consistently come up to the 800 lbs. minimum. This switch stand must be replaced.

c. To mechanically check the pressure as per the above, a clamp system shall be used which gives a pressure reading as you jack the point open. For consistency the clamp should be installed about 17 inches behind the point. The instrumented bolt gives readings a couple of hundred pounds below the clamp when tested on the same switch.

d. A reading 1,000 lbs. with the clamp system indicates that the stand should be immediately adjusted. If after adjustment it still cannot reach the necessary readings it should be changed. If you have a reading between 1,000 lbs. and 1200 lbs. with the clamp the stand should be rechecked on a monthly basis. Between 1200 lbs. and 1500 lbs. with the clamp should be checked twice a year. All stands should be checked once a year

e. If on inspection, ¼ in. (6 mm) wear is noted between the spindle and the top cover of the stand then a follow-up inspection with the clamp system should be done to measure the clamping forces on each point. Anything greater than the ¼ inch (6 mm) is noted the stand should be changed out.

f. There is a date on the case of the Racor 22 stand. If this is older than ten years on a stand with a lot of use or any stand older than fifteen years shall be changed out.

g. If the instrumented bolt tests show excessive wear or other internal problems with the stand do not attempt to repair it in the field or in track, change out the stand. Racor 22 stands can be rebuilt by the manufacturer.

9. Spring frogs require a detailed inspection at least twice a year. In addition to the other requirements found in Track Standard section 17.5.19 and this section, follow the additional procedure below:

   a. Check for breaks or cracks in the rails or castings

   b. The spring frog is designed to work with the wing closed during movement through the straight side. Even though a wheel should not drop in if the wing were to stay open, it should still close. Check the pressure on the spring (we do not use a pressure gage, but the spring should make the wing snap closed). Replace any broken springs in the spring box assembly. Occasionally, graphite-lubricate the base plate where the wing slides. Keep the flange-way between the wing and the fixed side of the frog clean of debris and ice and snow.

   c. Check that all of the stops are in place and doing their job. If you see bent stops or mushrooming on the face of the stops, perform the following test: jack the wing open enough to place a 1 7/8 in. (48 mm) block in the flange-way. If you can slide a ¼ in. (6 mm) taper or step gauge between the web of the rail and any of the stops they need to be repaired. They can be repaired by cutting them off and re-welding the stop closer or the welder can weld a repair plate to the face of the stop.

   d. Our spring frogs are designed to be open 3/8 in. at the 1/2 in. point of frog. But the spring wing rail should fit tightly against the frog along the entire length of the straight portion of the wing rail.

   e. Make sure that all bolts are in place and tight. The proper bolt torque for 1 3/8 in. (35 mm) bolts is 2,500 ft.-lbs., and 840 ft.-lbs. For 1 in. (25 mm) bolts. Thin head bolts are used along the spring wing on spring frogs. These bolts are not visible in the normal closed position and should be inspected by jacking open the spring wing. Replace only with thin head bolts. Remember do not put any portion of your body between the spring wing and the fixed point without adequate blocking.

f. Inspect the anchor pattern. All switch and track ties should have solid box anchors for 200 ft. (60.9 m) behind the turnout, 200 ft. (60.9 m) ahead of the turnout and solid anchors through the turnout.

g. Check the side clearance between the hold down housings and the horns. If the closure rails have moved, it is possible to bind the rail open

h. Look for signs of ballast pumping, unstable subgrade, or tie condition that may allow the wing rail to gap open.

i. If your spring frog is equipped with a wing rail retarder (shock absorber), check its function monthly. The proper closing time of the wing rail should fall between 1 and 3 minutes. If the area under the retarder has evidence of oil being present, the retarder may have failed.

j. All snow and ice buildup near a spring frog should be removed. Every employee (track, S&C, B&S) that traverses these frogs should make a point of stopping and inspecting the frog and cleaning any ice and snow that is evident.

17.7. Failures in Spring Frogs

1. Despite their reliability, there can be failures in a spring frog. The most common failures and associated remedial actions and speed restrictions are listed below:

   a. Broken springs - Even with a missing spring the frog opening should not be much bigger than an

Rail Bound Manganese (RBM) frog. However with a broken spring that cannot be replaced before the next train, it is recommended that movement be only on the straight side. Speed should be limited to no more than 25 mph. A close inspection of the hold down horn clearance, the stops, and the guard check gauge should be made. When replacing broken springs on a frog with double springs, replace both springs at the same time. When tightening a new spring, the bolts should be tightened until the spring is depressed 1 in. (25 mm).

b. Broken fixed point. This condition is more dangerous than a broken point on a RBM frog. The wheel dropping down in the broken area may get low enough to catch the wing rail. The fixed point can be welded, but it is recommended that speed be no greater than 10 mph and each train watched over the frog until repaired

c. Excessive wear on the wing rail. It is somewhat unusual to see much flange wear on the wing rail, but still is a possibility. If there is flange wear in excess of 3/8 in. (10 mm), the frog should be considered for replacement. No slow order is necessary but a detailed inspection should be made to determine a possible cause of the wear.

d. Pumping in the heel and/or broken toe pan. Pumping in the heel is usually caused by bad surface conditions. If allowed to exist, these conditions can cause failure in the hold-down housing. A broken toe pan is a warning sign that something has gone wrong. There should very rarely be enough pressure to crack the toe pan. If a track inspector encounters this condition, they shall look for other problems like running rail or inadequate anchors, possibly even a car has been off in the frog.

17.8. Diamond Inspection

1. Inspections of all railway crossings at grade (diamonds) shall be conducted as follows:
   a. Every time the crossing is traveled over by hi-rail it shall be visually inspected for defects.
   b. Crossings shall be inspected at least monthly on foot measuring gauge and looking closely at the condition of all components.
2. Unsafe conditions on either railway which cannot be corrected immediately will be reported to the Rail Traffic Controller or Train Dispatcher and the CM Manager of Track and proper action taken to protect traffic on all routes.
3. Follow the same procedures as those for turnouts found in Track Standard Sections 17.3, 17.4, 17.5, and 17.6.
4. In addition to Clause 17.8.3, see also the areas of inspection found in Table 37.
5. Notify the RTC and the CM Manager of Track immediately if there if any condition is identified on the crossing railway that requires protection.

Table 37 Areas for inspection

Items to Check	TS Requirements
Ballast and Drainage	• Cribs not less than three quarters full • Ballast shoulder not less than 10 in. (254 mm) • No standing water or indications of it.
Line, gauge, surface, and cross level	• Per Track Standard Section 16
Ties	• Sound and holding spikes and fasteners • Stops and shoulders firmly welded to plate • not worn in excess of 1/8 in. (3mm)
Plates	• None broken or cracked • None missing. • Not worn in excess of 1/8 in. (3 mm).
Rails (Including switch rails, closure rails, stock rails,	• Note rail condition such as rust streaks, ordinary breaks, vertical or horizontal split heads, engine burns, broken bases, crushed heads, bolt-hole breaks, etc.

and frog rails)	• End batter or mismatch not exceeding 0.040 in. (1 mm)
Fasteners	• Fully spiked (except hook twin tie plates which will have only one spike per plate end) or fastened with tie screws and Rail clips. • Spikes fully driven or timber tie screws drawn down. • Rail clips in place and shoulders not broken
Castings	• No breaks or cracks in manganese inserts • No breaks in blocks or rail braces, etc. • If the tread portion of a casting is worn down more than 3/8in. (10 mm) below the original contour, operating speed over that crossing may not be greater than 10 mph • Metal flow ground off
Bolts	• None loose, broken or missing. • All tight (torque per Track Standard Section 13.4) • Spring washers, flat washers or cotter pins present as required • Bolts are of correct strength, length , and diameter
Rail Anchors	• On main track or in CWR territory: o Fully box anchored on both tracks through diamond o Fully box anchored for 200 ft. (61 m) in both directions beyond the diamond. • On other tracks, sufficient number of rail anchors to prevent movement of diamond
Insulation	• In place and functional • not visibly damaged
Flange-ways	• Clear of foreign objects. • Not less than 1-1/2" (38 mm) deep for Class 2 through 5. Not less than 1 3/8" (35 mm) deep for class 1. • Not less than 1-3/4" (44 mm) wide.
Guard Check Gauge / Guard Face Gauge	• Guard check gauge – not less than that dimension in Table 36 in Track Standard section 17.5 • Guard face gauge - not less than that dimension in Table 36 in Track Standard section 17.5
Joints	• Joints from the outer signals on all routes

Recommended Method 3500-0: Joint Inspection of Power Operated Turnouts

Note: For the purposes of this Recommended Method a power operated turnout also includes dual control turnouts.

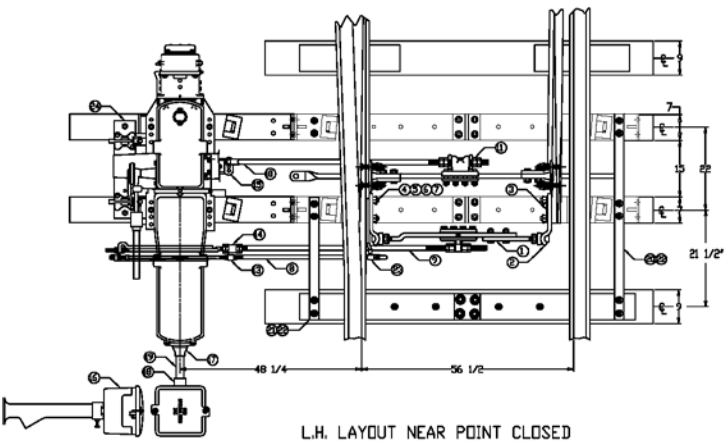
Introduction

This Recommended Method describes typical switch layout problems encountered at power operated switch locations that have a direct impact on the reliability of turnouts. Also described are appropriate corrective actions.

The intent of this Recommended Method is to provide a guideline for use by Track Foreman, Track Supervisors, S&C Supervisors, and Signal Maintainers when conducting switch layout inspections.

At least twice annually, it is recommended that switch layouts should be inspected jointly by Track and S&C maintainers.

Figure 33. Left Handed Power Switch Machine Layout



Power Switch Machines

The primary function of power switch machines is to provide remote control of turnouts and to detect and indicate the position of the switch points. A typical switch machine is connected to switch points via the front rod and 1st switch rod, with connecting rods. In some cases helper rod assemblies are also provided.

A typical switch machine contains a DC electric motor, gear drive, mechanical locking mechanism and indication contacts. It is adjusted internally and externally to throw the switch point, reverse or normal, and to detect if the switch points are within ¼ in. (6 mm) from the desired position.

The ¼ in. (6 mm) adjustment is a safety requirement all railways in North America must adhere to. By default it is also a performance measure of the quality of the switch layout since there are several external factors involving the Track portion of the layout, which will directly impact the ability of the switch points to move freely and to seat properly against the stock rail.

Switch Point Rollers

The use of Schwihag switch point rollers has been shown to significantly improve the performance of turnouts. These should be installed at problematic locations. Ordering information for rollers can be found on Standard Plan GTS-0390.

As with all turnout hardware, Schwihag rollers should be inspected and maintained regularly. Refer to S&C General Instruction GI-409.

References:

GI-329, GI-409 and appropriate turnout plans

Inspection Criteria

The following tables identify some of problems typically encountered at power switch layouts, the probable causes and/or preventative maintenance procedures that can mitigate them, and the impacts on the switch machine.

Problem	Impact on Switch Machine	Probable Cause	Corrective Action
Switch points are askew in relation to one another	Improper alignment of front rod and 1st switch rod places stress on the switch machine throw, lock and detector connecting rods including internal components. This often results in loss of correspondence.	Switch not installed properly	Ensure both switch points are flush with the edge of the head-block tie during installation Correct alignment during next replacement of the switch point or closure rail
		Thimbles in the heel casing are worn	Replace thimble in heel casting
Switch points does not fully close beyond switch tip	Prevents the point from seating, causing switch machine adjustment difficulties	Lips on point and/or stock rail	Grind off visible lip
		Stock rail braces over driven	Inspect stock rail to ensure properly seated, adjust braces if necessary
Switch point does not fully close beyond switch tip.	The switch point should fit flush against the stock rail for the full length of the head cut in the closed position. If it does not, the switch point may move under traffic causing component wear and loss of correspondence.	Improper adjustment of switch rods or helper rod (where so equipped)	Adjust rods ensuring gauge and flange-way clearance are maintained
		Track not properly gauged	If significant, turnout stock rail may need to be re-gauged.
Switch points not riding on all plates	When the switch points ride on only 2 or 3 plates, all the weight rides on those few plates, which will scrape off most of the lubrication the first time the switch is thrown, where normally lubrication may last for 1-2 months without replacement. The end result is higher friction causing the switch machine motor to overload.	Switch not surfaced properly	It is not unusual for a turnout to not ride evenly on all plates. However, if problem is severe, tamp or surface low spots. Installation of rollers also recommended.
		Bowed switch point	

Problem	Impact on Switch Machine	Probable Cause	Corrective Action
Switch plates are not properly lubricated. (turnouts with Schwihag rollers do not require lubrication)	Lack of lubrication causes too much friction between points and plates and overloads the switch machine motor.	Lack of graphite or other approved lubricant.	Graphite or lubricate switch.
	Using engine oil or grease gathers dirt, filings and other grit contributing to friction.	Switch has been lubricated using engine oil or grease.	Remove excess oil and grit and lubricate with approved product (graphite or WL191 lube).
Sand on switch plates.	Sand on switch plates increases friction and causes the switch machine motor to overload.	Locomotive sanders.	Remove excess oil and grit and lubricate with approved product (graphite or WL191 lube).
Rail grindings on switch plates and in crib.	Rail grindings become magnetized due to grinding action and grinding deposits adhere to switch plates and rods bypassing the insulation and short out the OS track circuit, resulting in a signal system outage	Rail grindings from switch grinders not properly removed after grinding.	Clean switch area.
Poor surfacing.	Excessive movement can cause switch machine adjustments to drift resulting in loss of correspondence.	Low or hanging joints. Insufficient tamping	Hand-tamp spot locations or surface whole turnout if feasible.
		Broken tie plates.	Replace broken tie plates.

Problem	Impact on Switch Machine	Probable Cause	Corrective Action
Worn, improperly adjusted or dry MJS clips.	MJS clips which are adjusted too tight and / or not lubricated will result in higher friction during switch movement causing overloading of the switch machine.	MJS clips are not properly installed or lubricated.	Lubricate MJS clips immediately.
	Worn MJS clips contribute to switch point misalignment and loss of correspondence.		Ensure MJS clips are lubricated regularly in accordance with GI-409.
	Note: Rocker clips are used in newer turnouts instead of MJS clips, and require no lubrication.		Check and replace shims
Failed insulator.	Failed insulators will short out the OS track circuit, resulting in a signal system outage.	Broken or fatigued insulators on front rods, switch rods, gauge rods, gauge plates, insulated joints, and insulated ductwork. Refer to S&C General Instruction GI-332.	Replace insulators.
			Ensure track appliances are inspected regularly in accordance with GI-332.

Problem	Impact on Switch Machine	Probable Cause	Corrective Action
Loose rail braces. Loose or missing clips, spikes, bolts or anchors.	Results in switch point misalignment, which affects the adjustment of the switch machine connecting rods resulting in loss of correspondence.	Lack of switch maintenance.	Promptly replace all missing hardware. When hardware is missing it results in overloading of remaining components resulting in premature wear and failure.
	Allows excessive rolling of the stock rail head resulting in point movement and loss of correspondence.		
Ties not properly spaced	Front rods and 1st, 2nd, 3rd, rods rub against the ties, resulting in friction resistance causing the switch machine to overload.	Switch not properly installed or maintained.	Reposition ties and install appropriate tie straps if missing.
The front rod or the 1st switch rod is rubbing against either head block tie.	Fluctuating temperatures causes rails to run and contributes to misalignment of the front rod and 1st switch rods resulting in loss of correspondence.	Switch is not properly installed.	Ensure that switch points are flush with head block tie during initial installation.
	Running switch points cause front rod or 1st switch rod to dig into the 1st or 2nd head block ties resulting in friction resistance, which overloads the switch machine.	Switch is not properly surfaced or anchored causing switch points to move or run under train traffic.	Ensure every tie is box anchored through the turnout and on either side by 200 ft. (60.9 m) In problem areas (directional running, bottom of grades) additional anchoring should be considered.
			Check tie spacing and readjust as necessary.

Problem	Impact on Switch Machine	Probable Cause	Corrective Action
Damaged or worn head block ties.	This results in the fastening bolts securing the switch machine and extended gauge plate to the head blocks to loosen resulting in loss of switch machine adjustment.	Lack of switch maintenance.	Replace head block ties as required. Consideration should be given to installing new gauge plates with the attached switch machine plate (Standard Plan GTS-520)
Excessive ballast in crib.	Excessive ballast in crib and around moving parts can create additional resistance to throw resulting in switch machine overloading.	Lack of switch maintenance.	Ensure adequate and appropriate ballast levels in all cribs, providing space for throw rods to move where applicable. All excess ballast that could interfere with switch point movement should be swept clear.
Tie straps at switch or helper crank loose or not in place.	Misalignment of ties results in rods eventually rubbing against the ties, causing the switch machine motor to overload.	Switch not properly installed. Lag screws pulled loose.	Re-install straps and tighten lag screws ASAP.
Helper crank not properly aligned.	Excessive down stroke of helper crank results in excessive force on the switch machine.	Incorrect height of helper crank.	Re-align helper height if possible; consider replacement with a helper crank of correct height.

Problem	Impact on Switch Machine	Probable Cause	Corrective Action
Damaged helper rod assembly.	Bent or broken helper rods result in additional force required to move the points and therefore higher motor current which can result in switch machine motor overload. This may also lead to additional switch point wear.	Track machines and other heavy work equipment drive over helper rods.	Replace or repair damaged components ASAP.
Over-tightening of helper rods.	Excessive pressure on the helper rod can prevent the switch from locking up. The helper only needs to move the back of the point into proper position.	Improperly adjusted helpers.	Ensure hardware is inspected regularly in accordance with GI-329(a), 329(b) (3) and 409, and that necessary adjustments are made promptly as required.
Loose fastening bolts securing switch machine.	Results in loss of switch machine adjustment.	Lack of switch machine maintenance.	Ensure bolts are inspected regularly in accordance with GI- 329(a) and adjust immediately.
		Damaged or worn head block ties (see above).	Install new switch plates
Missing or loose fastening hardware.	Loose switch components cause switch point misalignment resulting in switch machine motor overloading and loss of correspondence.	Switch point bolt cotter keys, lock washers, lag screws broken or loose.	Ensure fastening hardware is inspected regularly in accordance with GI-329(a) and GI-409, and adjust or replace immediately as required.

Problem	Impact on Switch Machine	Probable Cause	Corrective Action
Loose or worn ball end point lugs, rod bushings, bear paws, clevises, bent point detector or lock rods.	Excessive lost motion between the points and switch machine throw rod, lock rod, or point detector rod can result in loss of correspondence, or failure to properly detect an open point.	Lack of switch maintenance.	Ensure a general inspection in accordance with GI-329(a) is performed regularly and necessary adjustments or replacements are performed ASAP.
Excessive wear of point detector wear plates on GRS machines.	A gap of more than .060 in. (1.5 mm) between the top of the point detector rod and GRS Model 5 switch machine housing will cause excessive motion of the point detector rod resulting in loss of correspondence.	Lack of switch maintenance.	Ensure wear plates are inspected regularly in accordance with GI-329(c) (4), and replace as required.
Snow clearing device nozzles obstructing points.	Snow clearing device nozzles must be installed with 2 to 3 in. (51 -76 mm) of clearance to the point. Failure to do so can result in unreliable switch locking.	Improperly installed nozzles.	Ensure nozzles are correctly installed and inspected regularly.
			Plan for refurbishment of SCDs as required.
Snow and ice buildup under base of points.	Excessive snow and ice buildup can create obstruction or increase resistance to throw resulting in switch overloading.	Poorly adjusted or maintained snow clearing device.	Ensure regular inspections of snow clearing devices are performed.
		Incorrect type of snow clearing device for local environment.	Plan for refurbishment of SCDs as required.

Recommended Method 3500-1: Turnout Inspection

Items to Check	Regulatory Requirements	TS Requirements
Ballast and Drainage	• must restrain track laterally, vertically and horizontally (for thermal and mechanical loads) • provide adequate drainage • maintain proper cross-level, surface and alignment	• Cribs full except for switch point area for drainage as required in winter months. • Ballast shoulder not less than 12 in. (305 mm). • No standing water or indications of it.
Line, gauge, surface, and cross level	TC Rules Respecting Track Safety Part II - C II, C III, C VI	• Per Track Standard Section 16
Ties	TC Rules Respecting Track Safety Part II - D II	• Sound and holding spikes. • Properly spaced and square to track. • Firmly tamped for 16 in. (406 mm) on each side of mainline and turnout rails • Head block ties tamped as above with no voids under remainder of tie
Plates	TC Rules Respecting Track Safety Part II - D VI	• None broken. • None missing. • Not worn in excess of 1/8 inch (3 mm).
Rails (Including switch rails, closure rails, stock rails, and frog rails)	• Stock rails securely seated in switch plates, not canted by badly adjusted rail braces. TC Rules Respecting Track Safety Part II - D XII (a)	• Note rail condition such as rust streaks, ordinary breaks, vertical or horizontal split heads, engine burns, broken bases, and crushed heads. • End batter or mismatch not exceeding 1/8 " (3 mm) at toe of frog and heel of frog and switch.
Fasteners	• The fastenings must be intact and maintained so as to keep the components firmly in place. TC Rules Respecting Track Safety Part II - D XI (a)	• Fully spiked (except hook twin tie plates which will have only one spike per plate end) or fastened with tie screws and rail clips. • Spikes fully driven or timber tie screws drawn down.
Castings		• No broken castings (heel

		blocks, anchor blocks, rail braces, etc.) except frog casting heel extension.
Bolts	TC Rules Respecting Track Safety Part II - D V	• None loose, broken or missing. • All tight (torque per Track Standard Section 13.4) • Spring washers, flat washers or cotter pins present as required
Rail Anchors	• Classes 4 through 6 track must be equipped with rail anchors through and on each side of track crossings and turnouts, to restrain rail movement affecting switch points and frogs. TC Rules Respecting Track Safety Part II - D XI (a)	• On main track or in CWR territory: o Fully anchored on both tracks through turnouts (except where anchors will interfere with switch points). o Fully anchored for 200 ft. (60.1 m) in both directions beyond the turnout. • On other tracks, sufficient number of rail anchors to restrain rail movement affecting switch points and frogs.
Insulation		• In place and functional.
Lubrication	• Each switch point must fit its stock rail properly • Lateral or vertical movement of a stock rail in the switch plates or of the switch plate on a tie must not adversely affect the fit of the switch point to the stock rail. TC Rules Respecting Track Safety Part II - D XII (b)	• Slide plates clean and lubricated. • Switch stands lubricated. • Spring assemblies and base plates of spring frogs lubricated. • Special assemblies such as pipe connected derails and auxiliary throws, lubricated.
Switch Point Fit	• Unusually chipped or worn switch points must be repaired or replaced. • Metal flow must be removed to ensure proper closure TC Rules Respecting Track Safety Part II - D XII (b)	• Points not overhanging gauge plate not more than one in. (25 mm) back from front edge. • The entire planed portion of the rail head on switch points fits tight against stock rails. • Point of switch rail not less than 1/2 in. (13 mm) below top of stock rail. • No sharp kinks, loose bolts or rivets • No broken, bent or weld

		repaired clips or stop blocks. • No switch or connecting rods to be bent or broken or corroded to a depth exceeding 1/8 in. (3 mm.) • No weld repaired switch or connecting rods
Thickness / Flow	• Unusually chipped or worn switch points must be repaired or replaced. • Metal flow must be removed to ensure proper closure TC Rules Respecting Track Safety Part II - D XII (b), (h)	• On point ends which are chipped or broken the thickness must not exceed 3/16 in. (5 mm). • Flow should not exceed 1/16 in. (1.5 mm) on switch point or gauge side of stock rail.
Running Surface	• Each switch must be maintained so that the outer edge of the wheel tread cannot contact the gauge side of the stock rail. TC Rules Respecting Track Safety Part II - D XII (c), (h)	• Running surface of points should be ¼ in. (6 mm) above stock rail. When less than 3/16 in. (5 mm) above the stock rail monitor for signs of contact.
Heel of Switch	• The heel of each switch rail must be secure and the bolts in each heel must be kept tight. TC Rules Respecting Track Safety Part II - D XII (d)	• No missing, loose , bent or broken bolts • No missing cotter pins, if required.
Switch Locks / Keepers	• Each throw lever must be maintained so that it cannot be operated with the lock or keeper in place. TC Rules Respecting Track Safety Part II - D XII (f)	• Main track switches must be secured with an approved switch lock. • Other track switches secured with lock or keeper, as required.
Switch Stand (Inspection / Adjust)	• Each switch stand and connecting rod must be securely fastened and operable without excessive lost motion. TC Rules Respecting Track Safety Part II - D XII (e)	• In good operating condition. Rigid stands must have 1 ¾ in. (44 mm) crank eyebolts. • Switch handles of rigid switch stands cannot be placed in locking position with normal pressure when 1/8 in. (3 mm) shim placed between point and stock rail at first rod (check for lost motion).

		• The throw at the No. 1 rod and the auxiliary throw rod, where applicable, will be according to plan. • All switch rod and connecting rod bolts, except those under switch stand, with nuts up and protected by cotter pins.
Switch Targets	• Each target must be clearly visible at all times. TC Rules Respecting Track Safety Part II - D XII (e)	• Required targets per standard in place, visible, in good condition and displaying proper indication.
General	• If a frog point is chipped, broken or worn more than 5/8" (16 mm) down and 6 in. (150 mm) back, operating speed over that frog may not be more than 10 mph. • If the tread portion of a frog casting is worn down more than 3/8 in. (10 mm) below the original contour, operating speed over that frog may not be more than 10 mph. TC Rules Respecting Track Safety Part II - D XIII (b), (c)	• Heel risers not broken nor flowed sufficient to bow point rails. • Point and adjacent running surfaces not broken, chipped or excessively worn: 3/8 in. (9 mm) maximum • Good line on through track. • No broken , loose, bent or broken plates
Flange-ways	• Flange-way depth: o On Class 1 track may not be less than 1 3/8 in. (35 mm) or o On Classes 2 through 6 track not less than 1 1/2" (38 mm). • Flange-ways must be at least 1 ½ in. (38 mm) wide TC Rules Respecting Track Safety Part II - D XIII (a)	• Clear of foreign objects. • Not less than 1-1/2 in. (38 mm) deep. • Not less than 1-3/4 in. (44 mm) wide.
Spring Frogs	• Clearance between horn and hold-down housing not exceeding 1/4 in. (6 mm) • Each spring must have a tension sufficient to hold the wing rail against the point rail. • The outer edge of a wheel	• Horn not binding on hold down housing. • Each spring must have sufficient compression to hold the wing rail against the point rail. • Note: wing rail of 115 lb. and 132/136 lb. spring frogs is designed to be

	tread may not contact the gauge side of a spring wing rail. • The toe of each wing rail must be solidly tamped and fully and tightly bolted. • Each (spring) frog with a bolt hole defect or head-web separation must be replaced. TC Rules Respecting Track Safety Part II - D XIV	open 3/8 in. (9 mm) at the half inch point). • When spring wing rail is open, the opening between wing and point rail must not be less than 1 ¾ in. (44 mm) at any point. • No broken, loose or missing hold down bolts • Retarder, where installed, allows for full closure of wing rail in greater than 1 but less than 3 minutes.
Self-Guarded Frogs	• The raised guard rail on a self-guarded frog shall not be worn more than 3/8 in. (9.5 mm). • If repairs are made to a self-guarded frog without removing it from service, the guarding face must be restored before rebuilding the point. TC Rules Respecting Track Safety Part II - D XV	• Self-guarded frogs must not be used on turnouts where speeds will exceed 15 mph.
Guard Rails		
Guard Check Gauge / Guard Face Gauge	• Guard check gauge (distance from guard face of guard rail to gauge side of frog) • Free of obstructions that may interfere with the passage of wheels TC Rules Respecting Track Safety Part II - D XVI	• Distance between the gauge side of the frog and the bearing side of the guard rail should be maintained at 54 5/8 in. (1,387 mm), and shall not be less than Regulatory Requirements. • Side wear on raised guard bar must not exceed 5/8 in. (16 mm)
Surface	TC Rules Respecting Track Safety Part II – C.6	• Look for surface deviations such as hanging ties at the heel block area • Look for surface conditions about 1-2 car lengths ahead of the turnout. Look particularly for low joints • Address drainage issues and muddy spots

Section 18 Electronic Track Inspection

18.1. General Information

1. An Electronic Track Geometry Inspection vehicle is an automated track inspection vehicle used to measure, calculate and record geometric parameters of the track.
2. Two types of track geometry inspection vehicles, defined below, can be used to measure and evaluate track geometry.
   a. Light Geometry Inspection Vehicle (LGIV)
      i. must be capable of measuring:
         - Alignment / Curvature
         - Superelevation / Cross Level
         - Unloaded Gauge
         - GO Transit Track Standards and parameters calculated from these measurements
         - Transport Canada Rules Respecting Track Safety and parameters calculated from these measurements
      ii. GO Transit typically uses, an Andian truck as a LGIV
   b. Heavy Geometry Inspection Vehicle (HGIV)
      i. must have a vertical wheel load minimum of 10,000 lbs (4,545 kg) and be capable of measuring:
         - Surface / Longitudinal Profile
         - Alignment / Curvature
         - Super Elevation / Cross Level
         - Loaded and Unloaded Gauge*

- GO Transit Track Standards and parameters calculated from these measurements
- [Transport Canada Rules Respecting Track Safety](#) and parameters calculated from these measurements

* L/V ratios from 0.67 and less than 0.7 are acceptable. For safety reasons, test loads will be turned off when actual loaded gauge readings reach 58 in. (1,473 mm) which is equivalent to 1.5 in. (38 mm) wide gauge.

ii. GO Transit operates the Integrated Rail Inspection System (**I.R.I.S.)** truck for this purpose. This truck is also equipped with measurement capabilities for:

- Rail wear
- Ultrasonic rail testing

iii. Measurements obtained with this vehicle are considered dynamic geometry measurements representative of the track in a loaded condition.

3. A Rail Flaw Inspection is a continuous search for internal defects.

   a. As previously mentioned in 18.1.2.b.ii, GO Transit uses the I.R.I.S. truck to complete their Rail Flaw inspections.

18.2. Types of Test Methods

1. There are three types of test methods

   a. Track Geometry and Gauge Measurements

   b. Rail Surface and Internal Flaw Recordings Testing

   c. Rail Wear Measurement

2. Geometry and Rail Wear typically occur simultaneously.

3. On the I.R.I.S. truck, all three tests can occur simultaneously. However, when run simultaneously,

these tests are limited to the most restrictive speed of the equipment.

18.3. Frequency of Testing

1. Minimum track inspection frequencies shall be as outline in the Transport Canada Rules Respecting Track Safety, but not less than in Appendix B – Track Inspection Frequencies in Table 48 and Table 49.
2. An automated geometry inspection is required for all tracks.
3. If a portion of track cannot be inspected at the required interval, the CM Senior Manager of Track and Structures may permit a reduced frequency up to that mandated by the Transport Canada Rules Respecting Track Safety.
4. Should the Transport Canada Rules Respecting Track Safety required interval not be met, the railway must, before the expiration of the time or tonnage limits:
    a. Inspect that segment of track with a LGIV and be governed by the results of that inspection or perform an additional visual inspection per week until the required track geometry inspection frequency can be met;
    b. In the case of Class 3 to Class 5 track the next required track geometry inspection must be completed with a heavy geometry inspection vehicle;
    c. Reduce class of track to bring the track into compliance until such time as a valid track geometry inspection can be made; or
    d. If a portion of a crossover cannot be inspected at the required interval, the railway must, before the expiration of time or tonnage limits, perform a detailed inspection of both turnouts and the track in between.
5. A rail flaw inspection is required for all tracks.
    a. Yard tracks, also require rail flaw inspections.
    b. Where a test on the above cannot be performed the yard track speed cannot exceed 10mph.

6. If a valid search for internal defects cannot be conducted for any reason, the CM Senior Manager of Track and Structures may permit a reduced frequency up to that mandated by the Transport Canada Rules Respecting Track Safety.

7. Should the Transport Canada Rules Respecting Track Safety required interval not be met, the railway must, before the expiration of the time or tonnage limits:

   a. Conduct a valid search for internal defects, or

   b. Reduce class of track per Section 18.4.

18.4. Rail Flaw Detection (Ultra-Sonic)

1. Rail on main tracks, including crossovers and sidings contained on such lines will be ultrasonically tested (UTT) at the frequencies prescribed in Appendix B – Track Inspection Frequencies. The CM Sr. Manager of Track and Structures may increase the testing frequency or request additional rail flaw testing at critical locations or on non-main track as required. This policy also covers the following two areas:

   a. Used rail purchased from 3rd parties.

   b. Rail removed from track if it is to be reused.

2. For new construction, rail on all tracks must be ultrasonically tested prior to placing the new tracks in service unless otherwise authorized in writing by the CM Sr. Manager of Track and Structures.

3. A qualified person shall undertake ultrasonic inspection of rail. Rails that have been ultrasonically tested will be kept segregated from those that have not been tested (preferably on separate rail racks) and will display the markings as detailed below.

4. As grease interferes with proper ultrasonic testing, all lubricators must be shut off sufficiently in advance of any Ultrasonic Rail Testing to ensure no grease is present. Lubricators must be reactivated immediately after testing.

5. Rails to be tested out of track must be wire brushed to remove rust and scale. Rails shall have a complete

ultrasonic test for the full length of the rail. Ultrasonic tests will be undertaken using equipment capable of traversing single rails. Such equipment is not capable of testing the ends of the rail. Therefore, both rail ends must be tested using portable hand test units. Where the rail head has surface defects that prevent the ultrasonic inspection of the rail, such defects must be cut out or the rail scrapped.

6. Rails tested under this policy and found to be free of internal defects will be either identified by the letters “UTT” (for Ultrasonically Tested) or “UTC” (for Ultrasonically Certified), depending on the rails origin. These rails will be marked by minimum 2 in. (51 mm) high letters on the web of the rail in white paint or paint stick, along with the date tested. Rails tested shall be marked in the web starting 3 ft. (914 mm) from the end of the rail. The difference in markings (e.g. “UTT” or “UTC”) is to identify whether the rail was generated internally by the railway or obtained from an external source.

7. Rail tested under this policy and found to contain a defect must be marked:

   a. With permanent yellow paint on the web of the field and gauge side of the rail

   b. With white paint stick marker, 2 inch high, right side up letters indicating:

      i. Defect number / defect type / Defect size

      ii. Milepost / Date of Test / Unit Number

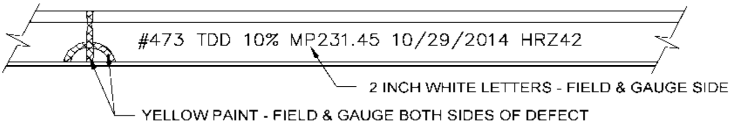


Figure 34. Rail Marking for defects

8. Used rail purchased from third parties must have an accompanying written certification that the rail has been ultrasonically tested after being removed from track and has been found to be free of internal defects. Rail must

be marked with the letters “UTC” as per the above, along with the date and supplier initials. Company owned rail sent to 3rd parties for welding must be tested, certified, and marked in the same manner.

9. Rail which contains a defect and has been removed from track immediately following a rail flaw detection run may be immediately reused or stock piled for later use, providing that all of the following is adhered to:

    a. Once the rail is removed from track, it is ascertained that the defect has been removed from the rail; and

    b. The rail is marked on the web with the letters “UTT” and the date it was ultrasonically inspected by the Rail Flaw Detection car.

10. Rail Removed from Track with:

    a. Less than 10 MGT accumulation since the last ultrasonic rail flaw detection run can be reinstalled in track without speed restriction. However, it must be marked “UTT” and the date of the last Rail Flaw Detection Run immediately after being removed from track. It can then be placed on the racks along with other tested rails.

    b. Greater than 10 MGT accumulation since the last ultrasonic rail flaw detection run shall be subject to one of the following procedures:

        i. The rail shall be considered as not having been ultrasonically tested and must be ultrasonically tested as soon as possible and the letters “UTT” marked on the web with white paint or paint stick along with the date tested. It must then be placed on the racks along with other tested rails;

        ii. If absolutely necessary to reinstall the rail without ultrasonically testing the rail after its removal from track, that portion of track must be speed restricted to maximum Class 2 track (25 mph freight, 30 mph passenger) until such time as the rail has been ultrasonically tested; or

c. Rail that has been removed from sidings, crossovers and connections, where the accumulated MGT since the last Ultrasonic Rail Flaw Detection run is not available, may be reinstalled in track if such rail was removed from track within 90 days after the last Ultrasonic Rail Flaw Detection run. The rail must be marked with the letters “UTT” along with the date of the last Ultrasonic Rail Flaw Detection run, on the web. It must then be placed on the racks along with other tested rails.

11. If a piece of rail is cut from a length of rail previously tested and marked UTT or UTC, the marking UTT or UTC and the applicable date of test must be transferred to the piece of rail cut off, so that both pieces are correctly marked.

12. No Test Rail (NTR) is rail that the rail flaw detector car is unable to test for whatever reason. Defect code NTR will appear on the list of defects.

13. If an NTR is detected in Class 3 or higher, one of the following actions are required:

    a. Mark the defect as per Track Standard Section 18.4.7 using the following coding:

        i. NT1 – Rail found to be a NTR for the first time

        ii. NT2 – Rail found to be a NTR for a second consecutive UTT inspection

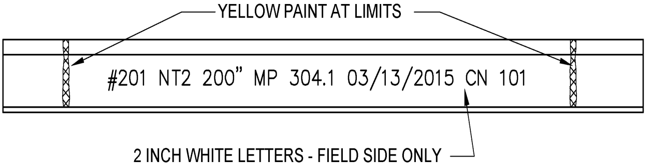


Figure 35. Marking a No Test Rail

    b. After a NTR is detected for the first time, the rail must be re-inspected ultrasonically within 30 days.

If the NTR is on a major structure (bridge, overpass, or in a tunnel), there must be an immediate one class reduction in speed. A second consecutive NTR in the same location will require a Class 2 speed restriction and the rail replaced within 7 days.

c. After a second consecutive NTR in the same location for Class 3, 4 and 5, a Class 2 speed restriction must be placed and the rail replaced within 7 days.

14. To correct a NTR, any of the following actions can be taken:

a. Hand test and ensure proper test performed;

b. Take corrective action on the rail to remove the reason for the NTR, e.g., use a grinder to remove corrugation or shelly so the rail flaw detector can perform a good test, Ensure lubricators are turned off and rail is not covered in grease;

c. Change the rail; or

d. Reduce speed to Class 2, and change the rail within 7 days unless otherwise directed by the CM Sr. Manager of Track and Structures.

15. No Test Rail, after remedial actions are taken which allow for a successful UTT inspection, and the RFD operator will mark the rail with:

a. “UTT”, plus RFD Test Car ID, date of successful UTT inspection and operators initials.

b. Black paint will cover over previous yellow paint.

Figure 36. Marking a NTR after a successful UTT test

16. Refer to Track Standard sections 4.15 and 4.16 for details on handling failures and defects in CWR.

18.5. Track Geometry Testing

1. Where speed related track geometry defects are detected during track geometry (I.R.I.S.) truck inspections, Appendix E – Allowable TSO for IRIS Truck Defects – Passenger and Appendix F – Allowable TSO for IRIS Truck Defects – Freight may be used to determine the maximum Temporary Slow Order speed to be applied for the seventy-two (72) hour period immediately following the inspection.
2. If the track defect has not been repaired upon the expiration of the seventy-two (72) hour period, the temporary slow order speed must be revised, restricting trains to a maximum speed that is within the track class allowed by the severity of the defect(s). (See Appendix D – Urgent Defects)
3. All URGENT defects must be corrected as soon as possible, and in no case will speed restrictions be removed until the URGENT defects have been checked on the ground and corrective actions are taken, as required.
4. All PRIORITY and NEAR URGENT defects must be monitored and corrected as per the requirements of Track Standard section 16.1.6.a.
5. Details of remedial action or speed restriction applied must be recorded on the exception reports initialled and dated for all defect types.
6. All gauge defects determined by the loaded gauge method must be field verified.
    a. Loaded gauge values should sum the unloaded measurements plus all signs of additional lateral rail movement.
    b. Delta Gauge is the difference between unloaded (static) and loaded (dynamic) gauge measurements.
    c. Gauge Widening Projection (GWP) – is a calculated value that gauge could reach in the event of a severe train brake application.

18.6. Rail Wear Testing

1. Rail wear testing shall be done simultaneously with track geometry testing when using the IRIS truck or any other inspection vehicle capable of simultaneously testing.
2. The Track Supervisor is responsible to review the rail wear report, and compare it to previous reports. This will aid the Supervisor to determine areas for planned rail replacement programs. This does NOT include transposing of the rail.
3. If automated rail wear testing is not available, the Track Supervisor shall manually measure and record the rail wear at least annually.
4. Rail wear shall be in conformance to Track Standard Section 4.6, and not exceed the limits in the applicable table in Appendix G – Rail Wear Limits
5. Should rail wear meet or exceed increased monitoring limits, the underside of the head must be physically inspected.
    a. See Section 15.5 for details on under-head inspection.

18.7. Vehicle Track Interaction (V/TI)

1. V/TI monitors are currently being tested on the GO Transit network. As such no TSOs will be associated with the V/TI monitors until sufficient test data is available.
2. Clauses 3 through 4 below are to be used for guidance.
3. V/TI is a locomotive based track measurement system that evaluates how the vehicle interacts with the track. The measurements reported are:
    a. Car body vertical (CBV)
        i. Locations are profile spots the locomotive is going up or down. Typically found around bridge approaches, road crossings, and mud spots.

b. Car body lateral (CBL)

i. Locations of where the locomotive rocks from side to side. Typically caused by cross-level and twist.

c. Truck lateral (TRL)

i. Usually is poor alignment spot or a problem with the locomotive truck.

d. Axle Vertical (AXV1 and AXV2)

i. An axle vertical exception is measured when the wheel hits a spot in the rail such as:

- Rail-to-rail crossings;
- Crushed heads;
- Joints with broken or cracked joint bars, or contact with the top of the joint bar;
- Frogs with heel or point conditions;
- Broken rails; or

e. Mid Chord Offset (MCO1 and MCO2)

i. MCO conditions are short profile locations such as missing spikes, missing plates, cracked bars, mud spots, crowned welds, bridge transitions, tie clusters, or switch support.

4. Two levels of V/TI exceptions require action – CRITICAL and HIGH priority.

a. CRITICAL Priority

i. Track must be inspected immediately.

b. HIGH Priority

i. Inspect track within 24 hours.

Section 19 Track Construction

19.1. Minimum Construction Standards

1. Appendix O – Minimum Construction Standards indicates the minimum standards and tolerances for the construction, and upgrades of all GO Transit track.
2. Only GO Transit approved track materials will be used for construction on GO Transit property.
3. All new main line track construction shall use concrete ties, except in turnouts, grade crossings, and special track-work or as specified by the CM Sr. Manager of Track and Structures.
4. Hardwood ties shall be Grade 1, 100% end plated, creosote treated and conform to the GO Transit's approved Timber Cross Tie and Switch Tie Specifications.
5. All new ballast to be used on mainlines shall be Class 1 and conform to the GO Transit Crushed Rock Track Ballast Specification.
   a. AREMA Class 4A gradation shall be used for all Steel tie applications.
   b. For more detailed ballast quantities, reference Standard Plan GTS-2205
6. All new track designs must be reviewed and approved by the Engineering – Track and Structure group, AND the CM Sr. Manager of Track and Structures prior to construction.
7. The maximum allowable effective elevation grade for track construction shall be 2.0%, unless authorized in writing by the CM Senior Manager of Track and Structures.
   a. Effective grade is a combination of the horizontal degree of curve and the grade. Every degree of curvature adds an effective 0.04% to the design grade.

8. New designs will limit the maximum curvature to 8 degrees unless specifically authorized by the CM Senior Manager of Track and Structures. Track designs with curvatures in excess of 8 degrees shall have additional requirements.

9. CM track inspectors will be required to inspect any track being placed into service, including non-main track construction.

10. Derails must be installed, where required. See Track Standard Section 10.3.

11. Turnouts shall be installed as per Track Standards Section 13

12. Heavy construction equipment, or other equipment not easily stored or removed from the right-of-way and required to facilitate the construction of a railway improvement, may be left on the right-of-way outside of working hours provided that:

    a. The equipment is parked at a minimum of 25 ft. (7.62 m) from any track.

    b. The equipment shall not be left within 500 ft. (152.4 m) of a roadway crossing

    c. Shall not impede the sightlines for public, contractors, construction crossings, and train operations;

    d. The equipment is locked;

    e. All tools and extraneous equipment is secured and out of view;

        i. Any booms or extendable apparatus shall be retracted and set in their lowest position, and locked out where possible. Review and approval of a methodology plan is required.

    f. Cannot be made to be moved in any way that the equipment will obstruct the movement of a passing train, or track equipment.

    g. Contact information for the Contractor storing this equipment has been made available to the CM Manager of Track.

h. If so authorized in writing by the CM Senior Manager of Track and Structures, the equipment can be stored in a location where all portions of the equipment are outside of the standard clearance envelope;

i. A GBO will be required if the equipment is parked within 14'7" (4.45 m) of the nearest rail.

13. Direct Fixation systems shall be designed and use components specifically designed and tested to resist Cooper E-80 train loading with diesel impact.

19.2. Construction Tolerances

1. Appendix O – Minimum Construction Standards indicates the allowable tolerances for the construction of track.

19.3. Track Clearances and Centres

1. The requirements of this Track Standard apply to all tracks over which the railway operates, regardless of location; and for all clearances regardless of whether they are temporary or permanent.

2. For new construction, track centres shall comply with the minimum distances between track centre lines prescribed by Table 38:

Table 38 Track Centres

Track Type	Track Centres
Main Tracks	13 ft. (3,962 mm)
Main and Siding Track	14 ft. (4,267 mm)
Main tracks and parallel yard tracks	14 ft. (4,267 mm)
Yard Tracks	14 ft. (4,267 mm)
Yard Tracks with pedestrian walkways	16 ft. (4,877 mm)
Yard Tracks with a service road between tracks (road at top of tie elevation)	24 ft. (7,315 mm)

Yard Track with service road and lighting poles	28 ft. (8,534 mm)
Yard track with 2 way road between tracks)	32 ft. (9,754 mm)
Yard Track with 2 way road and lighting poles	33 ft. (10,058 mm)
Ladder and other tracks	15 ft. (4,572 mm)
Parallel Ladder tracks	18 ft. (5,486 mm)
Passenger Station tracks without a platform between	13 ft. (3,962 mm)
Team tracks in pairs	12 ft. (3,658 mm)

3. The minimum distance between track centre lines shall be increased to account for curvature and superelevation as follows:

   a. By adding 2 in. (51 mm) per degree of curve or 12 in. (305 mm), whichever is less.

   b. Where the superelevation of the outer track exceeds the superelevation of the inner track add an additional 2½ in. (63 mm) per 1 in. (25 mm) of difference in curve superelevation between the adjacent tracks.

4. Should it not be possible to construct to the above clearance measurements, the CM Senior Manager of Track and Structures should ensure the proposed encroachment does not impact railway safety and that appropriate departments (e.g. Rail Services, CM, Standards, System Safety, etc.) and Transport Canada, where required, are advised of the less than standard clearance.

5. Track centre distance must not decrease without the authority of the CM Senior Manager of Track and Structures.

6. Existing track centres between the main line and existing adjacent tracks must be maintained to a minimum centreline to centreline as defined in Table 38. Track centres measuring less than specified in any location should immediately be reported to the CM Senior Manager of Track and Structures.

7. The clearances for railway bridges, structure, or catenaries, shall meet or exceed dimensions shown in Appendix X – GO Transit Heavy Rail Clearance

Envelopes. Any deviations from the required clearances must be approved in writing by the CM Senior Manager of Track and Structures prior to any construction work occurring.

8. All clearances for passenger station platforms shall be as per Track Standards Section 23
9. The standard clearance diagrams applicable to all tracks in the GO Transit system can be found in Appendix X – GO Transit Heavy Rail Clearance Envelopes.

19.4. Curve Design

1. Curve design shall meet the requirements of AREMA and the GO Transit Track Standards. Where these standards contradict each other, the more restrictive shall apply.
2. See Track Standard section 4.5.2 and 4.5.4 for additional requirements on high degree curves.
3. The superelevation must be constant on the circular curve (body) and increase/decrease at a uniform rate on the spiral.
4. Where the guidelines for either superelevation or spiral length cannot be met, the permissible speed of traffic through the curve would need to be reduced to allow conformance.
5. The basic equation relating superelevation, degree of curve, and speed of train can be found in equation (1):

$$E = 0.0007 \cdot D \cdot S^2 - E_u \qquad (1)$$

E: $Superelevation$ $(inch)$
D: $Degree\ of\ Curve$ $(decimal\ degrees)$
S: $Speed$ (mph)
E_u: $Imbalance$ $(inch)$ $(see\ Clause$ $19.4.10)$

6. When there is no imbalance (E_u = 0) the curve is “balanced“ or at equilibrium: the superelevation of the curve offsets the centrifugal force of the equipment traveling around the curve.

7. Appendix N – Curve and Vmax Tables lists the balanced and imbalanced superelevations for various curvatures and train speeds.

8. The maximum allowable operating speed for each curve is determined by equation (2) :

$$V_{max} = \sqrt{\frac{(E_A + E_u)}{0.0007 \cdot D}} \qquad (2)$$

V_{max}: *Maximum Operating Speed* (*MPH*)
E_A : *Actual Superelevation* (*inch*)
E_u: *Imbalance* (*inch*)
D : *Degree of Curve* (*decimal degrees*)

For the purposes of calculation V_{max} only, the actual elevation for each 155 ft. track segment in the body of the curve is determined by averaging the elevation for 11 points through the segment at 15 ft.6 in. (4.72 m) spacing. If the curve length is less than 155 ft. (47 m), average the points through the full length of the body

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

9. As curves may go out of cross level or be subjected to change in cross level as a result of rail replacement, design superelevation shall not exceed 5 in. (127 mm) without the authority of the CM Senior Manager of Track and Structures.

10. The minimum superelevation that can be applied on a curve shall be the greater of:

   a. ½ in. (13 mm) on Class 2 track or higher. Preferred minimum superelevation on all GO Transit track is ½" (13 mm).

   b. 1 in. (25 mm) below the balanced elevation for Canadian Pacific Freight dispatched tracks.

   c. 2 in. (51 mm) below the balanced elevation for Canadian National Freight dispatched tracks.

   d. 3 in. (76 mm) below the balanced elevation for all passenger trains;

e. A maximum of 4 in. (102 mm) below the balanced elevation for GO Trains and UP DMU's (GO Transit is exempt from the Transport Canada rule in item d.;

f. 6 in. (152 mm) below the balanced elevation for LRC (Light Rapid Commuter) Timetable Speed.

11. Superelevation imbalance shall be minimised and designed as close to a balanced condition as possible. Where a negative freight imbalance is unavoidable, the designed negative imbalanced superelevation values for freight need to be reviewed and approved in writing by the CM Sr. Manager of Track and Structures.

12. The degree of a curve is determined by stretching a 62 ft. (18.9 m) chord on the gauge side of the outer rail of the curve. The distance in inches between the centre of this chord and the gauge side of the rail is the degree of the curve.

13. The curve tables give the desired curve superelevation for a given curvature and train speed, and alternatively give the maximum train speed for a given curvature and curve elevation. See Appendix N – Curve and Vmax Tables for balanced and imbalanced superelevations.

14. Rail Services, Corridor Maintenance, and Engineering – Track and Structure must be consulted regarding the required zone speeds.

a. A zone speed analysis may be required to determine the proposed Timetable speed.

15. For each type of traffic (passenger, freight, LRC) determine the balanced superelevation. From there establish the maximum and minimum allowable superelevation that can be applied based on the traffic speed

16. The maximum elevation for the curve will then be the lesser of the maximum elevations that are calculated, the minimum elevation for the curve will be the greatest of the minimum elevations that are calculated.

17. The elevation for the curve can then be anywhere within this range. The minimum and maximum superelevation calculated above will ensure ride quality and safety for

each type of traffic. Selection should therefore be made with consideration to local traffic and conditions using the following guidelines:

a. Using a greater superelevation will result in the weight of slower trains being transferred to the low rail causing damage to the low rail.

b. Using a lesser superelevation will result in faster trains producing greater lateral forces through the curve. This can increase gauge widening and gauge face wear.

18. On main tracks in curves, spirals must be installed between tangents and all curves, and between any two parts of a compound curve if these differ by 1º or more. Spirals provide a transition in both curvature and elevation.

19. On non-main tracks in curves, spirals shall be installed where conditions permit.

20. Where there are adjacent tracks on a curve, the elevation on the outer track must not be more than the elevation of the inner track unless the distance between track centres is increased to make up for the difference in elevation.

21. On a spiral between a tangent and a curve, the elevation must increase/decrease uniformly from the end of a tangent to the beginning of the curve.

22. Similarly, on a spiral between two parts of a compound curve, the elevation must increase/decrease uniformly from the end of the flatter curve to the beginning of a sharper curve.

23. The minimum spiral length will be the greater of the two lengths calculated in the equations for Passenger Comfort (3) and Freight Torsion (4):

$$L = 1.63 \cdot E_u \cdot S_p \qquad (3)$$
$$L = 62 \cdot E_A \qquad (4)$$

$L: Length\ of\ Spiral\ (feet)$
$E_u: Passenger\ Imbalance\ (inch)$
$S_p: Maximum\ Passenger\ Speed\ (MPH)$

E_A : $Actual\ Superelevation\ (inch)$

24. The Passenger Comfort Equation (Equation 3) is used to ensure that the ride quality around the curve is appropriate for the speed of the passenger train and for the superelevation applied. In certain conditions, such as near open deck bridges or between reverse curves, the required length of spiral may not be available. If the spiral length for passenger comfort cannot be obtained this length of the spiral may be reduced by an amount not exceeding 25% at the discretion of the CM Sr. Manager of Track and Structures and must be approved in writing.

25. The Freight Torsion equation (Equation 4) ensures cars can physically negotiate the curve. The equation is designed so that the superelevation is never run off at a rate greater than 1 in. (25 mm) in 62 ft. (18.9 m). For safety reasons, this condition must always be met. At certain locations, such as near open deck bridges or between reverse curves, the required length of spiral may not be available. In order to maintain the appropriate runoff rate, the superelevation would then need to run out on to the tangent. This is only allowable under the following conditions:

    a. The rate of change of superelevation does not exceed 1 in. in 62 ft. e.g. the superelevation is run out for at least the length given by the Freight Torsion Equation (Equation 4).

    b. At least 75% of the superelevation is run out on the spiral.

    c. The maximum permissible speed of passenger trains on the curve is 60 mph. or less.

    d. The requirements for Passenger Comfort are still met: the length of spiral is not less than 75% of that required for Passenger Comfort (Equation 3).

26. Reverse curves and facing point switches of the same orientation shall be separated by a tangent of at least 100 ft. (30.5 m) in length unless otherwise authorized by the CM Sr. Manager of Track and Structures in writing.

a. For non-main tracks the length of the tangents shall conform to the appropriate design manuals.

27. The length of spiral between parts of a compound curve shall be determined by equation 4, where E_A will be modified to be the difference between the superelevations on the different parts of the curve.

Recommended Method 1305-0: Determining Superelevation, Spiral Length and Maximum Train Speed on Curves

All examples assume curves are on the GO Transit Network on Canadian National Railways dispatched track. (For Canadian Pacific Railway dispatched track the Freight superelevations would be calculated based on a 1" imbalance).

Example 1

- Degree of curve: 2º 00'
- Freight: 60 mph
- GO Train: 75 mph
- LRC: 85 mph

Determine Superelevation:

1. Freight

   From Appendix N – Curve and Vmax Tables, balanced Superelevation = 5"

   Imbalance allowed = 3"

   Superelevation = **2"**

2. GO Train

   From Appendix N – Curve and Vmax Tables, balanced Superelevation = 7 7/8"

   Imbalance allowed = 4"

   Superelevation = **3 7/8"**

3. LRC

   From Equation 1, balanced Superelevation = 10 1/8"

   Imbalance allowed = 6"

   Superelevation = **4 1/8"**

Based on the above calculations the maximum superelevation that meets the criteria for each type of traffic is 5" (based on freight and maximum design tolerances set by this Track Standard. The minimum superelevation that meets the criteria is 4 1/8".

Apply the minimum Superelevation

Superelevation = 4 1/8”

Check V_{max}:

Using Equation 2:

V_{max2}= 66 MPH

V_{max4}= 76 MPH

V_{max6}= 85 MPH

The allowable speeds are good for each type of traffic.

Determine Length of Spiral:

From Passenger Comfort (Equation 3)

$L = 1.63 \cdot E_u \cdot S_p$

E_u= 7 7/8” – 4 1/8” = 3 ¾”

S_p = 75 MPH

L = 458 ft.

From Freight Torsion (Equation 4)

$L = 62 \cdot E_A$

L = 256 ft.

The minimum Spiral shall be the greater of the 2.

Spiral Length = 458 ft.

Example 2

- Degree of curve: 5º 00’
- Freight: 40 mph
- GO Train: 45 mph

Determine Superelevation:

1. Freight

From Appendix N – Curve and V_{max} Tables, balanced Superelevation = 5 5/8”

Imbalance allowed = 3”

Superelevation = **2 5/8”**

2. GO Train

From Appendix N – Curve and V_{max} Tables, balanced Superelevation = 7 1/8”

Imbalance allowed = 4”

Superelevation = **3 1/8”**

Based on the above calculations the maximum superelevation that meets the criteria for each type of traffic is 5” (based on freight and maximum design tolerances set by this Track Standard. The minimum superelevation that meets the criteria is 3 1/8”.

Apply the minimum Superelevation

Superelevation = 3 1/8”

Check V_{max}:

Using Equation 2:

V_{max2}= 40 MPH

V_{max4}= 46 MPH

The allowable speeds are good for each type of traffic.

Determine Length of Spiral:

From Passenger Comfort (Equation 3)

$$L = 1.63 \cdot E_u \cdot S_p$$

E_u= 7 1/8” – 3 1/8” = 4”

S_p = 45 MPH

L = 293 ft.

From Freight Torsion (Equation 4)

$$L = 62 \cdot E_A$$

L = 194 ft.

The minimum Spiral shall be the greater of the 2.

Spiral Length = 293 ft.

Example 3

- Degree of curve: 6º 00’
- Existing Superelevation : 4 ¾”
- No Freight
- What is Max GO Train?

Allowable GO Train imbalance = 4”

Balanced Superelevation = 8 ¾”

V_{max} = 45 MPH

S = 45 MPH

Max Speed GO Train Speed = 45 MPH

Example 4

- Degree of curve: 3º 30’
- Freight: 50 MPH
- GO Train: 55 MPH
- Max Spiral Length = 300 ft. (bridge restrictions)

Determine Superelevation:

1. Freight

From Appendix N – Curve and V_{max} Tables, balanced Superelevation = 6 1/8”

Imbalance allowed = 3”

Superelevation = **3 1/8”**

2. GO Train

From Appendix N – Curve and V_{max} Tables, balanced Superelevation = 7 3/8”

Imbalance allowed = 4”

Superelevation = **3 3/8”**

Based on the above calculations the maximum superelevation that meets the criteria for each type of traffic is 5” (based on freight and maximum design tolerances set by this Track Standard. The minimum superelevation that meets the criteria is 3 3/8”.

Apply the minimum allowable Superelevation

Superelevation = 3 3/8”

Check V_{max}:

Using Equation 2:

V_{max2}= 50 MPH

V_{max4}= 57 MPH

The allowable speeds are good for each type of traffic.

Determine Length of Spiral Required:

From Passenger Comfort (Equation 3)

$L = 1.63 \cdot E_u \cdot S_p$

E_u= 7 3/8” – 3 3/8” = 4”

S_p = 55 MPH

L = 359 ft.

From Freight Torsion (Equation 4)

$L = 62 \cdot E_A$

L = 209 ft.

The minimum Spiral shall be the greater of the 2.

Spiral Length should be = 359 ft.

GO TRANSIT RECOMMENDED METHODS

The spiral length required by the passenger comfort formula exceeds the spiral available.

Permission can be obtained from the CM Senior Manager of Track and Structures to reduce the required spiral length by 25%. This would reduce the length of spiral to 270 ft.

$$359\ ft. \cdot 0.75 = 270\ ft.$$

This falls beneath the physical limitation of 300 ft. The spiral length of 300 ft. can be used provide the superelevation is runoff appropriately.

By the freight torsion formula, the superelevation must be runoff over at least 209 ft. Since the GO Train/passenger speed is below 60mph, up to 25% percent of the superelevation can be runoff on the tangent. As this is below the physical restriction, there is no need to runoff the superelevation in the tangent.

Section 20 Drilling and Excavating Around and Under Tracks

20.1. Excavation

1. The Contractor or any person on, under, over and/or adjacent to the Railway Corridor, whether under contract to Metrolinx or not, must make sure of their location before making any excavations, drilling, driving stakes or otherwise penetrating the ground surface.
2. It is the responsibility of the Contractor to arrange and conduct locates of all company's utilities, including but not limited to CN, CP, Metrolinx, and Ontario OneCall. Prior to starting excavation on the right-of-way, the Contractor has to ensure that no specific protocols are in place with all company's utilities
3. Excavations may be suspended by the Owner at any time, but especially during excessively hot periods or when rail temperature exceeds the PRLT.
4. The minimum requirements for trenching and excavations may be found in Appendix W – Excavation Limits Adjacent to a Railway.
    a. Any deviations from the standard profile require the written approval of a Geotechnical Engineer and notification to the CM Sr. Manager of Track and Structures.
    b. All shoring systems, dewatering, tunneling, and structures must be designed and conform to the Metrolinx General Guidelines for Design of Railway Bridges and Structures and the Metrolinx Design and Construction Guidelines for Tunneling on the GO Transit Right-of-Way.
5. All excavations must conform to OHSA requirements.
6. Excavations will be at least 18 in. (457 mm) from the top end of track tie. A 2:1 slope for the ballasted shoulder is required for adequate lateral rail holding capacity.

7. Excavations greater than 8 ft. (2.4 m) in depth must be protected by an adequate barrier at least 4 ft. 6 in. (1.4 m) measured from the edge of excavation on top of every wall of excavation.

8. Excavations flatter than 1.5:1 side slope in Zone 1 are allowed during construction.

    a. If construction is suspended or work will not be conducted for longer than 30 days, the slope shall be restored to a minimum of 2:1 side slope or other as specified by a Geotechnical Engineer.

9. Excavations steeper than 1.5:1 but flatter than 1:1 slope in Zone 2 are allowed under live load only when authorized in writing or supervised by a Geotechnical Engineer.

    a. All slopes in Zone 2 shall be restored to a 1.5:1 slope at the end of the working day, unless authorized otherwise in writing by a Geotechnical Engineer, or protected by a shoring system designed by a Professional Engineer.

10. Excavations with slopes steeper than 1:1 (Zone 3) are not allowed under train loads and require a shoring system designed by a Professional Engineer.

11. Excavations deeper than 12 ft. (3.65 m) will require the design and supervision of a geotechnical engineer.

12. Excavations longer than 100 ft. (30.48 m) must be reviewed and approved in writing by a Geotechnical Engineer to ensure safe train operations.

    a. Otherwise the excavation must be filled in and compacted at the end of the shift or prior to train operation.

13. Adequate dewatering shall be in place during the works to ensure the stability of the excavation.

14. A Professional Engineer must design all excavations that:

    a. Exceed 12 ft. (3.65 m) in width and / or depth.

    b. Exhibit signs of water seepage or are wet.

c. Are within Zone 2 or Zone 3.

d. Require shoring systems.

e. Require blasting operations.

15. For any excavation within 131 ft. (40 m) of a turnout, the Contractor must be prepared to rebuild that turnout.

16. Material excavated shall not be used as backfill, unless it conforms to the backfilling requirements.

a. Backfill material shall not be frozen;

b. Shall be free from any topsoil, organic matter, weak materials, and construction debris; and

c. Oversize materials greater than 6 in. (150 mm) in size shall be discarded.

17. The bottom of the excavation shall be proof-rolled using a heavy compactor.

18. Backfilling shall be carried out from the bottom of excavation in lifts of 6 in. – 12 in. (152 mm – 305 mm and compaction shall be at least 98% SPMDD.

19. Permanent timber lagging subject to railway loading is not permitted, and must be removed when work is completed.

20. Third party works shall adhere to the third party permit process.

21. All excavations shall be subject to monitoring as per Track Standard section 20.2.

a. No open excavation shall be left without visual inspection during long periods of time, i.e., holidays, etc.

20.2. Monitoring

1. Monitoring of excavations, shoring walls, and other construction works adjacent or under a railway corridor can be found in the Metrolinx General Guidelines for Design of Railway Bridges and Structures.

2. A ground movement monitoring or a shoring wall monitoring plan for both vertical and horizontal settlement is required for any excavation works

exceeding the Zone 1 limits in Appendix W – Excavation Limits Adjacent to a Railway, and must be sealed, signed, and dated by a Professional Engineer.

a. The monitoring plan shall include all tracks and any shoring wall.

b. The monitoring plan of the shoring wall shall include a formal procedure for visual inspection, the number of targets and location of the targets at pile locations, as well as all other monitoring instruments / equipment.

c. All monitoring plans shall meet the requirements of the Metrolinx General Guidelines for Design of Railway Bridges and Structures.

3. Monitoring devices shall be installed such that they do not create tripping hazards.

4. Ground movement monitoring and shoring wall monitoring must be completed by a qualified person.

5. A baseline survey shall be established by taking three (3) readings prior to construction, taken on 3 separate days; baseline monitoring must be submitted for review by the Owner/Owner's Representative review prior work commencement.

6. Visual ground movement monitoring readings should be taken a minimum of twice daily (before morning rush hour trains and prior to afternoon rush hour trains) during construction. If requested, reduction of reading intervals may be approved by the CM Sr. Manager Track and Structures.

7. Monitoring via surveying of in-ground monitoring points and rail surface shall be performed daily.

8. No open excavation shall be left without visual inspection during long periods of time, such as holidays, weekends, etc.

9. Readings must be reported regularly to Metrolinx

10. Metrolinx shall have the right to request additional monitoring regarding the frequency and accuracy of monitoring.

11. Should any erratic ground movement be observed or measured, the flagman and CM Manger of Track must be notified immediately.

12. Daily visual monitoring of the track shall be performed. Any cracks in the wall, or movement of the track must be reported immediately to the CM Sr. Manager of Track and Structures, and steps taken to remedy the situation.

13. Track monitoring alert levels are to be defined in the Metrolinx General Guidelines for Design of Railway Bridges and Structures. Table 39 below summarizes the 'alert levels' and the actions to be taken.

Table 39 Track Monitoring Alert Levels

Class of Track	Allowable Limits mm (in.)		Review Limits mm (in.)		Alarm Limits mm (in.)	
	Horiz.	**Elev.**	**Horiz.**	**Elev.**	**Horiz.**	**Elev.**
1 / yard **2**	0 – 10 (0 – 3/8)	0 – 12 (0 – ½)	10 – 15 (3/8 – 9/16)	12 – 20 (½ - 13/16)	>15 (>9/16)	>20 (>13/16)
3 **4** **5**	0 – 4 (0 – 3/16)	0 – 4 (0 – 3/16)	4 – 9 (3/16 – 3/8)	4 – 12 (3/16 – ½)	>9 (>3/8)	>12 (>½)

Actions to be taken

- Allowable Limit: Review the available data and provide comments on any potential ground movement concerns and implications to railway operations. The ground movement monitoring reports shall be forwarded to GO Transit / Metrolinx/ their representatives within 24 hours of readings.
- Review Limit: Immediately notify all parties involved. Monitoring frequency shall be increased to determine if any additional ground movement is occurring. Monitoring frequency shall remain increased until there is stabilization of the ground movement. The Contractor shall plan for remedial track works within 7 days. The work may continue.
- Alarm Limit: Immediately notify all parties involved. The work will **immediately cease** until an assessment of the observed ground movement is conducted and inspected by a qualified and competent Geotechnical Engineer. The Contractor shall arrange for immediate repairs to the track. The findings with a proposed action plan will be reviewed by GO Transit / Metrolinx. The CM Sr. Manager of Track and Structures will request emergency protection, if required.

14. After the construction is completed, Metrolinx may require a set of readings to be taken at each ground movement monitoring point for:

a. Once a day for 14 days;

b. Then twice weekly for the next 30 days (i.e. month);

c. Then once monthly for the remainder of 12 months (one year);

d. The above frequency may vary based on site conditions.

20.3. Tunneling and Boring

1. For monitoring requirements pertaining to tunneling, jack-and-bore, HDD (Horizontal Directional Drilling) and MTBM (Micro-Tunnelling Boring Machine) refer to the Metrolinx General Guidelines for Design of Railway Bridges and Structures and Design and Construction Guidelines for Tunneling on of GO Transit Right-of-Way.

2. Trenchless alignment shall be designed to cross tracks perpendicularly where feasible but not less than 45 degrees.

3. Track boring should be located at a minimum of 150 ft. (45.7 m) from any track turnout or rail-to-rail crossing unless otherwise approved in writing by the CM Sr. Manager of Track and Structures.

4. Construction below railroads shall not interfere or disrupt normal railway operations, or endanger surface operations.

5. Tunneling operations shall not be stopped if such stoppage would be detrimental to the Railway.

6. Fill annular space between the soil and the underground structure with cementitious grout immediately after installing the liner.

7. The face of the excavation shall be supported at all times.

8. Daily progress reports will be required and must include length of installed tunnel, ground water inflow, install forces, muck records, face pressure, downtimes and reasons, lubrication records, obstruction records, line and grade and any offsets from alignment and elevation.

9. Prior to any tunnelling operation, a plan AND contingency plan must be submitted and reviewed by the CM Senior Manager of Track and Structures.

10. Ground monitoring and visual monitoring shall be performed a minimum of twice daily (i.e. before morning rush hour trains and prior to afternoon rush hour trains) during construction/boring/tunneling activities.

Section 21 Bridges and Structures

21.1. Guard Rails

1. Guard rails must be installed at the following locations:
   a. All bridges that have supporting structure extending above the top of the ties;
   b. All bridges that have the underside supporting structure protruding beyond the deck of the bridge;
   c. All bridges that cross major roadways (two lane paved highway or greater);
   d. All bridges that cross commercially navigable waterways;
   e. All bridges longer than 100 ft. (30.5 m);
   f. All bridges with curves 2º and over;
   g. All tunnels, snow sheds, and rock sheds with timber lining, exposed arch ribs, or other lining or construction that is vulnerable to damage or dislodgement; guard rails are not required on unlined tunnels and tunnels with smooth concrete lining; and
   h. Any other locations designated by the CM Senior Manager of Track and Structures.
2. Guard rails should be considered, where piers of overhead structures are within 17 ft. (5.2 m) of centreline of track, there are no crash walls, and the track speed is greater than 10 mph.
3. Existing guardrails that are not required per the above criteria, may not be removed without notifying the CM Senior Manager of Track and Structures.
4. On bridges with three or more tracks, the centre tracks do not require guardrails.
5. Guard rails shall be installed as per Standard Plan GTS-1108.

a. Guard rails must extend a minimum of 8 ft. (2.5 m) off the end of a bridge or tunnel being protected, except in concrete tie territory, where the guard rails shall be ended at the end of the tunnel or back wall of the bridge consistent with Standards Plan GTS-1108.

   i. For overhead structures without crash walls, the guard rails shall extend 60 ft. (18.3 m) beyond the structure as per the Standards Plan GTS-1108.

b. The guard rails must converge at the end of the protected bridge, tunnel, or overhead structure where shown in Standards Plan GTS-1108.

c. Guard rails shall never be spaced less than 6 ¾ in. (171 mm) between the base of the running rail and the base of the guard rail.

6. Guardrails should be electrically isolated from the running rail in order to maintain broken rail protection. Guardrails and guardrail plates must not contact the tie plates and must be kept clean and free of debris, particularly metal shavings and filings.

7. In some locations, guardrails are incorporated into the signals system. Employees must take every precaution to avoid shorting out track circuits between the guardrail and the running rail when working around these locations.

8. Guard Rails will be spiked with two spikes per rail, without tie plates on every track tie.

9. Whenever guardrails are temporarily removed on main track to accommodate track or bridge work a temporary speed restriction of 30 mph, or posted track speed is required, whichever is more restrictive is required.

10. In multi-track concrete tie territory, guard rail ties shall be installed on all tracks where guard rails may be required on adjacent tracks. Guard rails shall only be applied where required.

11. The CM Senior Manager of Track and Structures may authorize exceptions to this Standard provided both of the following conditions are met:

a. The guard rails are removed by a gang to facilitate maintenance work; and

b. The gang performing the work does not leave the site unattended for a period greater than 15 days without replacing the guardrails.

21.2. Restraining Rails

1. Restraining rails shall be considered on any curve 14° or greater. See Track Standards section 4.5.2 and 4.5.4 for additional requirements on high degree curves.

   a. Note that the Metrolinx IRIS vehicle cannot navigate curves greater than 14°.

2. Restraining rails shall not be installed unless approved in writing by the CM Senior Manager of Track and Structures.

3. Restraining rails shall be of the type for heavy rail applications.

   a. A 33C1 rail section is recommended

4. The restraining rail shall be positions a maximum of 25mm (1 in.) above top of rail.

5. Restraining rails shall only be installed adjacent to the low rail.

6. The restraining rail shall be installed through the full body of the curve and the spirals with a 6 ft. (1.82 m) flare on the beginning and end as per AREMA plan no. 509-13.

   a. The restraining rail shall extend 40 ft. (12.2 m) into the tangent.

   b. Restraining rails shall overlap by 20 ft. (6 m) where reverse curves requiring restraining rails are present

7. All restraining rail connections shall be designed to withstand the applied forces including that of thermal expansion/contraction, train loading, hunting, steering, and other loads.

8. Lubrication shall be provided for the full length of the restraining rail.

9. The flange-way gap shall be determined through a Nytram analysis.
    a. This shall be completed for new and worn wheels for every type of equipment that will traverse the track affected.
    b. Both minimum and maximum operating ranges must be selected, but shall not be less than the values specified in Recommended Method 3500-1: Turnout Inspection.
10. On the Pearson Subdivision, the flange-way gap between the rail and restraining rail shall be between 48 and 52 mm. If the gap is measured to be less than or exceed this range remedial work will be required.
11. On other subdivisions, the flange-way gap between the rail and the restraining rail shall be designed for the specific application and location.
12. The flange-way gaps must be adjusted upon identification of gauge conditions.
    a. The use of shims is an acceptable practice to ensure the flange-way gap is within the minimum and maximum tolerances.

21.3. Roadbed and Drainage

1. The track shall have adequate sub-surface drainage.
2. Drainage design must take into consideration melt water produced by snow clearing devices.
3. Generally, there shall be one surface catch basin for every two turnouts, with the catch basin located no more than 33 ft. (10 m) from the switch points within yards and within the USRC.
4. Drainage infrastructure design must facilitate future maintenance, including but not necessarily limited to:
    a. Provision of vehicular & pedestrian access to catch basins;
    b. Provision of cleanouts at appropriate intervals; and

c. Consideration for adjacent track maintenance requirements such as undercutting and track tie replacement.

5. Ditches, culverts or any other drainage facility under or immediately adjacent to the roadbed **MUST** be maintained so as to allow the free flow of water.

6. Waterways, ditches, and drainage must:

   a. Be maintained to ensure adequate support for the safe passage of trains;

   b. Be regularly inspected to ensure they are operating as per design;

   c. Be maintained free of vegetation and debris so that drainage is not impeded;

   d. Not be filled with ballast or with waste from ditching, shoulder cleaning, or undercutting;

   e. Not be altered, adjusted, rerouted, or constricted unless approved by a Civil Engineer, all required permits have been acquired, and the CM Sr. Manager of Track and Structure has been notified in writing; and

   f. Be monitored for plugged or frozen conditions which can result in high water on one side of the track (differential water level).

7. Chronic subgrade soft spots, frost or mud boils, and heaves should be improved by:

   a. Providing ditches which are draining the track structure and flow freely;

   b. Installing cross (lateral) sub-surface drainage spaced along the track or below the road bed; or

   c. Evaluation by a geotechnical engineer.

8. When installing lateral drains:

   a. Cut to a depth below the granular layer or water pocket and slope to the toe of subgrade or ditch line;

   b. Fill the lateral drain with clean coarse ballast, wrapped in filter fabric; and

c. Locate the lateral drains every 20 to 50 ft. (6.1 to 15.2 m) along the track for the length of the soft track or poorly drained condition.

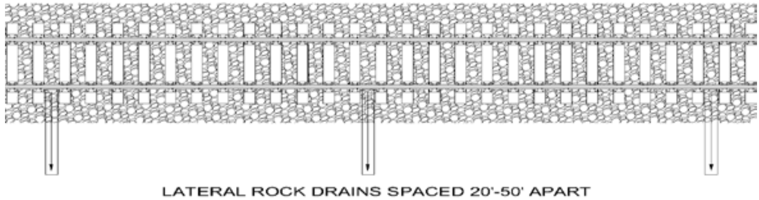


Figure 37. Lateral Rock Drains

9. Do not allow rip rap or other fill materials to remain on the top of embankments where it could be hit by on-track equipment or lead to overloading the subgrade.
10. Vegetation along and on embankments should be maintained so that stability of the track structure is not compromised.
11. Adjacent landowners, buildings, and overhead structures are not allowed to drain or modify existing drainage ways to divert water onto Railway Property without approval in writing from Metrolinx.
12. Culvert installation will be done in accordance with Track Standard Section 21.4 and the direction of the CM Manager of Bridges and Structures.
13. General culvert inspection shall be undertaken per Track Standard Section 15.12 and under the direction of the CM Manager of the Bridges and Structures.

21.4. Installation of Culverts

1. Culverts shall be installed as per the requirements of the SPC 4402 and Standard drawing R7A-80.2.
2. Culverts should be placed so that the stream will have as straight an entrance and outlet as possible.
3. The flow line grade of the culvert should be only slightly greater than the natural grade of the stream so the culvert will be self-cleaning. The minimum camber and

slope shall meet the minimum requirements of the SPC 4402 and Standard drawing R7A-80.2.

4. Place the culvert as close to the bottom of the stream bed as possible. Placing it too low may cause it to partially fill with sediment; placing it too high may cause ponding.

5. When a culvert is placed under a high fill or on a soil base that may settle, the culvert should be cambered (arched slightly upwards). This will help prevent low spots forming in the centre as settlement occurs.

6. The culvert should extend beyond the toe of the slope a sufficient distance as per SPC 4402 and Standard drawing R7A-80.2 to prevent possible erosion and sloughing of the embankment.

7. All culverts should be installed with the entire circumference well compacted and all voids filled.

8. All culverts should be placed on stable earth or fine granular foundation. Never install them on a bed that contains large rocks.

9. When soft, unstable material is found at the foundation level, it should be excavated below the flow line grade and backfilled to grade with screenings of another comparable crushed stone. In most cases, removing an additional 12 in. (305 mm) of material will be adequate.

10. Rock encountered in the foundation should be removed at least 12 in. (305 mm) below the bottom of the culvert pipe and replaced with granular material to cushion the pipe.

11. When placing two (2) or more corrugated steel pipes alongside of each other, there must be space between them. This is to allow room for tamping the backfill and to provide side support.

12. Backfill material should be free from rocks and hard earth clods larger than 3 in. (76 mm) in size. Well graded granular material containing a small amount of silt or clay is ideal because it makes a dense, stable fill.

13. When backfilling, start by tamping under the haunches, the lower part of the pipe below the widest part. Continue placing backfill equally on both sides of the

pipe. Backfill should be placed in layers of approximately 8 to 12 in (203 – 305 mm). Compacted layers should extend at least one diameter either side of the culvert.

14. Minimum cover should be as specified on the Bridges and Structures drawing R7A-80.2.

15. Tamping can be accomplished by using hand tampers. They should not weigh less than 20 lbs. (9 kg) and not have a tamping face larger than 6” x 6”.

16. Where room permits, power tampers or vibrators can be used.

17. When culverts are replaced by jacking a new pipe adjacent to it, the retired culvert will be completely filled with grout.

18. Changes to existing culvert size or type, or the installation of additional culverts will require a hydrology study and will be reported to the CM Senior Manager of Track and Structures.

19. Smooth steel pipe will be ½ in. (13 mm) minimum thickness for culverts up to 60 in. (1.52 m) in diameter.

20. Larger diameter smooth steel pipes will be of a design as approved by the CM Manager of Bridges and Structures.

21. Where feasible, the preferred method of installation is by auger or jacking.

21.5. Clearances

1. Every structure over or beside a railway track, shall afford the minimum clearances set out in Appendix X – GO Transit Heavy Rail Clearance Envelopes.

    a. Standard clearances and train envelopes have been provided for the most common cases to be encountered

    b. For cases of tunnels, and other structures not mentioned refer to AREMA or the governing Metrolinx Standard.

2. Clearances shall also be verified with the Metrolinx General Guidelines for Design of Railway Bridges and Structures.

3. A lateral allowance for track curvature of 1 in. (25 mm) per degree shall be provided.

   a. At platforms, the track designer shall take into account platform-track curve orientation, superelevation, car door positions, and operating equipment to ensure safe boarding and de-boarding of passengers.

4. All clearance diagrams shall be perpendicular to the plane of the top of rails.

5. All existing structures, bridges, snow-sheds, overhead timber bridges and tunnels which met previous clearance requirements, but encroach within the clearance limits prescribed herein, shall not be considered as having less than standard clearances and shall be permitted to remain until the restrictive feature is modified or replaced.

6. Clearances not meeting the requirements of this section, are permitted in the following circumstances:

   a. On a track at a main shop, diesel or car shop;

   b. Doorways in buildings;

   c. Ramps, platforms and similar structures to facilitate loading, unloading, servicing and maintenance;

   d. Permanent structures to provide for or support locomotive and car wash facilities;

   e. Temporary restrictions necessary to facilitate construction or repair of overhead structures, in which case the train crews are to be notified through an appropriate GBO or foreman's/flagman's instructions.

7. Where circumstances do not permit the standard clearances prescribed:

   a. Exceptions may be authorized by the CM Senior Manager of Track and Structures in writing.

b. Modifications may be made to clearances covered in Clause 21.5.5 and Clause 21.5.6 a, d, and e upon approval of the CM Senior Manager of Track and Structures in writing.

c. The construction of a structure creating less than standard clearances shall not begin until approved by the CM Senior Manager of Track and Structures in writing.

8. At locations described in Clause 21.5.6 b and c and where the CM Senior Manager of Track and Structures has approved a less than standard clearance pursuant to Clauses 21.5.1 and 21.5.7, a restricted clearance sign, shall be erected and maintained adjacent to the track on which the restriction is located and at an adequate distance from the restriction. Where physical impediments preclude the erection of such a sign, the less than standard clearance will be identified in special instructions.

9. Requests for approval of less than standard clearances shall be submitted to the CM Senior Manager of Track and Structures and shall include the following information:

a. Reasons for less than standard clearance;

b. If operations over the track concerned will be by locomotive, car puller or gravity;

c. If locomotives will pass the point of less than standard clearance;

d. Type of cars that will pass the point of less than standard clearance;

e. Confirmation that track cannot be realigned to avoid the less than standard clearance or that the restricting object cannot be placed where it would no longer represent a restriction;

f. If the less than standard clearance will be permanent or temporary;

g. A drawing showing the relative position of the track and the obstruction, with cross sections at each point of less than standard clearance indicating the vertical clearance from the top of rail and the horizontal clearance from the centre line of the track, together with the location of the restricted clearance sign.

Section 22 Signals and Communications and Power

22.1. Precautionary Measures

1. Equipment operators, Contractors, and Employees must take care to avoid damage to bootlegs, bond wires, signal and communication wires and other apparatus.
    a. Equipment operators shall walk the work area prior to commencing work to identify all signal appliances present.
2. All personnel must observe signal and communication devices. If any abnormal condition exists, they must immediately protect the traffic, whether by rail or public road, and advise the CM Manager of Signals or designate of the abnormal condition, immediately.
3. Locates MUST be obtained from the Signals maintenance department before work commences.
    a. Utility locates must include Metrolinx, and outside party utilities.
    b. CN, CP, and private companies such as Bell and Rogers may have fibre optic cables within the right of way. Ensure that these private firms are covered in locate requests for ROW fiber optic cable as well as the associated railway.

22.2. Underground Cables

1. Table 40 is a guideline of the associated risk with these and other equivalent types of activities.

Table 40 - Risk Association for Signals and Power

Work Activity	Risk
Ditching Undercutting Culvert Replacement Bridge Deck Replacement Derailment Clean-up	High
Surfacing and Ballast Regulating Mechanized Tie Replacement In-track Flash Butt Welding Rail Replacement	Medium
Brooming	Low

Note: work activities must not start without prior consultation with the responsible CM S & C Manager and if necessary with the development and approval of a Method of Procedure. If in doubt, review the proposed work with the CM S & C Manager.

2. Prior to any excavation along the right-of-way, the local Signals & Communications (S&C) Maintenance Superintendent and the CM Manager of Signals must be notified a minimum of 7 days in advance of work, except in case of emergencies.

   a. Where it is reasonably practical, the qualified S & C employee shall remain at the excavation site while the work is being performed.

   b. Permanent cable markers are installed only to indicate the presence of buried cable and are not meant to indicate the precise location of the cable. Cables shall be day-lighted to obtain exact location and depth.

   c. Cables may run anywhere on the right-of-way, and at varying depths. Shallow cables may be encountered, especially near culverts, station platforms, underground passageways, and the ends of ducts at approaches to bridges and tunnels.

   d. Buried signal and communication plant may include power distribution circuits energized at potentials as high as 7200 volts AC. Use extreme care when excavating near such facilities to avoid damage to cable or wire insulation. When necessary to protect persons excavating in proximity to hazardous equipment and cables, power distribution circuits in the affected area must be isolated or de-energized for work safety.

e. When it is necessary to isolate or de-energize 7200 Volt circuits for safety, a power clearance form will be generated by the responsible Corridor Maintenance Manager. No excavation work shall begin until the foreman has confirmed that this clearance form is in effect. When the work is complete, the foreman shall insure that all employees involved in the work area are free and clear from the power distribution circuits, before reporting so to the responsible Corridor Maintenance Manager.

f. Whenever excavating is done, in proximity to buried power distribution cables, it shall be done only by use of a vacuum truck or by hand digging using only tools with handles of wood or similar insulating material.

g. When excavation is done near electrified territory, the OCS shall be grounded, or excavation shall only be done by use of vacuum truck or by hand digging using only tools with handles of wood or similar insulating material.

h. The foreman shall report the location of damaged cable and other signals and communications plant to the S & C maintainer immediately and the CM Manager of Signals.

i. Temporary supports must be provided to ensure that exposed cable is never left unsupported for span lengths greater than 15 feet (4.6 m).

3. Cable installed in bridge troughing shall be treated in the same manner as underground cable. The above applicable requirements will be followed. The local S&C supervisor, and the CM Manager of Signals must be notified anytime bridge troughing is removed, repaired or disturbed in any way.

4. Where communications, signal, power and/or fibre optics cable is known or suspected to exist, stakes or flag masts may not be driven into the ground. At these locations, rail mounted flag staffs shall be used to display all track flags. This requirement also applies to all locations with buried gas or fuel lines.

5. In all other areas, when driving shallow stakes such as grade or line stakes, or when placing flags for temporary track protection, staffs shall not be driven to a depth greater than 12 inches (305mm) unless it is known to be clear of all cables and lines.

6. Track right-of-way sign posts must not be installed until a cable or utility locate has been performed by qualified Signals & Communications Maintenance maintainer and other utility locators, and markings have been placed on the ground. Excavation of the signpost hole must be done in compliance with SCP-1000 in its entirety.

22.3. Working within Crossing Circuits

1. When any work that is planned at a crossing or within the approach circuit of a crossing:
   a. The CM Manager of Signals requires 5 business days advance notice;
   b. If excavation is to occur a utility locate must be requested;
   c. Care must be taken to ensure the integrity of the crossing is not compromised; and
   d. Crossing warning device interference or nuisance ringing must be avoided.
      i. Crossing warning device interference requires flagging to protect the crossing.

2. When track work involves cutting or removing rail within an approach crossing circuit of a road crossing with a crossing warning device and may cause interference of the normal operation of the protection:
   a. The S&C Maintainer must be notified prior to the application of rail bypass cables or temporary bond wires;

b. The "*Metrolinx Work Method for the Use of Temporary Rail Bypass Cables (TRBC)"* must be followed;

c. A specific job briefing must be conducted identifying the use of the temporary bonds and rail bypass cables;

d. Temporary bonds and rail bypass cables should be applied only when rail cutting / welding is expected to be completed within the same shift that the temporary bonds are installed;

e. Obtain positive protection prior to applying temporary bonds or bypass cable through TOP or 842 with routing;

f. Use the appropriate Metrolinx form to record the use of the temporary bonds and rail bypass cables. Temporary rail bonds and rail bypass cables shall be an approved type and be a maximum of 100 ft. (30.48 m) long of orange S-8 signal bond wire;

g. Track, Welding, S & C and other employees, trained in the application of bonding and rail repair may install temporary rail bonds;

h. Temporary rail bond may be applied around any non-insulated joint;

    i. The maximum bond length is 60 in. (1524 mm);

    ii. The S&C Maintainer must be notified of the installation; and

    iii. The temporary bond wire must be removed and/or replaced with permanent bonds within 72 hours by a qualified S&C Employee.

i. The use of rail bypass cables and temporary bond wires must NOT be:

    i. Installed around insulated joints;

    ii. Installed within interlocking limits;

    iii. Installed across the track from one rail to the other; or

iv. Installed for the purpose of circumventing normal signal operation.

j. In the event the crossing activates with rail bypass cables applied, perform the following:

i. Check both ends of the cable for tightness and wait 20 seconds to see if the crossing recovers;

ii. If the crossing does not recover, remove and reapply each end of the cable;

iii. If the crossing does not recover, contact the S&C Maintainer and arrange for manual protection of the crossing until the issue is rectified.

k. The temporary rail bond(s) shall be removed from the track immediately when the work is complete.

i. Employees must contact the S & C maintainer prior to the removal of the temporary bonds.

ii. If bonds are removed and the S & C maintainer has not yet inspected the crossing circuit, instructions must be given to approaching trains that they must be prepared to stop and manually protect the crossing.

iii. In signalled territory, positive protection and routing must remain in place until the S & C maintainer has verified the proper operation of the signal system.

Section 23 Platforms

1. GO station platforms adjacent to tangent track shall be located laterally and vertically in accordance with the Table 41. (See Metrolinx Design Requirements Manual.)

Table 41 Platform Clearances

Location	Gauge Face to Edge of Platform†	Vertical Clearance ATR†	Vertical Clearance Tolerance
Mixed Use Corridors	915mm (36")	127mm (5")	- 25 mm (- 1")
GO Transit Use Only (Restricted Clearance) Corridors	915mm* (36")	254mm** (10")	± 25 mm (± 1")
UP Express Use Only Corridors‡	1,073 mm to edge of concrete (42 ¼") 1013 mm to edge of rubber (39 7/8")	1,220 mm (48")	± 13 mm (± ½")
UP Mixed Use Corridors‡	1086 mm to edge of concrete (42 ¾") 1036 mm to edge of rubber (40 ¾")	1,220 mm (48") 1,207 mm (USRC) (47 3/8")	± 13 mm (± ½")
Accessibility Platform	1,270 mm (50")	533 mm (21")	± 25 mm (± 1")

* 807mm (31 ¾") permitted for existing platforms in the USRC. All new platforms to be designed based on Table 41 above.
** 203mm (8") permitted for existing platforms in the USRC. All new platforms to be designed based on Table 41 above.
† For platforms on curved (super-elevated) track, clearances shall be determined through design to ensure safe boarding and de-boarding of passengers on both regular and accessible platform. For reference the height of floor of a GO consist ATR is 635mm (25").
‡ UP platform horizontal measurements can be confirmed by measuring the gap between the train and the platform at the doors. At Pearson station the gap should be 49 mm (15/16 in.). At all other stations, the gap should be 121 mm (4 ¾ in.).

2. Clearance from top of station tunnel structure to underside of the tie shall be a minimum of 8 in. (203

mm) plus the thickness of the ballast mat and waterproofing.

3. The tunnel roof shall have a minimum slope of 0.30% for drainage.

4. Pedestrian tunnels shall be designed for railway loading, minimum Cooper E80 plus diesel impact.

5. At a minimum utilities parallel to the track must be located laterally so as not to be within the Zone of Influence of the track. The Zone of Influence is defined as a line extending from the bottom of end of track tie at a slope of 1:1, and is subject to a required geotechnical review.

6. At a minimum, the top of utility structures such as duct banks, pull boxes, maintenance holes, catch basins, etc., must be no higher than the bottom of track tie.

7. During snow clearing operations on station platforms or other GO / Metrolinx owned facilities, snow shall NOT be plowed, shovelled, or by any other means, dumped onto the track, ballast, signals, or other railway infrastructure. This includes within the USRC.

8. All station platform tracks shall be constructed with concrete ties with galvanised rail clips.

9. All track surfacing activities near or adjacent to platforms must conform to Track Standard Section 12 .

Section 24 Fire Prevention

24.1. Precautionary Measures

1. Prevention of fires on railway property and structures must be considered at the beginning of each task when working in the right-of-way.
2. Fire risk is highest during spring when dry grasses are prevalent. Fire risk can also rise in the summer during extreme hot and dry periods, and anytime work is performed near wooden structures. Regional warnings or advisories should be noted when working in these types of conditions.
3. Prior to hot work being carried out, a hot work permit must be issued, and identify all tasks to be done, processes and tools, hazards, and exact locations of work.
4. Prior to any hot work being carried out when a fire risk exists, the ‘Right-of-Way and Bridge Fire Risk Assessment, Mitigation and Emergency Response’ form must be completed.
5. A Fire Watch shall be in place during and after the hot work and will:
    a. Have communication and contact information adequate to request assistance when required.
    b. Be equipped with sufficient fire-fighting equipment to supress any flare ups. Sufficient equipment is defined as:
        i. A filled 5 gallon (19 L) back-pack sprayer; and
        ii. One round nose shovel and adze
    c. Be stationed in a safe position to fight fires as work is being performed.
    d. Remain at the location for a minimum of two hours after the work is completed.

6. Fire prevention, and fire awareness training is required for any fire watch employees.

7. A Fire Services inspector has the right to request access to the right-of-way to assess fire safety risk and training.

8. When fire advisories are "High" or "Extreme" fire risk rating hot work activities will be restricted.

9. The following risk factors need to be considered prior to performing hot work in the right-of-way:

   a. Dry or dead vegetation;

   b. Ties or timbers stacked and/or distributed along the right-of-way;

   c. Weather (wind speed / direction, temperature, recent precipitation, humidity, forecasts);

   d. Structural materials such as timber caps, stringers, piling, posts, and ties. The older this material is, the higher the risk of igniting;

   e. Clothing – greasy and oily clothing can be ignited;

   f. If smoking is permitted, smoking in the right-of-way needs to be controlled and all butts should be buried or disposed of properly;

   g. Equipment with steel tracks or cutting heads that can spark;

   h. Fueling location and spills;

   i. Parking / vehicle stopping locations should be carefully selected so as hot exhaust gases do not ignite dry vegetation.

10. Working activities addressed through this section include but are not limited to:

   a. Cutting rail with a saw or torch, grinding, welding, drilling rail;

   b. Working on or near timber structures;

   c. Dragging rail;

   d. Milling.

11. For routine work during High and Extreme fire conditions, additional fire protection will include:

    a. Increasing the quantity of water carried on board trucks to at least 90 gallons (340 L) which includes at least 4 filled 5 gallon (19 L) backpack sprayers with foaming nozzles

    b. Foam fire suppressant added to the water supply

    c. Centrifugal pumps with at least 100 ft. (30.5 m) of 1½” (38 mm) diameter hose.

    d. Wetting of the area where sparks may be generated and in the direction of the wind

    e. Use of spark screens for all cutting, welding, and grinding

    f. Wetting of area after work is complete

    g. Posting a fire watch after the work is complete.

12. Hot Work on a structure or a timber lined structure will include:

    a. A site inspection to identify all hazards, in particular fire hazards including the structure itself.

    b. Removal of dried vegetation and any piled timbers

    c. Wetting of the immediate area and materials in the direction the wind is blowing prior to commencing hot work:

        i. Foam suppressant additive to be mixed with water

        ii. Foam must be protected from entering any nearby watercourse

        iii. Foam makes ties slippery, and additional caution needs to be exercised

    d. Fire proof mats or packing sand will be placed to protect timber. Sand must not foul any ballast.

    e. Spark shields will be used on timber structures in all conditions

i. Direct cutting sparks to the centre of track.

f. Cutting of structural components or rail will be made:

i. With a saws-all or shear for sway brace and hook bolts, drift pins, etc.

ii. Using abrasive saws for cutting rail

iii. Using a torch as the last option and only after discussing with the CM Manager of Bridges and Structures.

iv. Using chain saws to cut wood components

g. Wet the entire area as often as required both during and after the work is completed

h. A fire watch will remain in place for a minimum of 2 hours.

13. Long term bridge construction or repair projects, which involve pile driving, significant torch cutting or other fire risk, will have a fire fighting and prevention plan which includes pumps and hoses utilizing either river or a minimum of a 300 gallon (1,135 L) portable water tank.

14. For welding rail on bridges see Track Standards section 8.7.

15. A fire watch shall follow any rail dragging operation checking for damaged rail fasteners and for fires or smoldering ties.

16. When dragging rail over an open-deck bridge and temperatures are above -10°C (20°F):

a. Rail will not be dragged faster than 3 mph across the bridge.

b. Care must be taken to avoid steel on steel contact over the bridge.

c. At least one fire watch will remain in place at each structure for at least 2 hours after the move is completed.

17. For rail grinding see Track Standards section 6.3.

18. For field welding see Track Standards Section 8 .

19. In the event of a fire or flare up on or near any part of a structure, a fire watch will remain in place for a minimum of 4 hours after the fire has been extinguished.

24.2. Job Briefings

1. The minimum job briefing required for any hot work must include:
   a. Completing the ‘Right-of-Way and Bridge Fire Risk Assessment, Mitigation and Emergency Response’ form.
   b. Status of OCS wires (whether cables are energised or grounded)
   c. The requirements in Track Standards Section 24.2.2 also apply.
2. The minimum job briefing required for any hot work fire watch must include:
   a. The nearest fire department or fire service
   b. The contact number for fire / emergency services
   c. Access to the location and directions to the site
   d. Any warnings, advisories or work restrictions issued by any agencies concerning fire risk status
   e. Fire-fighting equipment on hand and ensuring operability of such equipment
      i. A minimum of two 5 gallon (19 L) backpack sprayers with foaming nozzles
      ii. A minimum of two round nose shovels
      iii. A minimum of two adzes
      iv. Fire equipment to be staged no more than 50 feet (15.2 m) from the work location

APPENDIX A – CLASS OF TRACK

Table 42 Class of Track

Class of Track	**Maximum Allowable Speed (mph)**	
	Passenger	**Freight**
1	**15**	**10**
2	**30**	**25**
3	**60**	**40**
4	**80**	**60**
5	**95***	**80**
6	*110*	*N/A*
7	*125*	*N/A*

*LRC Trains -100mph

Class of Track	**Maximum Allowable Speed (km/h)**	
	Passenger	**Freight**
1	25	15
2	50	40
3	100	65
4	130	100
5	150*	130
6	*175*	*N/A*
7	*200*	*N/A*

*LRC Trains -160km/h

APPENDIX B – TRACK INSPECTION FREQUENCIES

Table 43 Routine Track Inspection Frequencies

Routine Track Inspection Frequency				
Type of Track	**Class of Track**	**Annual Tonnage**		
		< 5 MGT	**5-15 MGT**	**>15MGT**
All Track	1	Monthly*	Twice Monthly*	Weekly
	2, 3	Twice Weekly	Twice Weekly	Twice Weekly
	4, 5	Twice Weekly	Twice Weekly	Twice Weekly
Yard Track	Category 1†	Twice Monthly	Twice Monthly	Twice Monthly
	All Other	Monthly	Monthly	Monthly
Inactive Track		Before being used		

* For Class 1 tracks where passenger trains / GO Trains operate inspection frequency shall be weekly
† Category 1 is defined as yard track carrying more than 500 cars daily.
Note: GO Transit yards are considered Class 1.

Table 44 Walking Track Inspection Frequencies

Walking Track Inspection Frequency				
Class of Track	**Annual Tonnage**			
	<5 MGT	**5 - 15 MGT**	**>15 – 30 MGT**	**> 30 MGT**
1**	Every 2nd year	Every 2nd year	Every 2nd year	Every 2nd year
2	Every 2nd year	Every 2nd year	Every 2nd year	Annually
3	Every 2nd year	Every 2nd year	Annually	Annually
4,5	Annually	Annually	Annually	Annually

*Note: If electronic or camera inspection of joint bars is performed, walking inspection of tangent track and curves less than 4 degrees in jointed track is not required by Transport Canada.
** Includes non-main track

Table 45 Joint Bar Inspection Frequencies

Joint Bar Inspection Frequency					
Minimum Number of Inspections Per Calendar Year[1]					
Class of Track	**Passenger (MGT)**		**Freight (MGT)**		
	<20	**≥20**	**<40**	**≥40 and <60**	**≥60**
5	3[2]	4[2]	2	3[2]	4[2]
4	2	3[2]	2	3[2]	4[2]
3	2	2	1	2	2
2	1	1	0	0	0
1	0	0	0	0	0
Excepted Track	N/A	N/A	0	0	0

[1] Where GO Transit 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 an inspection of a particular territory within the required interval, the CM Senior Manager of Track and Structures may extend the interval by up to 30 calendar days from the last day that the extreme weather condition prevented the required inspection.

Table 46 Derail Inspection Frequency

Inspection Frequency for Derails	
Type of Inspection	**Description**
Walking Inspection	Each derail shall be inspected on foot at least monthly, observing overall condition.
Detailed Inspection	A thorough detailed observation of each derail shall be performed annually. Particular attention should be paid to tie, spike/screw, and ballast condition. Check for any distortion, fractures, damage from derailments or accidents or unusual wear on the derail.
Note: Electronic derails must also be inspected by a qualified signals maintainer.	

Table 47 Turnout, Crossing, and Special Track Work Inspection Frequency

Turnout and Special Track Work Inspection Frequency	
Type of Inspection	**Description**
Routine Inspection	Each time the turnout is crossed it shall be visually inspected for defects and noted on the track inspection report.
Walking Inspection	Each turnout shall be inspected on foot **at least monthly** and observing overall condition. In the case that the track is used less than monthly, each turnout will be inspected on foot before the track is used. Inspections will be noted on the turnout inspection report. For turnouts on Class 4 or 5 track with a tonnage exceeding 35 MGT per year, this inspection shall be bi-weekly.
Detailed Inspection	A thorough detailed inspection of the condition of all components in each turnout shall be performed **annually***. Inspections will be noted on the switch inspection report. *Spring Frogs will be inspected in detail twice annually.

Table 48 Rail Flaw Inspection Frequency

Designated Minimum Rail Flaw Inspection Frequency				
Class of Track	**<5 MGT**	**5 – 15 MGT**	**>15 – 30 MGT**	**>30 MGT**
Class 4 & 5	Annually	Twice Annually	Three Times Annually	Quarterly
Class 3	Annually	Annually	Annually	Twice Annually
Class 2	Annually	Annually	Annually	Twice Annually
Class 1	N/A*	N/A*	N/A*	N/A*
Yard Track	N/A	N/A	N/A	N/A

Note: GO Transit yards and layover facilities are considered class 1.
* All GO Transit layover facilities, yard, and lead tracks including non-main tracks and Class 1 main tracks leading from/to these yards shall be hand-tested at least annually.

Table 49 Electronic Geometry Inspection Frequency

Designated Minimum Electronic Geometry Inspection Frequency				
Class of Track	**<5 MGT**	**5 – 15 MGT**	**>15 – 30 MGT**	**>30 MGT**
Class 5	HGIV – Twice Annually	HGIV - Twice Annually	HGIV - Twice Annually	HGIV - Three Times Annually
Class 4	HGIV - Twice Annually	HGIV - Twice Annually	HGIV - Twice Annually	HGIV - Twice Annually
Class 3	HGIV – Annually	HGIV – Annually	HGIV - Twice Annually	HGIV - Twice Annually
Class 2	HGIV – Annually	HGIV – Annually	HGIV – Twice Annually	HGIV – Twice Annually
Class 1	LGIV - Annually†	HGIV – Annually	HGIV – Annually	HGIV – Annually
Crossovers*	HGIV – Annually	HGIV – Annually	HGIV – Annually	HGIV – Annually
Yard Tracks	LGIV - Annually†	LGIV - Annually†	LGIV - Annually†	LGIV - Annually†

*Track geometry inspection on non-mainline crossovers where track speed is 30mph or less is not required unless otherwise directed by the CM Sr. Manager of Track and Structures.

†LGIV requirement may be substituted for a device capable of measuring, recording and evaluating deviations in gauge and cross-level.

NOTE: The CM Sr. Manager of Track and Structures can request the use of an HGIV instead of and LGIV based on location.

APPENDIX C – PRIORITY DEFECTS

PRIORITY DEFECTS	Track Class						
	1	2	3	4	5	*6*	*7*
Passenger (mph)	**15**	**30**	**60**	**80**	**95***	***110***	***125***
Freight (mph)	**10**	**25**	**40**	**60**	**80**	***N/A***	***N/A***
Wide Gauge	57-1/2” (1460)	57-1/4” (1454)	57-1/4” (1454)	57-1/4” (1454)	57-1/4” (1454)	*57” (1448)*	*57” (1448)*
Narrow Gauge	56-1/8” (1425)	56-1/8” (1425)	56-1/8” (1425)	56-1/4” (1429)	56-1/4” (1429)	*56-3/8” (1432)*	*56-3/8” (1432)*
Alignment Tangent 62 ft. (18.9 m)	3-3/4” (95)	2-1/4” (57)	1-3/8” (35)	1-1/8” (28)	3/8” (10)	*3/8” (10)*	*3/8” (10)*
Alignment Curve/Spiral 62 ft. (18.9 m)	3-3/4” (95)	2-1/4” (57)	1-3/8” (35)	1-1//8” (28)	1/2” (13)	*3/8” (10)*	*3/8” (10)*
Alignment Curve/Spiral 31 ft. (9.45 m)	N/A	N/A	7/8” (22)	3/4” (19)	3/8” (10)	*3/8” (10)*	*3/8” (10)*

* 100 mph for LRC Trains

PRIORITY DEFECTS	Track Class						
	1	2	3	4	5	*6*	*7*
Passenger (mph)	**15**	**30**	**60**	**80**	**95***	***110***	***125***
Freight (mph)	**10**	**25**	**40**	**60**	**80**	***N/A***	***N/A***
Surface	2” (51)	1-1/2” (38)	1-1/4” (32)	1” (25)	3/4” (19)	*3/4” (19)*	*3/4” (19)*
Warp 31 ft. (9.45 m)	1-7/8” (48)	1-5/8” (41)	1-1/8” (29)	7/8” (22)	5/8” (16)	*3/8” (10)*	*3/8” (10)*
Warp 62 ft. (18.9 m)	2-1/4”(57)	1-3/4” (44)	1-1/2” (38)	1-3/8” (35)	1-1/8” (29)	*3/4” (19)*	*3/4” (19)*
Cross-Level from Design	1” (25)	1” (25)	3/4” (19)	1/2” (13)	1/2” (13)	*1/4” (6)*	*1/4” (6)*
* 100 mph for LRC Trains							

APPENDIX D – URGENT DEFECTS

URGENT DEFECTS	Track Class 1	2	3	4	5	6	7
Passenger (mph)	**15**	**30**	**60**	**80**	**95***	***110***	***125***
Freight (mph)	**10**	**25**	**40**	**60**	**80**	***N/A***	***N/A***
Wide Gauge†	57-3/4" (1466)	57-5/8" (1463)	57-5/8" (1463)	57-1/2" (1460)	57-1/2" (1460)	*57-1/4" (1454)*	*57-1/8" (1451)*
Narrow Gauge†	56" (1422)	56" (1422)†	56" (1422)†	56" (1422)†	56" (1422)†	*56-1/4" (1429)†*	*56-1/4" (1429)†*
Alignment Tangent 62 ft. (18.9 m)	5" (127)	3" (76)	1-3/4" (44)	1-1/2" (38)	3/4" (19)	*5/8" (16)*	*1/2" (13)*
Alignment Curve / Spiral 62 ft. (18.9 m)	5" (127)	3" (76)	1-3/4" (44)	1-1/2" (38)	5/8" (16)	*1/2" (13)*	*1/2" (13)*
Alignment Curve / Spiral 31 ft. (9.45 m)	N/A	N/A	1-1/4" (32)	1" (25)	1/2" (13)	*1/2" (13)*	*1/2" (13)*

* 100 mph for LRC Trains

† See Track Standards Section 16.2.2 for more details on narrow gauge restriction.

URGENT DEFECTS	Track Class						
	1	2	3	4	5	*6*	*7*
Passenger (mph)	**15**	**30**	**60**	**80**	**95***	***110***	***125***
Freight (mph)	**10**	**25**	**40**	**60**	**80**	***N/A***	***N/A***
Surface	3” (76)	2-3/4” (70)	2-1/4” (57)	2” (51)	1-1/4” (32)	*1” (25)*	*1” (25)*
Warp 31 ft. (9.45 m)	2” (51)	1-3/4” (44)	1-1/4” (32)	1” (25)	3/4” (19)	*1/2” (13)*	*1/2” (13)*
Warp 62 ft. (18.9 m)	3” (76)	2-1/4” (57)	2” (51)	1-3/4” (44)	1-1/2” (38)	*1” (25)*	*1” (25)*
Cross-Level from Design	3” (76)	2” (51)	1-3/4” (44)	1-1/4” (32)	1” (25)	*7/8” (22)*	*7/8” (22)*
Runoff at End of a Raise	3-1/2” (89)	3” (76)	2” (51)	1-1/2” (38)	1” (25)	*3/4” (19)*	*3/4” (19)*

* 100 mph for LRC Trains

URGENT DEFECTS (Multiple Defects)		Track Class			
		4	5	*6*	*7*
Passenger (mph)		**80**	**95***	***110***	***125***
Freight (mph)		**60**	**80**	***N/A***	***N/A***
Multiple Surface	31 ft. Chord	N/A	N/A	*1/2" (13)*	*1/2" (13)*
	62 ft. Chord	1" (25)	3/4" (19)	*1/2" (13)*	*1/2" (13)*
Multiple Alignment	31 ft. Chord	N/A	N/A	*1/4" (6)*	*1/4" (6)*
	62 ft. Chord	N/A	N/A	*3/8" (10)*	*1/4" (6)*

For three or more non-overlapping deviations occurring within a distance equal to five times the chord length.

*100 mph for LRC Trains

NOTE:

Wide Gauge: The distance between the gauge points of the rails 5/8" (16 mm) below the top of the rail may not be more than:
Narrow Gauge: The distance between the gauge points of the rails 5/8" (16 mm) below the top of the rail may not be less than:
Alignment 62 Tangent: The deviation of the mid-offset from a 62 ft. (18.9 m) chord may not be more than:
Alignment 62 Curve: The deviation of the mid-ordinate from a 62 ft. (18.9 m) chord may not be more than:
Alignment 31: The deviation of the mid-ordinate from a 31 ft. (9.45 m) chord may not be more than:
Surface: The deviation from uniform profile on either rail at the mid-ordinate of a 62 ft. (18.9m) chord may not be more than:
Warp 31: The difference in cross level between any two points within 31ft. (9.45 m) apart in spirals may not be more than:
Warp 62: The difference in cross level between any two points within 62 ft. (18.9m) apart may not be more than:
Cross-level from Design: Deviation from zero cross-level at any point on tangent track or from designated cross-level or reverse elevation on curves and spirals may not be more than:
Runoff: The runoff in any 31ft. (9.45 m) of rail at the end of a raise may not be more than:

APPENDIX E – ALLOWABLE TSO FOR IRIS TRUCK DEFECTS – PASSENGER

Class of Track	Passenger Train Speed	Defect inch (mm)									
		Wide Gauge	**Alignment Tangent 62 ft. (18.9 m)**	**Alignment Curve 62 ft. (18.9 m)**	**Alignment Curve 31 ft. (9.45 m)**	**Surface**	**Warp 31ft. (9.45 m) Spirals**	**Warp 62 ft. (18.9 m) Tangents, Spirals, and Curves**	**Cross-Level Tangents and Curves**	**Cross-Level Spirals**	**Runoff at End of Raise**
1	15	57-3/4 (1466)	5 (127)	5 (127)	No Limit	3 (76)	2 (51)	3 (76)	3 (76)	1-3/4 (44)	3-1/2 (89)
2	20	57-3/4 (1466)	4-1/4 (108)	4-1/4 (108)	No Limit	2-7/8 (73)	1-7/8 (47)	2-5/8 (66)	2-5/8 (66)	1-5/8 (41)	3-5/16 (84)
	25	57-3/4 (1466)	3-5/8 (92)	3-5/8 (92)	No Limit	2-13/16 (71)	1-13/16 (46)	2-5/16 (59)	2-5/16 (58)	1-9/16 (39)	3-1/8 (79)
	30	57-5/8 (1464)	3 (76)	3 (76)	No Limit	2-3/4 (70)	1-3/4 (44)	2 (51)	2 (51)	1-1/2 (38)	3 (76)
3	45	57-5/8 (1464)	2-3/8 (60)	2-3/8 (60)	1-1/4 (31)	2-1/2 (63)	1-1/2 (38)	1-7/8 (47)	1-7/8 (47)	1-3/8 (35)	2-1/2 (63)
	50	57-5/8 (1464)	2-1/8 (54)	2-1/8 (54)	1-1/4 (31)	2-3/8 (60)	1-3/8 (35)	1-13/16 (46)	1-13/16 (46)	1-5/16 (33)	2-5/16 (58)
	55	57-5/8 (1464)	1-15/16 (49)	1-15/16 (49)	1-1/4 (31)	2-5/16 (58)	1-5/16 (33)	1-3/4 (44)	1-3/4 (44)	1-1/4 (31)	2-1/8 (54)
	60	57-5/8 (1464)	1-3/4 (44)	1-3/4 (44)	1-1/4 (31)	2-1/4 (57)	1-1/4 (31)	1-3/4 (44)	1-3/4 (44)	1-1/4 (31)	2 (51)

Class of Track	Passenger Train Speed	Defect inch (mm)									
		Wide Gauge	Alignment Tangent 62 ft. (18.9 m)	Alignment Curve 62 ft. (18.9 m)	Alignment Curve 31 ft. (9.45 m)	Surface	Warp 31 ft. (9.45 m) Spirals	Warp 62 ft. (18.9 m) Tangents, Spirals, and Curves	Cross-Level Tangents and Curves	Cross-Level Spirals	Runoff at End of Raise
4	65	57-5/8 (1464)	1-11/16 (43)	1-11/16 (43)	1-3/16 (30)	2-3/16 (55)	1-3/16 (30)	1-5/8 (41)	1-5/8 (41)	1-3/8 (35)	1-7/8 (48)
	70	57-5/8 (1464)	1-5/8 (41)	1-5/8 (41)	1-1/8 (28)	2-1/8 (54)	1-1/8 (28)	1-1/2 (38)	1-1/2 (38)	1-1/8 (28)	1-3/4 (44)
	75	57-9/16 (1462)	1-9/16 (39)	1-9/16 (39)	1-1/16 (27)	2-1/16 (52)	1-1/16 (27)	1-3/8 (35)	1-3/8 (35)	1-1/16 (27)	1-5/8 (41)
	80	57-1/2 (1460)	1-1/2 (38)	1-1/2 (38)	1 (25)	2 (51)	1 (25)	1-1/4 (31)	1-1/4 (31)	1 (25)	1-1/2 (38)
5	85	57-1/2 (1460)	1-1/4 (31)	1-3/16 (30)	13/16 (21)	1-3/4 (44)	7/8 (22)	1-1/8 (28)	1-1/8 (28)	7/8 (22)	1-5/16 (33)
	90	57-1/2 (1460)	1 (25)	7/8 (22)	5/8 (16)	1-1/2 (38)	13/16 (21)	1-1/16 (27)	1-1/16 (27)	13/16 (21)	1-1/8 (28)
	95	57-1/2 (1460)	¾ (19)	5/8 (16)	½ (13)	1-1/4 (32)	¾ (19)	1 (25)	1 (25)	¾ (19)	1 (25)

Note: These tables are used for when speed related track geometry defects are detected during track geometry (IRIS) truck inspections. The tables may be used to determine the maximum Temporary Slow Order speed to be applied for the seventy-two (72) hour period.

APPENDIX F – ALLOWABLE TSO FOR IRIS TRUCK DEFECTS – FREIGHT

Class of Track	Freight Train Speed	Defect inch (mm)									
		Wide Gauge	Alignment Tangent 62 ft. (18.9 m)	Alignment Curve 62 ft. (18.9 m)	Alignment Curve 31 ft. (9.45 m)	Surface	Warp 31 ft. (9.45 m) Spirals	Warp 62 ft. (18.9 m) Tangents, Spirals, and Curves	Cross-Level Tangents and Curves	Cross-Level Spirals	Runoff at End of Raise
1	10	57-3/4 (1466)	5 (127)	5 (127)	N/A	3 (76)	2 (51)	3 (76)	3 (76)	1-3/4 (44)	3-1/2 (89)
2	15	57-3/4 (1466)	4-1/4 (108)	4-1/4 (108)	N/A	2-7/8 (73)	1-7/8 (47)	2-5/8 (66)	2-5/8 (66)	1-5/8 (41)	3-5/16 (84)
	20	57-3/4 (1466)	3-5/8 (92)	3-5/8 (92)	N/A	2-13/16 (71)	1-13/16 (46)	2-5/16 (59)	2-5/16 (58)	1-9/16 (39)	3-1/8 (79)
	25	57-5/8 (1464)	3 (76)	3 (76)	N/A	2-3/4 (70)	1-3/4 (44)	2 (51)	2 (51)	1-1/2 (38)	3 (76)
3	30	57-5/8 (1464)	2-1/2 (63)	2-1/2 (63)	1-1/4 (31)	2-9/16 (65)	1-9/16 (40)	1-7/8 (48)	1-7/8 (47)	1-3/8 (35)	2-5/8 (66)
	35	57-5/8 (1464)	2-1/8 (54)	2-1/8 (54)	1-1/4 (31)	2-3/8 (60)	1-3/8 (35)	1-13/16 (46)	1-13/16 (46)	1-5/16 (33)	2-5/16 (59)
	40	57-5/8 (1464)	1-3/4 (44)	1-3/4 (44)	1-1/4 (31)	2-1/4 (57)	1-1/4 (31)	1-3/4 (44)	1-3/4 (44)	1-1/4 (31)	2 (51)

GO TRANSIT TRACK STANDARDS

Class of Track	Freight Train Speed	Defect inch (mm): Wide Gauge	Alignment Tangent 62 ft. (18.9 m)	Alignment Curve 62 ft. (18.9 m)	Alignment Curve 31 ft. (9.45 m)	Surface	Warp 31 ft. (9.45 m) Spirals	Warp 62 ft. (18.9 m) Tangents, Spirals, and Curves	Cross-Level Tangents and Curves	Cross-Level Spirals	Runoff at End of Raise
4	45	57-5/8 (1464)	1-11/16 (43)	1-11/16 (43)	1-3/16 (30)	2-3/16 (55)	1-3/16 (30)	1-5/8 (41)	1-5/8 (41)	1-3/8 (35)	1-7/8 (48)
	50	57-5/8 (1464)	1-5/8 (41)	1-5/8 (41)	1-1/8 (28)	2-1/8 (54)	1-1/8 (28)	1-1/2 (38)	1-1/2 (38)	1-1/8 (28)	1-3/4 (44)
	55	57-9/16 (1462)	1-9/16 (39)	1-9/16 (39)	1-1/16 (27)	2-1/16 (52)	1-1/16 (27)	1-3/8 (35)	1-3/8 (35)	1-1/16 (27)	1-5/8 (41)
	60	57-1/2 (1460)	1-1/2 (38)	1-1/2 (38)	1 (25)	2 (51)	1 (25)	1-1/4 (31)	1-1/4 (31)	1 (25)	1-1/2 (38)
5	65	57-1/2 (1460)	1-5/16 (33)	1-1/4 (32)	7/8 (22)	1-13/16 (46)	15/16 (24)	1-3/16 (30)	1-3/16 (30)	15/16 (24)	1-3/8 (35)
	70	57-1/2 (1460)	1-1/8 (29)	1-1/16 (27)	¾ (19)	1-5/8 (41)	7/8 (22)	1-1/8 (29)	1-1/8 (29)	7/8 (22)	1-1/4 (32)
	75	57-1/2 (1460)	15/16 (24)	13/16 (21)	5/8 (16)	1-7/16 (37)	13/16 (21)	1-1/16 (27)	1-1/16 (27)	13/16 (21)	1-1/8 (28)
	80	57-1/2 (1460)	¾ (19)	5/8 (16)	½ (13)	1-1/4 (32)	¾ (19)	1 (25)	1 (25)	¾ (19)	1 (25)

Note: These tables are used for when speed related track geometry defects are detected during track geometry (IRIS) truck inspections. The tables may be used to determine the maximum Temporary Slow Order speed to be applied for the seventy-two (72) hour period.

APPENDIX G – RAIL WEAR LIMITS

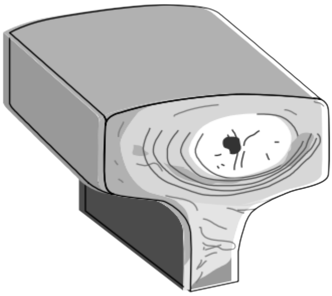
TABLE A: RAIL WEAR LIMITS

Vertical Wear Limits							
Rail Size	**141 lbs.**	**136RE**	**132RE**	**115RE**	**100ARA**	**100 lbs. HF**	**85lbs.**
Increased Monitoring	19 mm 3/4 “	17 mm 5/8”	14.5 mm 9/16”	12 mm 1/2”	7 mm 1/4”	5 mm 3/16”	4 mm 1/8”
Urgent	25.5 mm 1”	22.5 mm 7/8”	19 mm 3/4”	16 mm 5/8”	9.5 mm 3/8”	6.5 mm 1/4”	5 mm 3/16”
Gauge Face Wear Limits							
Rail Size	**141 lbs.**	**136RE**	**132RE**	**115 RE**	**100ARA**	**100 lbs. HF**	**85lbs.**
Increased Monitoring	12 mm 1/2"				9.5 mm 3/8”	8 mm 5/16”	6 mm 1/4"
Urgent	16 mm 5/8”				13 mm 1/2"	11 mm 7/16”	8 mm 5/16”
Combined Vertical and Gauge Face Wear Limits							
Rail Size	**141 lbs.**	**136RE**	**132RE**	**115 RE**	**100ARA**	**100 lbs. HF**	**85lbs.**
Increased Monitoring	24 mm 15/16”	22 mm 7/8”	18 mm 11/16”	16 mm 5/8”	10.5 mm 3/8”	8 mm 5/16”	6 mm 1/4”
Urgent	32 mm 1-1/4”	28.5 mm 1-1/8”	24 mm 15/16”	21 mm 13/16”	14 mm 9/16”	11 mm 7/16”	8 mm 5/16”

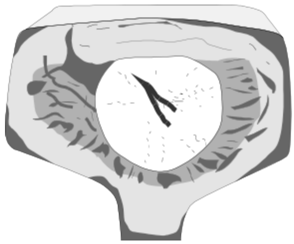
<table>
<tr><th colspan="8">TABLE B: RAIL WEAR LIMITS ON BRIDGES, OVERPASSES, AND TUNNELS</th></tr>
<tr><th colspan="8">Vertical Wear Limits</th></tr>
<tr><th>Rail Size</th><th>141 lbs.</th><th>136RE</th><th>132RE</th><th>115RE</th><th>100ARA</th><th>100 lbs. HF</th><th>85lbs.</th></tr>
<tr><td>Increased Monitoring</td><td>14.5 mm
9/16”</td><td>13 mm
1/2”</td><td>11 mm
7/16”</td><td>9 mm
3/8”</td><td>5.5 mm
3/16”</td><td>4 mm
1/8”</td><td>3 mm
1/8”</td></tr>
<tr><td>Urgent</td><td>19 mm
3/4 “</td><td>17 mm
5/8”</td><td>14.5 mm
9/16”</td><td>12 mm
1/2”</td><td>7 mm
1/4”</td><td>5 mm
3/16”</td><td>4 mm
1/8”</td></tr>
<tr><th colspan="8">Gauge Face Wear Limits</th></tr>
<tr><th>Rail Size</th><th>141 lbs.</th><th>136RE</th><th>132RE</th><th>115 RE</th><th>100ARA</th><th>100 lbs. HF</th><th>85lbs.</th></tr>
<tr><td>Increased Monitoring</td><td colspan="4">9 mm
3/8”</td><td>7 mm
1/4”</td><td>6 mm
1/4”</td><td>4.5 mm
3/16”</td></tr>
<tr><td>Urgent</td><td colspan="4">12 mm
1/2"</td><td>9.5 mm
3/8”</td><td>8 mm
5/16”</td><td>6 mm
1/4"</td></tr>
<tr><th colspan="8">Combined Vertical and Gauge Face Wear Limits</th></tr>
<tr><th>Rail Size</th><th>141 lbs.</th><th>136RE</th><th>132RE</th><th>115 RE</th><th>100ARA</th><th>100 lbs. HF</th><th>85lbs.</th></tr>
<tr><td>Increased Monitoring</td><td>18 mm
11/16”</td><td>16.5 mm
5/8”</td><td>13.5 mm
1/2"</td><td>12 mm
1/2"</td><td>8 mm
5/16”</td><td>6 mm
¼”</td><td>4.5 mm
3/16”</td></tr>
<tr><td>Urgent</td><td>24 mm
15/16”</td><td>22 mm
7/8”</td><td>18 mm
11/16”</td><td>16 mm
5/8”</td><td>10.5 mm
3/8”</td><td>8 mm
5/16”</td><td>6 mm
1/4”</td></tr>
</table>

APPENDIX H – RAIL DEFECT DESCRIPTIONS

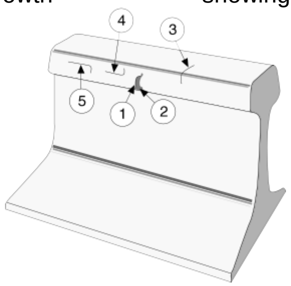
TRANSVERSE DEFECTS – TDT, TDW, TDC, TDD



Transverse fissure, showing rapid growth



Transverse fissure, showing sudden growth



Appearance of transverse defects in track

Compound Fissure

Detail Fracture

No evidence of a transverse defect is visible until the separation has reached the rail surface (cracks out). One or more of the following may then help recognize a transverse defect:

1. A hairline crack at right angles to the running surface, usually on the field or gauge side of the head or at the fillet under the head.
2. Bleeding around the crack.
3. A hairline crack at the gauge corner of the rail head. A rail that has been turned may have a crack on the field side. Numerous cracks on the gauge 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 that 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 shelling).

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

1. **"Transverse Fissure"** (Defect Code TDT or TDW) means a progressive crosswise fracture starting from a crystalline centre or nucleus inside the head from which it spreads outward as a smooth, bright, or dark, round or oval surface substantially at a right angle to the length of the rail. The distinguishing features of a transverse fissure from other types of fractures or defects are the crystalline centre or nucleus and the nearly smooth surface of the development that surrounds it.
2. **"Compound Fissure"** (Defect Code TDC) means a progressive fracture originating in a horizontal split head which turns up or down in the head of the rail as a smooth bright, or dark surface progressing until substantially at a right angle to the length of the rail. Compound fissures require examination of both faces of

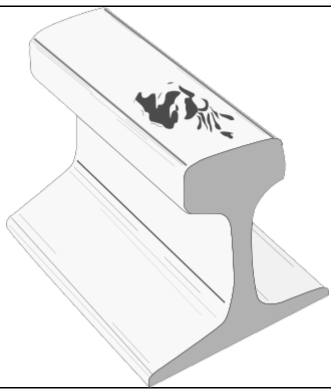
the fracture to locate the horizontal split head from which they originate.

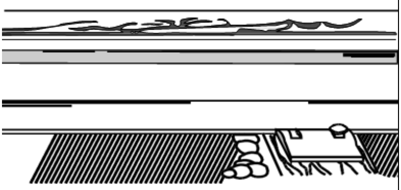
3. **"Detail Fracture**" (Defect Code TDD) means a progressive fracture originating at or near the surface of the rail head. These fractures should not be confused with transverse fissures, compound fissures, or other defects that have internal origins. Detail fractures may arise from shelly spots, head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

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

This type of defect is usually caused by imperfections in the rail steel when rolled. In non-control-cooled rail and chrome rail, a transverse defect is commonly caused by shatter crack from hydrogen. If one crack is found, there are likely to be many others in the same rail.

Defects are defined in the definition section, however a description of their appearance in track is below:

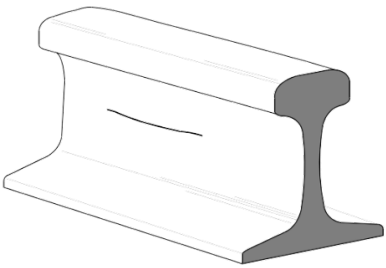
	**Engine Burn (EBF)**
	Appearance in Track: An oval or round dark area on the running surface of the rail where damaged metal breaks out forming a cavity. There are usually several marks. Sometimes they match on both rails. Others are located on the same rail and spaced at a distance corresponding to the spacing of the locomotive wheels.



Shelly Rail

Appearance in Track:
1. Dark spots irregularly spaced on the gauge side of the running surface.
2. Longitudinal separations at one or more levels in the upper gauge corner
3. It occurs most frequently on curves.

Shelly Rail is not to be confused with spalling from burnt steel in chrome rail, which is a type of mill defect. Spalling from burnt steel will show up within a few days after the rail is laid. Shell will not occur till rail has carried substantial traffic.

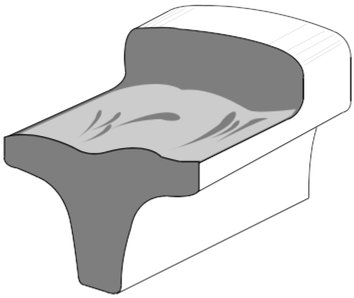


Split Web (SWJ, SWO)

Appearance in Track:
Bleeding cracks in the web

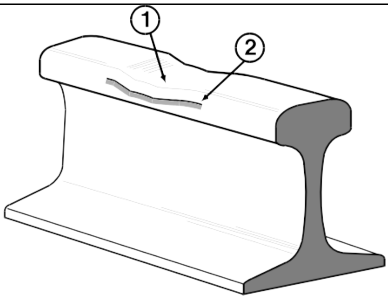
Note: This type of failure is frequently caused by bruises on the web resulting from striking the web with a spike maul or other object.

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



Horizontal Split Head (HSH, HSJ)

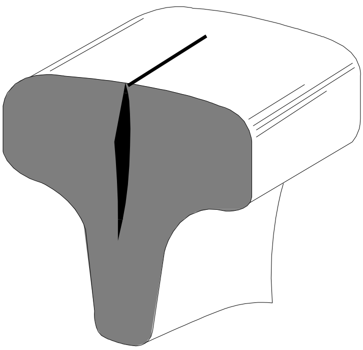
Appearance in Track:
1. Before cracking out, a horizontal split head will cause the appearance of a flat spot on the running surface. There may be a slight widening of the rail head.
2. After cracking out, a horizontal split head will appear as a hairline crack in the side of the head on one or both 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

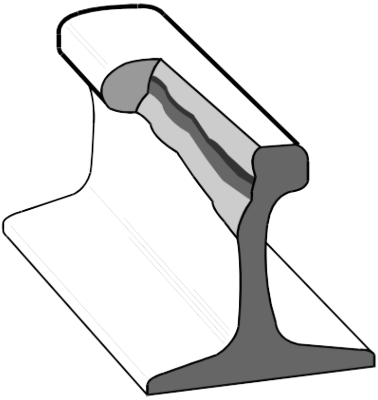


gauge side and in rail laid with tie plates, on the field side.

Note: This type of failure is caused by a manufacturing defect

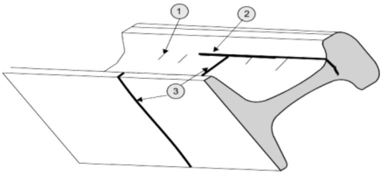
Vertical Split Head (VSH, VSJ)





Appearance in Track:
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.

Note: 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). In chrome rail vertical split heads in nearly new rail commonly result from shatter crack from hydrogen and the whole length of the rail is likely to be affected.

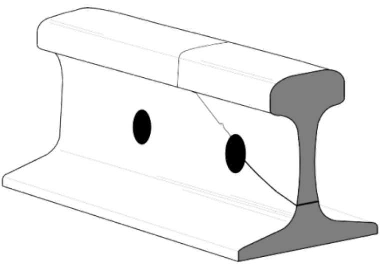


Head-Web Separation (HWJ, HWO)

Appearance in Track:

1. In earlier stages, wrinkled lines appear along the 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.

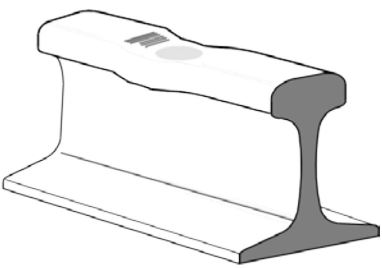
Note: This type of defect frequently occurs in rails through crossings, in tunnels and other wet locations.



Bolt Hole Break (BHJ, BHO)

Appearance in Track:
Cracks in the web extending radially from a bolt hole.

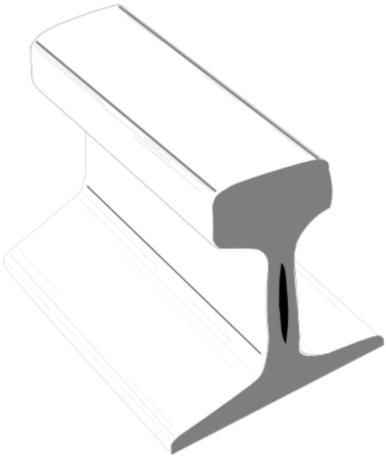
Note: This type of failure is frequently caused by loose bolts in the joint or inadequate anchoring of the track causing the bolts to strike the sides of the hole and damage the metal.



Crushed Head / Flattened Rail (CHJ, CHO)

Appearance in Track:

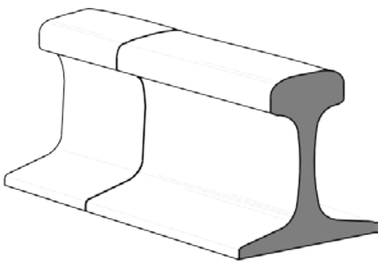
1. A flattening and widening of the head with the **entire** head sagging,
2. Small cracks in the depression of the running surface.
3. In advanced stages, a bleeding crack may appear in the fillet under the head.



Piped Rail (PRJ, PRO)

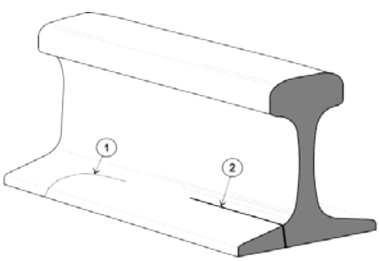
Appearance in Track:
1. Bulging of the web on either or both sides. There may be shallow cracks apparent on the sides of the bulge.
2. A slight sinking of the rail head in the area above the pipe with no other deformation of the head.

Note: This type of failure is due to a manufacturing defect.



Ordinary Break (BRJ, BRO)

Appearance in Track:
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.



Broken Base (BBJ, BBO)

Appearance in Track:
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.

Note: 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.

Hot Tear (DWF)

Appearance in Track:
1. Change in grain structure, likely near the base of the rail.
2. Discoloration

Battered End

Appearance in Track:
3. Flattening and widening of the head of the rail at the end.
4. The underside of the head is not affected in any way.

Mill Defect

Appearance in Track:
1. A deformation of the rail head that can cause wheels to batter the rail severely.
2. Broken out inclusions that leave cavities in the side or top of the head.
3. Inclusion of foreign material in the rail.
4. Vertical rust marks at regular intervals along the side of the rail web.

Defective Weld (DWF [field], DWP [plant])

Appearance in Track:
A transverse or longitudinal crack or separation in any portion of the weld or the rail within six inches of the weld.

Defective CAD Weld (DWC)

Appearance in Track:
A transverse crack across the rail head and progressing down into the web usually originating at the surface in the area of the cad weld. The weld area will often have grinding marks from where the cad weld has been ground off. It may appear to be a bolt hole crack, but originates from the cad weld and not the bolt hole.

Note: The defect grows in the area of a heat zone created by the weld that is very brittle. Because of the brittleness, any severe blow, such as a flat spot on a wheel, can cause sudden rupture.

Defective Gas Weld (DWG)

Appearance in Track:
A hairline crack at right angles to the running surface that may display bleeding or rust on the side of the head. The crack will be perpendicular to the rail and is often vertical without the “lean” of 20 degrees common in transverse defects. Breaks will occur in the middle of the weld and will appear as a transverse defect with a black nucleus.

Note: Welds may be in track for many years before a defect develops but defect growth can be very rapid.

Localised Surface Collapse (LSC)

Appearance in Track:

1. Flattening and widening of the head of the rail, other than at the end.
2. The underside of the head is not affected in any way.

Damaged Rail

Appearance in Track:
Any rail broken or injured by wrecks, broken, flat, or unbalanced wheels, slipping, or similar causes.

Damage by Defective Rolling Stock

Appearance in Track:
Nicks, cuts, dents or scars on any part of the surface of the rail.

Damage by Derailment

Appearance in Track:
Rail that has been broken, bent, nicked or otherwise damaged by derailment of equipment. Rail defects caused by derailments will have defect codes which reflect the type of defect the derailment created, i.e.: BBJ, BRO, TDT…etc.

APPENDIX I – REMEDIAL ACTION FOR RAIL DEFECTS

Table 50 Remedial Action for Surface Defect

Depth of Surface Defect		Remedial Action
Rail Wear is less the increased monitoring limits	Rail wear is greater than the increased monitoring limits	
less than 3/16 (5mm)	less than 1/8" (3mm)	Monitor and repair
3/16" to 5/16" (5mm) to (8mm)	1/8" to 3/16" (3mm) to (5mm)	Limit operating speed to 30 mph and repair or replace
greater than 5/16" (8mm)	greater than 3/16" (5mm)	Limit operating speed to 10 mph and repair or replace

Table 51 Remedial Action for Joint Batter in Winter Months

Joint Batter		
>3.5 mm	> 4mm	>= 5mm
• Must be measured twice a week.	• Must be changed out or welded within 48 hours • If rail cannot be changed a 30 mph speed restriction must be placed until the rail is replaced.	• 30 mph if the rail wear is less than the increased monitoring limits • 10 mph if the rail is greater than the increased monitoring limits. • Must be changed within 48 hours or welded with no exceptions

Table 52 Rail Defects on Class 1 and 2 Track, and 3 Track with Less Than 20 MGT Annually, No Hazardous Materials, and No Passenger Service

Defect	Percent of rail head cross-sectional area weakened by the defect	If the defective rail is not replaced immediately, take the following remedial action denoted by note:
Compound Fissure	0 to 69	B and E
	70 to 99	A1
	100	A
Transverse Fissure, Detail Fracture, Engine Burn , or Defective Weld	0 to 20	C or C1
	21 to 99	D
	100	A or (E and H)
Defect	**Defect Size in. (mm)**	**If the defective rail is not replaced immediately, take the following remedial action denoted by note:**
Vertical or Horizontal Split Head	0 to 2 (0 - 51)	H and F
	Over 2 to 4 (>51 – 102)	B and G
	Over 4 (>102)	B
	Break out in rail head	A
Split Web, Piped Rail, or Head Web Separation	0 to ½ (0 – 13)	H and F
	Over ½ to 3 (>13 – 76)	B and G
	Over 3 (>76)	B
	Break out in rail head	A
Bolt Hole Crack	0 to ½ (0 – 13)	H and F
	Over ½ to 1½ (>13 – 38)	B
	Over 1½ (>38)	B and G
	Break out in rail head	A
Broken Rail Base	0 to 6 (0 – 152)	D
	Over 6 (>152)	A or (E then B)

Defect	If the defective rail is not replaced immediately, take the following remedial action denoted by note:
Ordinary Break	A and E
Damaged Rail	D
Flattened Rail, Crushed Head, or Localised Surface Collapse	Apply Track Standard Section 4.16

REMEDIAL ACTION APPLICABLE TO DEFECTS IN Table 52

A. A qualified person must visually supervise each operation over the defective rail. See Track Standard Section 4.17.

1. After visual inspection, that person may authorize operation over the defective rail without continuous visual supervision at a maximum speed of 10 mph for up to 24 hours prior to making another visual inspection, repair or replacement of the rail.

B. Limit operating speed over the defective rail to speed as authorized by a qualified person to a maximum of 30 mph or the maximum allowable for that class of track, whichever is lower.

C. In Class 1 and 2 track, apply joint bars to the defect and bolt through the outermost holes, within 10 days of being discovered.

In Class 3 track, limit operating speed over the defective rail to maximum 30 mph until such time as joint bars have been applied. After joint bars have been applied, limit operating speed to 40 mph or the maximum allowable for that class of track, whichever is lower. Joint bars are to be applied to the defect and bolted through the outermost holes within 10 days after discovery. When joint bars have not been applied within 10 days, speed must be limited to 10 mph, until joint bars are applied.

1. Where the defect is identified by ultrasonic inspection, limit operating speed to a maximum 40 mph or the maximum for the class of track, whichever is lower for a period not to exceed 4 days. If joint bars are not applied within 4 days follow procedure in item C (where the date of defect identification is the date discovered by the ultrasonic inspection).

D. Limit operating speed over the defective rail to maximum 30 mph or less as authorized by a qualified person, until such time as joint bars have been applied. After joint bars have been applied, limit operating speed to 40 mph or the maximum allowable operating speed for that class of track whichever is lesser. Joint bars are to be applied to the defect and bolted through the outermost holes within 7 days of discovery. When joint bars have not been applied within 7 day, speed must be limited to 10 mph, until joint bars are applied.

E. Apply joint bars to the defect and bolt with the appropriate number of bolts for the class of track involved.

F. Inspect rail or remove defect within 90 days* of detecting the defect.

G. Inspect rail or remove defect within 30 days* of detecting the defect.

H. Limit operating speed over the defective rail to maximum 40 mph or the maximum allowable operating speed for the class of track, whichever is lesser, and remove defect within 90 days.

*For Rail Flaw Detected (Ultrasonic) defects that are strictly internal and not visible, perform another inspection with either rail-mounted or hand-held Rail Flaw Detection (ultrasonic) equipment. For defects that are visible and measurable, a visual or Rail Flaw Detection inspection is acceptable. For defects enclosed within the joint bar area, such as bolt-hole defects, the joint bars must be removed and a visual re-inspection must be made. The re-inspection must be performed prior to the expiration of the 30 or 90 day interval. If the rail remains in track and is not replaced, the cycle starts over. If the defect increased in size, it may become subject to more restrictive remedial action, as described in this table.

Table 53 – Rail Defects on Class 4 and 5 Tracks and Class 3 Tracks Carrying Passenger Traffic or Hazardous Materials

Defect[1]	Percent of rail head cross-sectional area weakened by the defect	If the defective rail is not replaced immediately, take the following remedial action denoted by note:
Compound Fissure	0 to 70	1
	71 to 99	2
	100	3
Transverse Fissure, Detail Fracture, Engine Burn, or Defective Weld	0 to 19	4
	20 to 59	5
	60 to 99	6
	100	3 or 13 then 9
Defect[1]	**Defect Size in. (mm)**	**If the defective rail is not replaced immediately, take the following remedial action denoted by note:**
Vertical or Horizontal Split Head, or Horizontal Split Web, Piped Rail, Head-Web Separations, or Defective Weld Longitudinal	0 to ½ (0 - 13)	7
	Over ½ to 3 (>13 – 76)	8
	Over 3 (>76)	9
	Break out in rail head	3
Bolt Hole Crack	0 to ½ (0 – 13)	7
	Over ½ to 3 (>13 – 76)	8
	Over 3 (>76)	9
	Break out in rail head	3
Broken Rail Base	0 to 6 (0 – 152)	10 or 13 then 7
	Over 6 (>152)	11 or 10

Defect[1]	If the defective rail is not replaced immediately, take the following remedial action denoted by note:
Ordinary Break	3 or 10
Damaged Rail	12
Flattened Rail, Crushed Head, or Localised Surface Collapse	Apply Track Standard Section 4.16

[1] Defects in special track-work or highway crossings must be protected as per the above inspected visually at the minimum frequency required by regulation for track inspections and removed within 14 days.

REMEDIAL ACTION APPLICABLE TO DEFECTS IN TABLE 53

1. Inspect defect immediately. Limit operating speed to maximum 30 mph. Remove defect within 72 hours of being detected.
2. Assign a qualified person to make a visual inspection once every 24 hours. Limit operating speed to 10 mph. If joint bars are applied the operating speed can be increased to 30 mph. Remove defect within 72 hours of being detected.
3. Assign a qualified person to visually supervise each train movement over the defective rail. See Track Standard Section 4.17. The defect must be repaired as soon as track time permits but not longer than 24 hours of being detected.
4. Inspect defect. Limit operating speed to 30 mph until joint bars are applied. Apply joint bars and bolt through outer most holes. Thereafter, limit operating speed to 50 mph or the maximum for the class of track, whichever is more restrictive. Remove defect within 7 days of being detected.
5. Inspect defect. Limit operating speed to 30 mph as authorized by a qualified person until joint bars are applied. Apply joint bars and bolt through outer most holes. Thereafter, limit operating speed to 50 mph or the maximum for the class of track, whichever is more restrictive. Remove defect within 72 hours of being detected.
6. Inspect defect. Limit operating speed to 10 mph until joint bars are applied. Apply joint bars to the defect. Thereafter, limit operating speed to 50 mph or the maximum for the class of track, whichever is more restrictive. Remove defect within 24 hours of being detected.

7. Inspect immediately. Limit operating speed to a maximum of 50 mph. Remove defect within 7 days of being detected.

8. Inspect immediately. Limit operating speed to a maximum of 30 mph. Remove defect within 72 hours of being detected.

9. Inspect immediately. Limit operating speed to a maximum of 10 mph. Remove defect within 24 hours of being detected.

10. Inspect immediately. Apply joint bars to the defect and fully bolt for class of track. Limit operating speed to a maximum of 30 mph. Remove defect within 72 hours of being detected.

11. Inspect immediately. Limit operating speed to 10 mph until repaired. Assign a qualified person to visually supervise each train movement over the defective rail until a repair has been completed. See Track Standard Section 4.17.

12. Inspect immediately. Apply joint bars within 10 days. Limit operating speed to a maximum of 30 mph until joint bars are applied. Thereafter, limit the operating speed to 50 mph.

13. Apply joint bars to the defect and bolt through outer most holes.

Table 54 Corrective and Remedial Actions for Single Surface Irregularities

Condition	Depth	Remedial Action	Corrective action
Crack-out in the upper fillet under the rail head	N/A	Limit train operations to not more than 10mph and visually supervise each movement until the defective rail is removed	Change out rail
Corrugation	All depths	Record Location	Grind with local welding forces, switch & crossing grinder or grinding train if possible, or change rail
Flaking	N/A	Record Location	Grind with local welding forces, switch & crossing grinder or grinding train
Spalling and Shelling	≤ 3mm (1/8”)	Record Location and check for escalation of defect once per month	Grind with local welding forces, switch & crossing grinder or grinding train
	> 3mm (1/8”) ≤ 5 mm (3/16“)	Record Location and check for crack-out under head once per week	Change out rail
	>5 mm (3/16“) ≤7mm (¼“)	Limit train operation to not more than 60mph and check for crack-out under head once per week	Change out rail
	>7mm (¼ ”)	Limit train operations to not more than 30mph and check for crack-out under head on each routine inspection	Change out rail

NOTE: If a crack-out condition exists in the upper fillet area under the rail head, trains and engines must not be allowed over this rail condition until the defective rail is changed-out, unless the person assigned to visually supervise the movement is on-site, in constant communication with the locomotive engineer, and the movement is restricted to a speed not exceeding 10 mph.

APPENDIX J – SPEED RESTRICTIONS FOR TRACK WORK

Table 55 – Speed Restrictions for Track Work

<table>
<tr><th rowspan="2">Activity</th><th rowspan="2">Forecasted Rail Temp within 24 hrs</th><th colspan="2">Speed Restriction</th></tr>
<tr><th>Without Dynamic Stabilizer</th><th>With Dynamic Stabilizer</th></tr>
<tr><td rowspan="3">• Mechanized tie renewal
• Panelized turnout replacement
• Out-of-face surfacing
• Ballast Cleaning / Undercutting
• Lining
• Track Construction
• Crossing rehabilitation</td><td>>PRLT</td><td>• 10 mph for 8,000 tons
• Inspect
• 30 mph[2] for 100,000 tons
• Inspect
• If ok return to track speed</td><td>• 30 mph[2] for 16,000 tons
• Inspect
• If ok return to track speed</td></tr>
<tr><td>≤PRLT and ≥PRLT-30°F[1]</td><td>• 10 mph for 8,000 tons
• Inspect
• 30 mph[2] for 50,000 tons
• Inspect
• If ok return to track speed</td><td>N/A</td></tr>
<tr><td><PRLT-30°F[1]</td><td>• 30 mph[2] for 8,000 tons
• Inspect
• If ok return to track speed</td><td>N/A</td></tr>
<tr><td>• Spot tie renewal
• Spot surfacing
• Shoulder cleaning</td><td>>PRLT</td><td>• 30 mph[2] for 8,000 tons[3]
• Inspect
• If ok return to track speed</td><td>N/A</td></tr>
<tr><td>• Rail Installation (any length)
• Realignment of track
• Lifts in excess of 1 in. (25 mm)</td><td>All</td><td colspan="2">When rail temperature is forecasted to have an increase greater than 40 ºF or 22 ºC above the RLT, a 30 mph[3] speed restriction shall apply as per Track Standard Section 4.9.22</td></tr>
</table>

***Speed restriction may not be removed in the heat of the day.**

[1] 30°F (16.6°C)

[2] Between the hours of 22:00 and 10:00 the speed restriction may be 40 mph. If required tonnage is not accumulated by 10:00 speed must be restricted to 30 mph.

[3] The speed restriction can be avoided by replacing up to a maximum of 2 ties per 39 ft. (12 m) track section.

Table 56 – Speed Restrictions for Repairs to Buckled Track Without Cutting the Rail

Forecasted Rail Temperature	Stabilizer Available	TSO Requirement
Below PRLT	Yes	• 8,000 tons at 30mph
	No	• 50,000 tons at 30mph
Above PRLT	Yes	• 16,000 tons at 30mph
	No	• 16,000 tons at 10mph and inspect; • 50,000 tons at 30mph and inspect; • Then 50,000 tons at 40mph and inspect;

NOTE: Speed restriction may not be removed in the heat of the day.

Table 57 - Equipment Tonnage

Equipment (empty / AW0 loading)	Tonnage	8,000 Tons	50,000 Tons
12-Car GO Train	800 Tons	10 Trains	62 Trains
10-Car GO Train	690 Tons	12 Trains	72 Trains
6-Car GO Train	471 Tons	17 Trains	106 Trains
3-Car UP DMU	235 Tons	34 Trains	213 Trains
2-Car UP DMU	157 Tons	51 Trains	319 Trains

8,000 tons – 1 freight train

Note: tonnage determined based on empty equipment weight.

1. The limits of the speed restriction should be 500 feet (1/10 mile) (152.4 m) on either side of the work area.
2. More restrictive speed restrictions may be required depending on local conditions, such as: subgrade condition, weak ballast, insufficient anchors, and poor ties etc.

3. Prior to increasing or removing or modifying a speed restriction, the track must be inspected to ensure the anchor pattern meets the requirements of Track Standards section 10.2 and that there are no signs of tight rail per Track Standard Section 4.13, or any other defects. Verification must also be made that the required tonnage has actually passed over the track being restricted. Speed restrictions should not be removed in the heat of the day.

APPENDIX K – AUTHORIZING MOVEMENTS OVER RAIL BREAKS

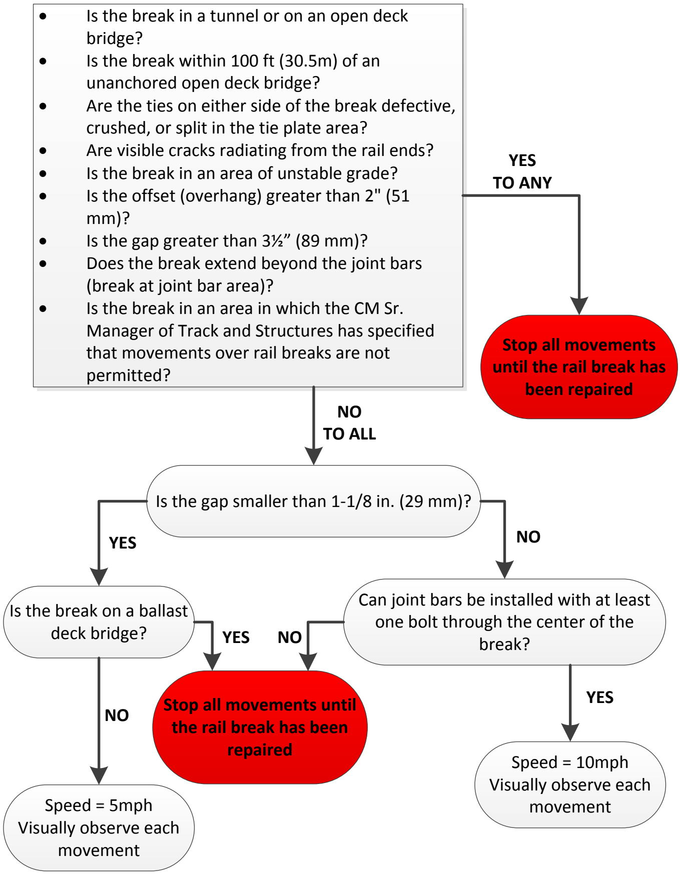


Figure 38. Supervised Movements over Rail Breaks (where the failure, joint bars, weld repair bars, and supporting ties can be visually observed.)

APPENDIX L – CONTINUOUS WELDED RAIL THERMAL EXPANSION CHART

Determination of rail expansion for lengths between those shown in the Table must be calculated using the formula provided.

TEMP. Difference from PRLT		LENGTH OF CWR ft. (m)							
		200 (61)	400 (122)	600 (183)	800 (244)	1000 (305)	1200 (366)	1400 (427)	1482 (452)
°F	°C	CWR MOVEMENT in. (mm)							
5	2	1/8 (3)	1/8 (3)	1/4 (6)	3/8 (10)	3/8 (10)	1/2 (13)	1/2 (13)	5/8 (15)
10	5	1/8 (3)	3/8 (10)	1/2 (13)	5/8 (15)	3/4 (20)	1 (25)	1-1/8 (29)	1-1/8 (29)
15	7	1/4 (6)	1/2 (13)	3/4 (20)	1 (25)	1-1/4 (32)	1-1/2 (38)	1-5/8 (41)	1-3/4 (44)
20	9	3/8 (10)	5/8 (15)	1 (25)	1-1/4 (32)	1-5/8 (41)	1-7/8 (48)	2-1/4 (57)	2-3/8 (60)
25	11	3/8 (10)	3/4 (20)	1-1/4 (32)	1-5/8 (41)	2 (51)	2-3/8 (60)	2-3/4 (75)	3 (76)
30	13	1/2 (13)	1 (25)	1-1/2 (38)	1-7/8 (48)	2-3/8 (60)	2-7/8 (73)	3-3/8 (84)	3-1/2 (89)
35	16	1/2 (13)	1-1/8 (29)	1-5/8 (41)	2-1/4 (57)	2-3/4 (75)	3-3/8 (84)	3-7/8 (98)	4-1/8 (105)
40	18	5/8 (15)	1-1/4 (32)	1-7/8 (48)	2-1/2 (64)	3-1/4 (83)	3-7/8 (98)	4-1/2 (114)	4-3/4 (121)
45	20	3/4 (20)	1-1/2 (38)	2-1/8 (54)	2-7/8 (73)	3-5/8 (92)	4-3/8 (111)	5 (127)	5-3/8 (137)
50	22	3/4 (20)	1-5/8 (41)	2-3/8 (60)	3-1/4 (83)	4 (102)	4-3/4 (121)	5-5/8 (143)	5-7/8 (149)
55	24	7/8 (23)	1-3/4 (44)	2-5/8 (67)	3-1/2 (89)	4-3/8 (111)	5-1/4 (133)	6-1/8 (156)	6-1/2 (165)
60	27	1 (25)	1-7/8 (48)	2-7/8 (73)	3-7/8 (98)	4-3/4 (121)	5-3/4 (146)	6-3/4 (171)	7-1/8 (181)

TEMP. Difference from PRLT		LENGTH OF CWR ft. (m)							
		200 (61)	400 (122)	600 (183)	800 (244)	1000 (305)	1200 (366)	1400 (427)	1482 (452)
°F	°C	CWR MOVEMENT in. (mm)							
65	29	1 (25)	2-1/8 (54)	3-1/8 (79)	4-1/8 (105)	5-1/4 (133)	6-1/4 (159)	7-1/4 (184)	7-3/4 (197)
70	31	1-1/8 (29)	2-1/4 (64)	3-3/8 (86)	4-1/2 (114)	5-5/8 (143)	6-3/4 (171)	7-7/8 (200)	8-1/4 (210)
75	33	1-1/4 (32)	2-3/8 (60)	3-5/8 (92)	4-3/4 (121)	6 (152)	7-1/4 (184)	8-3/8 (213)	8-7/8 (225)
80	36	1-1/4 (32)	2-1/2 (64)	3-7/8 (98)	5-1/8 (130)	6-3/8 (162)	7-5/8 (194)	9 (229)	9-1/2 (241)
85	38	1-3/8 (35)	2-3/4 (70)	4-1/8 (105)	5-1/2 (140)	6-3/4 (171)	8-1/8 (206)	9-1/2 (241)	10-1/8 (257)
90	40	1-1/2 (38)	2-7/8 (73)	4-3/8 (111)	5-3/4 (146)	7-1/4 (184)	8-5/8 (219)	10-1/8 (257)	10-5/8 (270)
95	42	1-1/2 (38)	3 (76)	4-1/2 (114)	6-1/8 (156)	7-5/8 (194)	9-1/8 (232)	10-5/8 (270)	11-1/4 (286)
100	44	1-5/8 (41)	3-1/4 (83)	4-3/4 (121)	6-3/8 (162)	8 (203)	9-5/8 (244)	11-1/4 (286)	11-7/8 (302)
105	47	1-5/8 (41)	3-3/8 (86)	5 (127)	6-3/4 (171)	8-3/8 (213)	10-1/8 (257)	11-3/4 (298)	12-1/2 (318)
110	49	1-3/4 (44)	3-1/2 (89)	5-1/4 (133)	7 (178)	8-3/4 (222)	10-1/2 (267)	12-3/8 (314)	13 (330)

MOVEMENT (in) = RAIL LENGTH (ft.) x TEMP DIFF FROM PRLT (°F) x 0.00008
MOVEMENT (mm) = RAIL LENGTH (m) x TEMP DIFF FROM PRLT (°C) x 0.0145

Temperature differential from the PRLT		Length of Rail ft. (m)			
		150 (45.7)	225 (68.6)	300 (91.4)	500 (152.4)
° F	°C	Adjustment Required in. (mm)			
5	2	1/8 (3)	1/8 (3)	1/8 (3)	1/8 (3)
10	5	1/8 (3)	1/4 (6)	1/4 (6)	3/8 (10)
15	7	1/4 (6)	3/8 (10)	3/8 (10)	5/8 (15)
20	9	1/4 (6)	3/8 (10)	1/2 (13)	7/8 (23)
25	11	3/8 (10)	1/2 (13)	5/8 (16)	1 (25)
30	13	3/8 (10)	5/8 (16)	3/4 (19)	1-1/4 (32)
35	16	1/2 (13)	3/4 (19)	7/8 (22)	1-3/8 (35)
40	18	1/2 (13)	3/4 (19)	1 (25)	1-5/8 (41)
45	20	5/8 (16)	7/8 (22)	1-1/8 (29)	1-7/8 (48)
50	22	5/8 (16)	1 (25)	1-1/4 (32)	2 (51)
55	24	3/4 (19)	1 (25)	1-3/8 (35)	2-1/4 (57)
60	27	3/4 (19)	1-1/8 (29)	1-1/2 (38)	2-3/8 (60)
65	29	7/8 (22)	1-1/4 (32)	1-5/8 (41)	2-5/8 (67)
70	31	7/8 (22)	1-3/8 (35)	1-3/4 (44)	2-7/8 (73)
75	33	1 (25)	1-3/8 (38)	1-7/8 (48)	3 (76)
80	36	1 (25)	1-1/2 (41)	2 (51)	3-1/8 (79)
85	38	1-1/8 (29)	1-5/8 (41)	2-1/8 (54)	3-1/2 (89)
90	40	1-1/8 (29)	1-5/8 (41)	2-1/4 (57)	3-5/8 (92)
95	42	1-1/4 (32)	1-3/4 (44)	2-3/8 (60)	3-3/4 (95)
100	44	1-1/4 (32)	1-7/8 (48)	2-1/2 (64)	4 (102)

APPENDIX M – EFFECTIVE LENGTH ADDED FOR CURVES CHORDING INWARD

DEGREE OF CURVE	DISTANCE CURVE HAS CHORDED INWARD in. (mm)											
	1/2 (13)	1 (25)	1-1/2 (38)	2 (51)	2-1/2 (64)	3 (76)	3-1/2 (89)	4 (102)	4-1/2 (108)	5 (127)	5-1/2 (140)	6 (152)
	EFFECTIVE RAIL LENGTH ADDED TO CURVE PER 1000 ft. OF CURVE in. (mm)											
0°30’	0	1/8 (3)	1/8 (3)	1/8 (3)	1/4 (6)	1/4 (6)	1/4 (6)	3/8 (10)	3/8 (10)	3/8 (10)	1/2 (13)	1/2 (13)
1°00’	1/8 (3)	1/8 (3)	1/4 (6)	3/8 (10)	1/2 (13)	1/2 (13)	5/8 (16)	3/4 (19)	3/4 (19)	7/8 (22)	1 (25)	1 (25)
1°30’	1/8 (3)	1/4 (6)	3/8 (10)	1/2 (13)	5/8 (16)	3/4 (19)	7/8 (22)	1 (25)	1-1/8 (29)	1-1/4 (32)	1-1/2 (38)	1-5/8 (41)
2°00’	1/8 (3)	3/8 (10)	1/2 (13)	3/4 (19)	7/8 (22)	1 (25)	1-1/4 (32)	1-3/8 (35)	1-1/2 (38)	1-3/4 (44)	1-7/8 (48)	2-1/8 (54)
2°30’	1/4 (6)	3/8 (10)	5/8 (16)	7/8 (22)	1-1/8 (29)	1-1/4 (32)	1-1/2 (38)	1-3/4 (44)	1-7/8 (48)	2-1/8 (54)	2-3/8 (60)	2-5/8 (67)
3°00’	1/4 (6)	1/2 (13)	3/4 (19)	1 (25)	1-1/4 (32)	1-5/8 (41)	1-7/8 (48)	2-1/8 (54)	2-3/8 (60)	2-5/8 (67)	2-7/8 (73)	3-1/8 (79)
3°30’	1/4 (6)	5/8 (16)	7/8 (22)	1-1/4 (32)	1-1/2 (38)	1-7/8 (48)	2-1/8 (54)	2-1/2 (64)	2-3/4 (70)	3-1/8 (79)	3-3/8 (79)	3-5/8 (92)
4°00’	3/8 (10)	3/4 (19)	1 (25)	1-3/8 (35)	1-3/4 (44)	2-1/8 (54)	2-1/2 (64)	2-3/4 (70)	3-1/8 (79)	3-1/2 (89)	3-7/8 (98)	4-1/4 (108)
4°30’	3/8 (10)	3/4 (19)	1-1/8 (29)	1-5/8 (41)	2 (51)	2-3/8 (60)	2-3/4 (70)	3-1/8 (79)	3-1/2 (89)	3-7/8 (98)	4-3/8 (111)	4-3/4 (121)
5°00’	1/2 (13)	7/8 (22)	1-1/4 (32)	1-3/4 (44)	2-1/8 (54)	2-5/8 (67)	3 (76)	3-1/2 (89)	3-7/8 (98)	4-3/8 (111)	4-3/4 (121)	5-1/4 (133)

When a curve chords inward, it is equivalent to adding rail into the track. The effective amount of rail added into a curve is based on the amount the curve has shifted, or chorded inward, which can be calculated by the table above.

DEGREE OF CURVE	DISTANCE CURVE HAS CHORDED INWARD in. (mm)											
	1/2 (13)	1 (25)	1-1/2 (38)	2 (51)	2-1/2 (64)	3 (76)	3-1/2 (89)	4 (102)	4-1/2 (108)	5 (127)	5-1/2 (140)	6 (152)
	EFFECTIVE RAIL LENGTH ADDED TO CURVE PER 1000 FT. OF CURVE in. (mm)											
5°30'	1/2 (13)	1 (25)	1-1/2 (38)	1-7/8 (78)	2-3/8 (60)	2-7/8 (73)	3-3/8 (86)	3-7/8 (98)	4-1/4 (108)	4-3/4 (121)	5-1/4 (133)	5-3/4 (146)
6°00'	1/2 (13)	1 (25)	1-5/8 (41)	2-1/8 (54)	2-5/8 (67)	3-1/8 (79)	3-5/8 (92)	4-1/8 (105)	4-5/8 (117)	5-1/4 (133)	5-3/4 (146)	6-1/4 (159)
6°30'	5/8 (16)	1-1/8 (29)	1-3/4 (45)	2-1/4 (57)	2-7/8 (73)	3-3/8 (86)	4 (102)	4-1/2 (114)	5 (127)	5-5/8 (143)	6-1/4 (159)	6-3/4 (172)
7°00'	5/8 (16)	1-1/4 (32)	1-7/8 (48)	2-1/2 (64)	3 (76)	3-5/8 (92)	4-1/4 (108)	4-7/8 (124)	5-1/2 (140)	6-1/8 (156)	6-3/4 (172)	7-3/8 (187)
7°30'	5/8 (16)	1-1/4 (32)	2 (51)	2-5/8 (67)	3-1/4 (83)	3-7/8 (98)	4-5/8 (117)	5-1/4 (133)	5-7/8 (149)	6-1/2 (165)	7-1/4 (184)	7-7/8 (200)
8°00'	3/4 (19)	1-3/8 (35)	2-1/8 (54)	2-3/4 (70)	3-1/2 (89)	4-1/4 (108)	4-7/8 (124)	5-5/8 (143)	6-1/4 (159)	7 (178)	7-5/8 (194)	8-3/8 (213)
8°30'	3/4 (19)	1-1/2 (38)	2-1/4 (57)	3 (76)	3-3/4 (95)	4-1/2 (114)	5-1/4 (133)	5-7/8 (149)	6-5/8 (168)	7-3/8 (187)	8-1/8 (206)	8-7/8 (225)
9°00'	3/4 (19)	1-1/2 (38)	2-3/8 (60)	3-1/8 (79)	3-7/8 (98)	4-3/4 (121)	5-1/2 (140)	6-1/4 (159)	7 (178)	7-7/8 (200)	8-5/8 (219)	9-3/8 (238)
9°30'	7/8 (22)	1-5/8 (41)	2-1/2 (64)	3-3/8 (86)	4-1/8 (105)	5 (127)	5-3/4 (146)	6-5/8 (168)	7-3/8 (187)	8-1/4 (210)	9-1/8 (232)	10 (254)
10°00'	7/8 (22)	1-3/4 (45)	2-5/8 (67)	3-1/2 (89)	4-3/8 (111)	5-1/4 (133)	6-1/8 (156)	7 (178)	7-3/4 (197)	8-3/4 (222)	9-5/8 (245)	10-1/2 (267)

Example:

A 2000 ft. (610 m), 4 degree curve is found to have shifted inwards an average of 3 in. (76 mm). What is the effective amount of rail added to the curve?

Per the Table, for a 4 degree curve and 3 inches (76 mm) of movement, it is equivalent to adding 2-1/8 in. (54 mm) of rail per 1000 ft. (305 m) or a reduction in the Neutral rail temperature by 30°F (13°C). For a 2,000 ft. (610 m) curve the effective rail length added would therefore be 4¼ in. (108 mm).

Refer to Track Standard section 12.3.6 for applicable speed restrictions due to effective steel added. Speed restrictions per Track Standards section 16.2 also apply.

APPENDIX N – CURVE AND V_{MAX} TABLES

Degree of Curve	Balanced Superlelevation Speed (MPH)																			
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
0°15'	0	0	0	1/8	1/8	1/8	1/4	1/4	3/8	1/2	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 5/8	1 3/4
0°30'	0	0	1/8	1/8	1/4	3/8	3/8	1/2	3/4	7/8	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 7/8	3 1/8	3 1/2
0°45'	0	0	1/8	1/4	3/8	1/2	5/8	7/8	1 1/8	1 3/8	1 5/8	1 7/8	2 1/4	2 5/8	3	3 3/8	3 3/4	4 1/4	4 3/4	5 1/4
1° 00'	0	1/8	1/8	1/4	1/2	5/8	7/8	1 1/8	1 3/8	1 3/4	2 1/8	2 1/2	3	3 3/8	4	4 1/2	5	5 5/8		
1° 30'	0	1/8	1/4	3/8	5/8	1	1 1/4	1 5/8	2 1/8	2 5/8	3 1/8	3 3/4	4 3/8	5 1/8	5 7/8					
2° 00'	0	1/8	3/8	1/2	7/8	1 1/4	1 3/4	2 1/4	2 7/8	3 1/2	4 1/4	5	5 7/8							
2° 30'	0	1/8	3/8	3/4	1 1/8	1 5/8	2 1/8	2 3/4	3 1/2	4 3/8	5 1/4									
3° 00'	0	1/4	1/2	7/8	1 3/8	1 7/8	2 5/8	3 3/8	4 1/4	5 1/4										
3° 30'	0	1/4	1/2	1	1 1/2	2 1/4	3	3 7/8	5											
4° 00'	1/8	1/4	5/8	1 1/8	1 3/4	2 1/2	3 3/8	4 1/2	5 5/8											
4° 30'	1/8	3/8	3/4	1 1/4	2	2 7/8	3 7/8	5												
5° 00'	1/8	3/8	3/4	1 3/8	2 1/4	3 1/8	4 1/4	5 5/8												
5° 30'	1/8	3/8	7/8	1 1/2	2 3/8	3 1/2	4 3/4													
6° 00'	1/8	3/8	1	1 5/8	2 5/8	3 3/4	5 1/8													
6° 30'	1/8	1/2	1	1 7/8	2 7/8	4 1/8	5 5/8													
7° 00'	1/8	1/2	1 1/8	2	3 1/8	4 3/8	6													
7° 30'	1/8	1/2	1 1/8	2 1/8	3 1/4	4 3/4														
8° 00'	1/8	1/2	1 1/4	2 1/4	3 1/2	5														
8° 30'	1/8	5/8	1 3/8	2 3/8	3 3/4	5 3/8														
9° 00'	1/8	5/8	1 3/8	2 1/2	4	5 5/8														
9° 30'	1/8	5/8	1 1/2	2 5/8	4 1/8	6														
10° 00'	1/8	3/4	1 5/8	2 3/4	4 3/8															
10° 30'	1/8	3/4	1 5/8	3	4 5/8															
11° 00'	1/4	3/4	1 3/4	3 1/8	4 7/8															
11° 30'	1/4	3/4	1 3/4	3 1/4	5															
12° 00'	1/4	7/8	1 7/8	3 3/8	5 1/4															
12° 30'	1/4	7/8	2	3 1/2	5 1/2															
13° 00'	1/4	7/8	2	3 5/8	5 3/4															
13° 30'	1/4	1	2 1/8	3 3/4	5 7/8															
14° 00'	1/4	1	2 1/4	3 7/8																
14° 30'	1/4	1	2 1/4	4																
15° 00'	1/4	1	2 3/8	4 1/4																

$$E = 0.0007\ D\ S^2$$

E = Superelevation (in)
D = Degree of curvature (decimal degrees)
S = Speed (mph)

Degree of Curve	1" Imbalanced Superlelevation (CP Freight) Speed (MPH) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
0°15'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	5/8	3/4
0°30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	3/4	1	1 1/4	1 1/2	1 7/8	2 1/8	2 1/2
0°45'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	5/8	7/8	1 1/4	1 5/8	2	2 3/8	2 3/4	3 1/4	3 3/4	4 1/4
1° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	3/4	1 1/8	1 1/2	2	2 3/8	3	3 1/2	4	4 5/8	5 3/8	6
1° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	5/8	1 1/8	1 5/8	2 1/8	2 3/4	3 3/8	4 1/8	4 7/8	5 3/4				
2° 00'	1/2	1/2	1/2	1/2	1/2	1/2	3/4	1 1/4	1 7/8	2 1/2	3 1/4	4	4 7/8	5 7/8						
2° 30'	1/2	1/2	1/2	1/2	1/2	5/8	1 1/8	1 3/4	2 1/2	3 3/8	4 1/4	5 1/4								
3° 00'	1/2	1/2	1/2	1/2	1/2	7/8	1 5/8	2 3/8	3 1/4	4 1/4	5 3/8									
3° 30'	1/2	1/2	1/2	1/2	1/2	1 1/4	2	2 7/8	4	5 1/8										
4° 00'	1/2	1/2	1/2	1/2	3/4	1 1/2	2 3/8	3 1/2	4 5/8	6										
4° 30'	1/2	1/2	1/2	1/2	1	1 7/8	2 7/8	4	5 3/8											
5° 00'	1/2	1/2	1/2	1/2	1 1/4	2 1/8	3 1/4	4 5/8												
5° 30'	1/2	1/2	1/2	1/2	1 3/8	2 1/2	3 3/4	5 1/8												
6° 00'	1/2	1/2	1/2	5/8	1 5/8	2 3/4	4 1/8	5 3/4												
6° 30'	1/2	1/2	1/2	7/8	1 7/8	3 1/8	4 5/8													
7° 00'	1/2	1/2	1/2	1	2 1/8	3 3/8	5													
7° 30'	1/2	1/2	1/2	1 1/8	2 1/4	3 3/4	5 3/8													
8° 00'	1/2	1/2	1/2	1 1/4	2 1/2	4	5 7/8													
8° 30'	1/2	1/2	1/2	1 3/8	2 3/4	4 3/8														
9° 00'	1/2	1/2	1/2	1 1/2	3	4 5/8														
9° 30'	1/2	1/2	1/2	1 5/8	3 1/8	5														
10° 00'	1/2	1/2	5/8	1 3/4	3 3/8	5 1/4														
10° 30'	1/2	1/2	5/8	2	3 5/8	5 5/8														
11° 00'	1/2	1/2	3/4	2 1/8	3 7/8	5 7/8														
11° 30'	1/2	1/2	3/4	2 1/4	4															
12° 00'	1/2	1/2	7/8	2 3/8	4 1/4															
12° 30'	1/2	1/2	1	2 1/2	4 1/2															
13° 00'	1/2	1/2	1	2 5/8	4 3/4															
13° 30'	1/2	1/2	1 1/8	2 3/4	4 7/8															
14° 00'	1/2	1/2	1 1/4	2 7/8	5 1/8															
14° 30'	1/2	1/2	1 1/4	3	5 3/8															
15° 00'	1/2	1/2	1 3/8	3 1/4	5 5/8															

$$E = 0.0007\,D\,S^2 - 1$$

2" Imbalanced Superlelevation (CN Freight)

Degree of Curve	Balanced Speed (MPH) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
0°15'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
0°30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	7/8	1 1/8	1 1/2
0°45'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	5/8	1	1 3/8	1 3/4	2 1/4	2 3/4	3 1/4
1° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1 3/8	2	2 1/2	3	3 5/8	4 3/8	5
1° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	5/8	1 1/8	1 3/4	2 3/8	3 1/8	3 7/8	4 3/4	5 5/8			
2° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	7/8	1 1/2	2 1/4	3	3 7/8	4 7/8	5 7/8					
2° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	3/4	1 1/2	2 3/8	3 1/4	4 1/4	5 3/8							
3° 00'	1/2	1/2	1/2	1/2	1/2	1/2	5/8	1 3/8	2 1/4	3 1/4	4 3/8	5 1/2								
3° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1	1 7/8	3	4 1/8	5 3/8									
4° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1 3/8	2 1/2	3 5/8	5										
4° 30'	1/2	1/2	1/2	1/2	1/2	7/8	1 7/8	3	4 3/8	5 7/8										
5° 00'	1/2	1/2	1/2	1/2	1/2	1 1/8	2 1/4	3 5/8	5 1/8											
5° 30'	1/2	1/2	1/2	1/2	1/2	1 1/2	2 3/4	4 1/8	5 3/4											
6° 00'	1/2	1/2	1/2	1/2	5/8	1 3/4	3 1/8	4 3/4												
6° 30'	1/2	1/2	1/2	1/2	7/8	2 1/8	3 5/8	5 1/4												
7° 00'	1/2	1/2	1/2	1/2	1 1/8	2 3/8	4	5 7/8												
7° 30'	1/2	1/2	1/2	1/2	1 1/4	2 3/4	4 3/8													
8° 00'	1/2	1/2	1/2	1/2	1 1/2	3	4 7/8													
8° 30'	1/2	1/2	1/2	1/2	1 3/4	3 3/8	5 1/4													
9° 00'	1/2	1/2	1/2	1/2	2	3 5/8	5 3/4													
9° 30'	1/2	1/2	1/2	5/8	2 1/8	4														
10° 00'	1/2	1/2	1/2	3/4	2 3/8	4 1/4														
10° 30'	1/2	1/2	1/2	1	2 5/8	4 5/8														
11° 00'	1/2	1/2	1/2	1 1/8	2 7/8	4 7/8														
11° 30'	1/2	1/2	1/2	1 1/4	3	5 1/4														
12° 00'	1/2	1/2	1/2	1 3/8	3 1/4	5 1/2														
12° 30'	1/2	1/2	1/2	1 1/2	3 1/2	5 7/8														
13° 00'	1/2	1/2	1/2	1 5/8	3 3/4															
13° 30'	1/2	1/2	1/2	1 3/4	3 7/8															
14° 00'	1/2	1/2	1/2	1 7/8	4 1/8															
14° 30'	1/2	1/2	1/2	2	4 3/8															
15° 00'	1/2	1/2	1/2	2 1/4	4 5/8															

$$E = 0.0007\ D\ S^2 - 2$$

3" Imbalanced Superlelevation (Passenger Trains)																				
Degree of	Balanced Speed (MPH)																			
Curve	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
0°15'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
0°30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
0°45'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	3/4	1 1/4	1 3/4	2 1/4
1° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1 1/2	2	2 5/8	3 3/8	4
1° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	3/4	1 3/8	2 1/8	2 7/8	3 3/4	4 5/8	5 1/2		
2° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1 1/4	2	2 7/8	3 7/8	4 7/8	6				
2° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1 3/8	2 1/4	3 1/4	4 3/8	5 5/8						
3° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1 1/4	2 1/4	3 3/8	4 1/2	5 7/8							
3° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	7/8	2	3 1/8	4 3/8	5 7/8								
4° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1 1/2	2 5/8	4	5 1/2									
4° 30'	1/2	1/2	1/2	1/2	1/2	1/2	7/8	2	3 3/8	4 7/8										
5° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1 1/4	2 5/8	4 1/8	5 3/4										
5° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1 3/4	3 1/8	4 3/4											
6° 00'	1/2	1/2	1/2	1/2	1/2	3/4	2 1/8	3 3/4	5 1/2											
6° 30'	1/2	1/2	1/2	1/2	1/2	1 1/8	2 5/8	4 1/4												
7° 00'	1/2	1/2	1/2	1/2	1/2	1 3/8	3	4 7/8												
7° 30'	1/2	1/2	1/2	1/2	1/2	1 3/4	3 3/8	5 3/8												
8° 00'	1/2	1/2	1/2	1/2	1/2	2	3 7/8	6												
8° 30'	1/2	1/2	1/2	1/2	3/4	2 3/8	4 1/4													
9° 00'	1/2	1/2	1/2	1/2	1	2 5/8	4 3/4													
9° 30'	1/2	1/2	1/2	1/2	1 1/8	3	5 1/8													
10° 00'	1/2	1/2	1/2	1/2	1 3/8	3 1/4	5 5/8													
10° 30'	1/2	1/2	1/2	1/2	1 5/8	3 5/8	6													
11° 00'	1/2	1/2	1/2	1/2	1 7/8	3 7/8														
11° 30'	1/2	1/2	1/2	1/2	2	4 1/4														
12° 00'	1/2	1/2	1/2	1/2	2 1/4	4 1/2														
12° 30'	1/2	1/2	1/2	1/2	2 1/2	4 7/8														
13° 00'	1/2	1/2	1/2	5/8	2 3/4	5 1/4														
13° 30'	1/2	1/2	1/2	3/4	2 7/8	5 1/2														
14° 00'	1/2	1/2	1/2	7/8	3 1/8	5 7/8														
14° 30'	1/2	1/2	1/2	1	3 3/8															
15° 00'	1/2	1/2	1/2	1 1/4	3 5/8															

$$E = 0.0007\ D\ S^2 - 3$$

4" Imbalanced Superlelevation (GO Trains and UP Express DMUs)																				
Degree of	Balanced Speed (MPH)																			
Curve	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
0°15'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
0°30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
0°45'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	3/4	1 1/4
1° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1 5/8	2 3/8	3
1° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1 1/8	1 7/8	2 3/4	3 5/8	4 1/2	5 1/2	
2° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1 7/8	2 7/8	3 7/8	5				
2° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1 1/4	2 1/4	3 3/8	4 5/8	5 7/8					
3° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1 1/4	2 3/8	3 1/2	4 7/8							
3° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	2 1/8	3 3/8	4 7/8								
4° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1 5/8	3	4 1/2									
4° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	2 3/8	3 7/8	5 1/2									
5° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1 5/8	3 1/8	4 3/4										
5° 30'	1/2	1/2	1/2	1/2	1/2	1/2	3/4	2 1/8	3 3/4	5 5/8										
6° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1 1/8	2 3/4	4 1/2											
6° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1 5/8	3 1/4	5 1/4											
7° 00'	1/2	1/2	1/2	1/2	1/2	1/2	2	3 7/8	5 7/8											
7° 30'	1/2	1/2	1/2	1/2	1/2	3/4	2 3/8	4 3/8												
8° 00'	1/2	1/2	1/2	1/2	1/2	1	2 7/8	5												
8° 30'	1/2	1/2	1/2	1/2	1/2	1 3/8	3 1/4	5 1/2												
9° 00'	1/2	1/2	1/2	1/2	1/2	1 5/8	3 3/4													
9° 30'	1/2	1/2	1/2	1/2	1/2	2	4 1/8													
10° 00'	1/2	1/2	1/2	1/2	1/2	2 1/4	4 5/8													
10° 30'	1/2	1/2	1/2	1/2	5/8	2 5/8	5													
11° 00'	1/2	1/2	1/2	1/2	7/8	2 7/8	5 3/8													
11° 30'	1/2	1/2	1/2	1/2	1	3 1/4	5 7/8													
12° 00'	1/2	1/2	1/2	1/2	1 1/4	3 1/2														
12° 30'	1/2	1/2	1/2	1/2	1 1/2	3 7/8														
13° 00'	1/2	1/2	1/2	1/2	1 3/4	4 1/4														
13° 30'	1/2	1/2	1/2	1/2	1 7/8	4 1/2														
14° 00'	1/2	1/2	1/2	1/2	2 1/8	4 7/8														
14° 30'	1/2	1/2	1/2	1/2	2 3/8	5 1/8														
15° 00'	1/2	1/2	1/2	1/2	2 5/8	5 1/2														

$$E = 0.0007\, D\, S^2 - 4$$

	6" Imbalanced Superlelevation (LRC)																			
Degree of	Balanced Speed (MPH)																			
Curve	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
0°15'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
0°30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
0°45'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
1° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1
1° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	3/4	1 5/8	2 1/2	3 1/2	4 1/2
2° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	7/8	1 7/8	3	4 1/8	5 3/8		
2° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1 3/8	2 5/8	3 7/8	5 1/4				
3° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1 1/2	2 7/8	4 1/4	5 7/8					
3° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1 3/8	2 7/8	4 3/8	6						
4° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	2 1/2	4 1/8	5 7/8							
4° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1 7/8	3 1/2	5 3/8								
5° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1 1/8	2 3/4	4 5/8									
5° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1 3/4	3 5/8	5 5/8									
6° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	3/4	2 1/2	4 1/2										
6° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1 1/4	3 1/4	5 3/8										
7° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1 7/8	3 7/8											
7° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2 3/8	4 5/8											
8° 00'	1/2	1/2	1/2	1/2	1/2	1/2	7/8	3	5 3/8											
8° 30'	1/2	1/2	1/2	1/2	1/2	1/2	1 1/4	3 1/2	6											
9° 00'	1/2	1/2	1/2	1/2	1/2	1/2	1 3/4	4 1/8												
9° 30'	1/2	1/2	1/2	1/2	1/2	1/2	2 1/8	4 5/8												
10° 00'	1/2	1/2	1/2	1/2	1/2	1/2	2 5/8	5 1/4												
10° 30'	1/2	1/2	1/2	1/2	1/2	5/8	3	5 3/4												
11° 00'	1/2	1/2	1/2	1/2	1/2	7/8	3 3/8													
11° 30'	1/2	1/2	1/2	1/2	1/2	1 1/4	3 7/8													
12° 00'	1/2	1/2	1/2	1/2	1/2	1 1/2	4 1/4													
12° 30'	1/2	1/2	1/2	1/2	1/2	1 7/8	4 3/4													
13° 00'	1/2	1/2	1/2	1/2	1/2	2 1/4	5 1/8													
13° 30'	1/2	1/2	1/2	1/2	1/2	2 1/2	5 5/8													
14° 00'	1/2	1/2	1/2	1/2	1/2	2 7/8	6													
14° 30'	1/2	1/2	1/2	1/2	1/2	3 1/8														
15° 00'	1/2	1/2	1/2	1/2	5/8	3 1/2														

$$E= 0.0007\ D\ S^2 - 6$$

Vmax3

Degree of Curve	Measured Superelevation (in.)																								
	0	**1/4**	**1/2**	**3/4**	**1**	**1 1/4**	**1 1/2**	**1 3/4**	**2**	**2 1/4**	**2 1/2**	**2 3/4**	**3**	**3 1/4**	**3 1/2**	**3 3/4**	**4**	**4 1/4**	**4 1/2**	**4 3/4**	**5**	**5 1/4**	**5 1/2**	**5 3/4**	**6**
0°15'	131	136	141	146	151	156	160	165	169	173	177	181	185	189	193	196	200	204	207	210	214	217	220	224	227
0°30'	93	96	100	104	107	110	113	116	120	122	125	128	131	134	136	139	141	144	146	149	151	154	156	158	160
0°45'	76	79	82	85	87	90	93	95	98	100	102	105	107	109	111	113	115	118	120	121	123	125	127	129	131
1° 00'	65	68	71	73	76	78	80	82	85	87	89	91	93	94	96	98	100	102	104	105	107	109	110	112	113
1° 30'	53	56	58	60	62	64	65	67	69	71	72	74	76	77	79	80	82	83	85	86	87	89	90	91	93
2° 00'	46	48	50	52	53	55	57	58	60	61	63	64	65	67	68	69	71	72	73	74	76	77	78	79	80
2° 30'	41	43	45	46	48	49	51	52	53	55	56	57	59	60	61	62	63	64	65	67	68	69	70	71	72
3° 00'	38	39	41	42	44	45	46	48	49	50	51	52	53	55	56	57	58	59	60	61	62	63	64	65	65
3° 30'	35	36	38	39	40	42	43	44	45	46	47	48	49	51	52	52	53	54	55	56	57	58	59	60	61
4° 00'	33	34	35	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	53	54	55	56	57
4° 30'	31	32	33	35	36	37	38	39	40	41	42	43	44	45	45	46	47	48	49	50	50	51	52	53	53
5° 00'	29	30	32	33	34	35	36	37	38	39	40	41	41	42	43	44	45	46	46	47	48	49	49	50	51
5° 30'	28	29	30	31	32	33	34	35	36	37	38	39	39	40	41	42	43	43	44	45	46	46	47	48	48
6° 00'	27	28	29	30	31	32	33	34	35	35	36	37	38	39	39	40	41	42	42	43	44	44	45	46	46
6° 30'	26	27	28	29	30	31	31	32	33	34	35	36	36	37	38	39	39	40	41	41	42	43	43	44	44
7° 00'	25	26	27	28	29	29	30	31	32	33	34	34	35	36	36	37	38	38	39	40	40	41	42	42	43
7° 30'	24	25	26	27	28	28	29	30	31	32	32	33	34	35	35	36	37	37	38	38	39	40	40	41	41
8° 00'	23	24	25	26	27	28	28	29	30	31	31	32	33	33	34	35	35	36	37	37	38	38	39	40	40
8° 30'	22	23	24	25	26	27	28	28	29	30	30	31	32	32	33	34	34	35	36	36	37	37	38	38	39
9° 00'	22	23	24	24	25	26	27	27	28	29	30	30	31	31	32	33	33	34	35	35	36	36	37	37	38
9° 30'	21	22	23	24	25	25	26	27	27	28	29	29	30	31	31	32	32	33	34	34	35	35	36	36	37
10° 00'	21	22	22	23	24	25	25	26	27	27	28	29	29	30	30	31	32	32	33	33	34	34	35	35	36
10° 30'	20	21	22	23	23	24	25	25	26	27	27	28	29	29	30	30	31	31	32	32	33	34	34	35	35
11° 00'	20	21	21	22	23	23	24	25	25	26	27	27	28	28	29	30	30	31	31	32	32	33	33	34	34
11° 30'	19	20	21	22	22	23	24	24	25	26	26	27	27	28	28	29	29	30	31	31	32	32	32	33	33
12° 00'	19	20	20	21	22	22	23	24	24	25	26	26	27	27	28	28	29	29	30	30	31	31	32	32	33

$$V_{max} = \sqrt{\frac{(E_A + 3)}{0.0007 \cdot D}}$$

E_A = Actual Superelevation (in)

D = Degree of curvature (decimal degrees)

V_{max} = Maximum Speed (mph)

Degree of Curve	Vmax4 Measured Superelevation (in.)																								
	0	**1/4**	**1/2**	**3/4**	**1**	**1 1/4**	**1 1/2**	**1 3/4**	**2**	**2 1/4**	**2 1/2**	**2 3/4**	**3**	**3 1/4**	**3 1/2**	**3 3/4**	**4**	**4 1/4**	**4 1/2**	**4 3/4**	**5**	**5 1/4**	**5 1/2**	**5 3/4**	**6**
0°15'	151	156	160	165	169	173	177	181	185	189	193	196	200	204	207	210	214	217	220	224	227	230	233	236	239
0°30'	107	110	113	116	120	122	125	128	131	134	136	139	141	144	146	149	151	154	156	158	160	163	165	167	169
0°45'	87	90	93	95	98	100	102	105	107	109	111	113	115	118	120	121	123	125	127	129	131	133	135	136	138
1° 00'	76	78	80	82	85	87	89	91	93	94	96	98	100	102	104	105	107	109	110	112	113	115	116	118	120
1° 30'	62	64	65	67	69	71	72	74	76	77	79	80	82	83	85	86	87	89	90	91	93	94	95	96	98
2° 00'	53	55	57	58	60	61	63	64	65	67	68	69	71	72	73	74	76	77	78	79	80	81	82	83	85
2° 30'	48	49	51	52	53	55	56	57	59	60	61	62	63	64	65	67	68	69	70	71	72	73	74	75	76
3° 00'	44	45	46	48	49	50	51	52	53	55	56	57	58	59	60	61	62	63	64	65	65	66	67	68	69
3° 30'	40	42	43	44	45	46	47	48	49	51	52	52	53	54	55	56	57	58	59	60	61	61	62	63	64
4° 00'	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	53	54	55	56	57	57	58	59	60
4° 30'	36	37	38	39	40	41	42	43	44	45	45	46	47	48	49	50	50	51	52	53	53	54	55	56	56
5° 00'	34	35	36	37	38	39	40	41	41	42	43	44	45	46	46	47	48	49	49	50	51	51	52	53	53
5° 30'	32	33	34	35	36	37	38	39	39	40	41	42	43	43	44	45	46	46	47	48	48	49	50	50	51
6° 00'	31	32	33	34	35	35	36	37	38	39	39	40	41	42	42	43	44	44	45	46	46	47	48	48	49
6° 30'	30	31	31	32	33	34	35	36	36	37	38	39	39	40	41	41	42	43	43	44	44	45	46	46	47
7° 00'	29	29	30	31	32	33	34	34	35	36	36	37	38	38	39	40	40	41	42	42	43	43	44	45	45
7° 30'	28	28	29	30	31	32	32	33	34	35	35	36	37	37	38	38	39	40	40	41	41	42	43	43	44
8° 00'	27	28	28	29	30	31	31	32	33	33	34	35	35	36	37	37	38	38	39	40	40	41	41	42	42
8° 30'	26	27	28	28	29	30	30	31	32	32	33	34	34	35	36	36	37	37	38	38	39	39	40	40	41
9° 00'	25	26	27	27	28	29	30	30	31	31	32	33	33	34	35	35	36	36	37	37	38	38	39	39	40
9° 30'	25	25	26	27	27	28	29	29	30	31	31	32	32	33	34	34	35	35	36	36	37	37	38	38	39
10° 00'	24	25	25	26	27	27	28	29	29	30	30	31	32	32	33	33	34	34	35	35	36	36	37	37	38
10° 30'	23	24	25	25	26	27	27	28	29	29	30	30	31	31	32	32	33	34	34	35	35	35	36	36	37
11° 00'	23	23	24	25	25	26	27	27	28	28	29	30	30	31	31	32	32	33	33	34	34	35	35	36	36
11° 30'	22	23	24	24	25	26	26	27	27	28	28	29	29	30	31	31	32	32	32	33	33	34	34	35	35
12° 00'	22	22	23	24	24	25	26	26	27	27	28	28	29	29	30	30	31	31	32	32	33	33	34	34	35

$$V_{max} = \sqrt{\frac{(E_A + 4)}{0.0007 \cdot D}}$$

E_A = Actual Superelevation (in)
D = Degree of curvature (decimal degrees)
V_{max} = Maximum Speed (mph)

APPENDIX O – MINIMUM CONSTRUCTION STANDARDS

Description	Class 4 and Above	Class 2 and 3	Class 1, Yard
Rail Weight	Per Appendix P – Rail Usage Guidelines or as specified by the CM Senior Manager of Track and Structures		
Rail (CWR or Jointed)	CWR	CWR	Jointed or CWR
Tie Plates	100% ties plated per Track Standard Section 10.1 and Appendix S – Recommended Tie Plate Usage		
Rail Anchors	Improved Fair Type Anchors or approved equivalent Per Track Standard Section 10.2		
Fasteners	Elastic Fasteners (Rail Clips) 6" Cut Spikes	Elastic Fasteners (Rail Clips) 6" Cut Spikes	
Joint Bars	6 hole bars, punched for alternating oval-head bolts per Standard Plan TS-1202		
Track Tie Spacing			
Concrete	24" (609 mm) (2640/mile)		
Hardwood Grade 1	20 3/8" (518 mm) (3110/mi)		21¾" (552 mm) (2980/mi)
Hardwood Grade 2	N/A	N/A	21¾" (552 mm) (2980/mi)
Insulated Steel (M10, M12, H10, H12) As directed by the CM Sr. Manager of Track and Structures	N/A	N/A	24" (610 mm)(2640 /mi) (<4°) 22" (558 mm) (2880/mi)(4° - 12 ° Curves) 20" (508 mm) (3168/mi) (>12°)

Description	Class 4 and Above	Class 2 and 3	Class 1, Yard
Track Ties	Concrete	Concrete or Hardwood**	Concrete, Insulated Steel, or Hardwood
Turnout / Crossing Ties	Hardwood Grade 1, or Concrete**		Hardwood Grade 1 or Insulated Steel
Ballast Crushed Rock	GO Transit Spec Class 1 –Main-line ballast		GO Spec Class 1 – Main track GO Spec Class 2 – Non-main track only AREMA Class 4A (For steel ties)
Minimum Depth Below Bottom of Tie	12 inch (305 mm)		9 inch (230 mm)
Shoulder Width CWR	12inch (305 mm)		
Shoulder width - Jointed	N/A		6inch (152 mm)
Sub-Ballast** Minimum Depth	12 inch (305 mm)		
Top Width	22 ft. (6.7 m) – Single Track		
Turnouts Hardwood Tie Turnouts	#20 RBM 136RE (GTS-278) #12 RBM 136RE (GTS-271)		#12 RBM (GTS-271) #10 RBM (GTS-267) #8 RBM** (GTS-9)
Steel Tie Turnouts	N/A		Narstco #12 RBM Narstco #10 RBM Narstco #8 RBM**
Concrete Tie Turnouts	As directed by the CM Sr. Manager of Track and Structures		
Frogs	RBM with low impact heel, Jump Frogs**, SGM Frogs** SGM Frogs are not preferred for new construction		

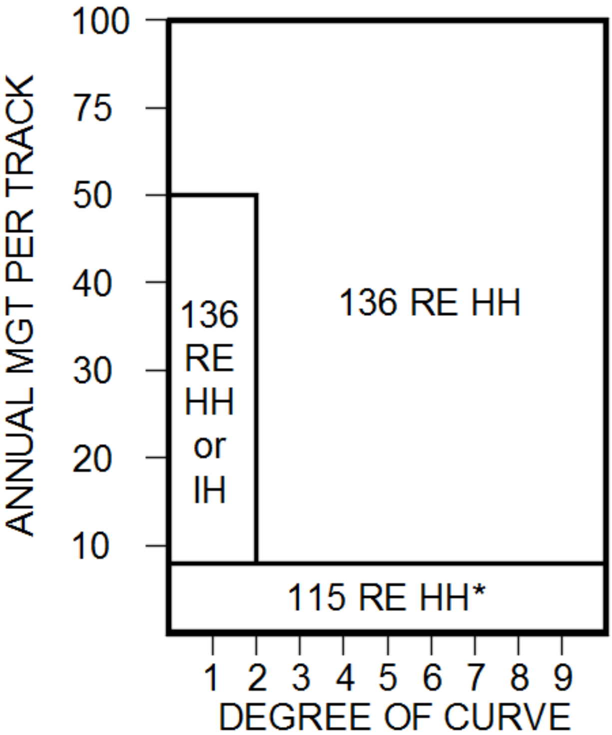
* Where walking ballast is required, it shall be applied in a minimum 4” (102 mm) thick layer
** Only when authorized in writing by the CM Senior Manager of Track and Structures

Construction and Rehabilitation Tolerances*

This table applies to all classes of main track and non-main tracks.

Defect	Description	Tolerance
Gauge	The deviation from the standard gauge for track measured between the running rails at right angles to the alignment of the track 5/8 in (16 mm) below the top of rail.	± 1/8 in. (3 mm)
Track Centres	The tolerance distance between the centre lines of two adjacent tracks.	+ ¼ in. (6 mm) - 0
Horizontal Position	Horizontal track centreline from the design requirements.	± ¼ in. (6 mm)
Alignment	The deviation of the mid-ordinate from a 62 ft. (18.9 m) chord.	± 1/8 in. (3 mm)
Surface	The deviation from uniform profile on either rail at the mid-ordinate of a 62 ft. (18.9 m) chord	± 1/8 in. (3 mm)
Runoff	The runoff in any 31 ft. (9.5 m) of rail at the end of a raise or track lift	± ½ in. (13 mm)
Warp	The difference in cross-level between any two points less than 62 ft. (18.9 m) apart	± ¼ in. (6 mm)
Cross-level	The deviation from the designed cross-level at any point on a tangent or curve	± ¼ in. (6 mm)
Tie Spacing	Horizontal spacing tolerance between adjacent tie, applying to all tie types.	± 1 in. (25 mm)
Tie Placement	Applicable to hardwood ties, the difference of plate to edge of tie on both field sides of tie. A measure of how centre the ties is between the rails.	± ½ in. (13 mm)
Minimum Ballast Section	The Ballast section must conform to the requirements of Track Standard Section 11	

APPENDIX P – RAIL USAGE GUIDELINES



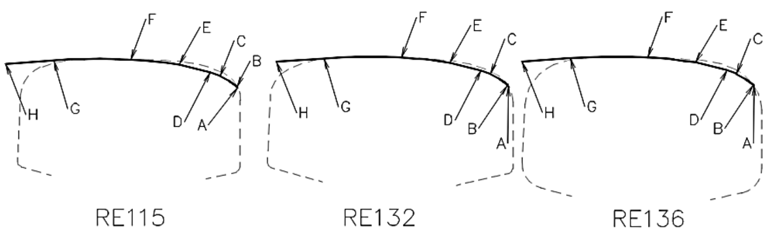
* 100 ARA and 132 RE rail may be used for maintenance only. All mainline 100 ARA rail shall be scheduled for upgrade to the appropriate rail section above.

Note: Any rail section smaller than 100 ARA shall be scheduled for upgrade to the appropriate rail size.

APPENDIX Q – STANDARD RAIL HEAD PROFILES

Rail Profile Information	
Contact Point Centre (CPC)	**Contact Point Field (CPF)**
This profile is to be used on lower speed lines below 60 mph or in locations of low speed such as at stations.	This profile is to be used on higher speed lines (60 mph and higher) in order to reduce the possibility of wheel hunting
High Rail (HR)	**Low Rail (LR)**
This profile is required for all curves greater than 1° 00’ 00”. This profile is required to extend up to 100 ft. (30.48 m) into the tangent beyond the spiral. If another curve is located with the 100 ft. (30.48 m) length, the extension of the profile shall be reduced to half the distance.	This profile is required for all curves greater than 1° 00’ 00”. This profile is required to extend up to 100 ft. (30.48 m) into the tangent beyond the spiral. If another curve is located with the 100 ft. (30.48 m) length, the extension of the profile shall be reduced to half the distance.

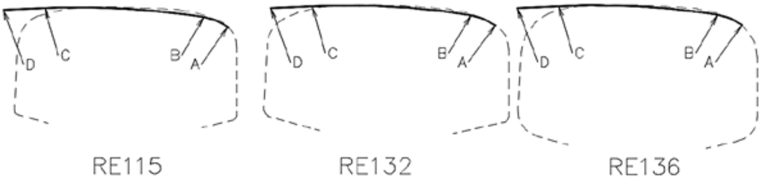
High Rail



Point Coordinates		
Point	X	Y
A	-3.2049	6.9025
B	-3.4525	7.1427
C	-8.6547	10.5628
D	-11.6432	11.7071
E	-21.3552	14.0849
F	-36.2116	15.6255
G	-60.1504	15.3878
H	-75	14.3494

Segment Center Coordinates and Radius			
Segment	X	Y	Radius
A-B	-11.3353	-1.2306	11.5
B-C	-15.7929	-5.9613	18
C-D	-23.7251	-24.3211	38
D-E	-30.7181	-45.1801	60
E-F	-43.2034	-124.1998	140
F-G	-46.1988	-184.1250	200
G-H	N/A	N/A	-2.5° segment

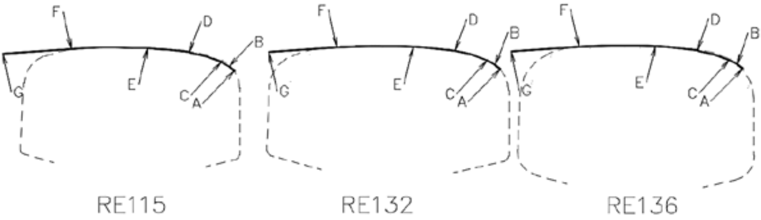
Low Rail



Point Coordinates		
Point	X	Y
A	-5.2844	9.8778
B	-12.8496	12.9204
C	-62.0765	15.6371
D	-75	15.0728

Segment Center Coordinates and Radius			
Segment	X	Y	Radius
A-B	-15.6088	-4.8669	18
B-C	-51.1717	-234.1250	250
C-D	N/A	N/A	-2.5° segment

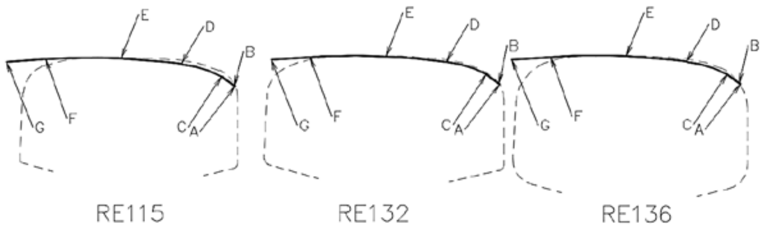
Contact Point Centre



Point Coordinates		
Point	X	Y
A	-2.3031	8.5238
B	-3.9473	9.8875
C	-6.4770	11.3305
D	-16.5508	14.3458
E	-29.6817	15.6251
F	-53.6268	15.3878
G	-75	13.8933

Segment Center Coordinates and Radius			
Segment	X	Y	Radius
A-B	-10.4350	0.3923	11.5
B-C	-14.1016	-4.9749	18
C-D	-21.7263	-21.2802	36
D-E	-36.6766	-124.2000	140
E-F	-39.6759	-184.1250	200
F-G	N/A	N/A	-2.5° segment

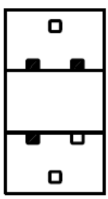
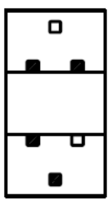
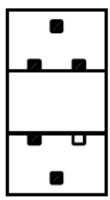
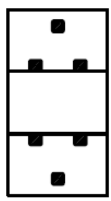
Contact Point Field



Point Coordinates		
Point	X	Y
A	-2.6027	6.8480
B	-2.8811	7.0883
C	-6.8811	9.9515
D	-19.6287	13.9393
E	-38.6817	15.6252
F	-62.6268	15.3878
G	-75	14.5225

Segment Center Coordinates and Radius			
Segment	X	Y	Radius
A-B	-10.2551	-1.7363	11.5
B-C	-15.2598	-5.9795	18
C-D	-24.4236	-23.7570	38
D-E	-51.1742	-234.0625	250
E-F	-48.6750	-184.1250	200
F-G	N/A	N/A	-2.5° segment

APPENDIX R – SPIKING PATTERNS

	Spiking Pattern (Field / Gauge)	MGT per Year	Degree of Curve 0º - 2º	Degree of Curve >2º - 4º	Degree of Curve >4º - 6º	Degree of Curve >6º
A		Non-Main Track	X	X	X	X
		0-20	X			
B		0-20		X	X	
		>20	X			
C		0-20				X
		>20		X	X	
D		>20				X
		Turnout spiking pattern D will be applied to turnouts per Track Standard section 10.4 Figure 19.				

NOTE: When Forged Plates (e.g. MSR Plates) are used, ALL holes shall be fully lagged and spiked

APPENDIX S – RECOMMENDED TIE PLATE USAGE

Annual Tonnage (MGT)	Class of Track	5½" (140mm) Rail Base, 1:40 Canted Rail Seat*		
		14" (356mm) DS plate MSR 16" (406mm) and 18" (457mm) Plates		
All	Yard	All (Existing 11" DS Tie plates and Rolled Plates* shall be replaced through routine maintenance)		
All	1 - 5	All		
		6" (152mm) Rail Base, 1:40 Canted Rail Seat*		
		14" (356mm) DS Plate with 1:40 Cant	16" (406mm) DS Plate	16" (406mm) Forged
		Degree of Curve		
≤5	1 - 5	0º - 6º	> 6º	N/A
>5 - 20	1 - 5	0º - 4º	>4º - 6º	> 6º
>20 - 40	1 - 2	0º - 4º	>4º - 6º	> 6º
	3 - 5	0º - 2º	>2º - 4º	> 4º
>40	3 - 5	N/A	0º - 2º	>2º

NOTE: See Standard Plan GTS-501 for details
*1:20 Canted Rail Seat is permitted for Galt Sub Maintenance only

APPENDIX T – TYPICAL BALLAST PROFILES

See Standard Plan GTS-2205 for details.

Also refer to the Metrolinx Crushed Rock Track Ballast Specification

For use with Steel Ties see the manufacturers recommended instructions (for example: Narstco Steel Tie and Turnout Set Assembly Instructions Manual

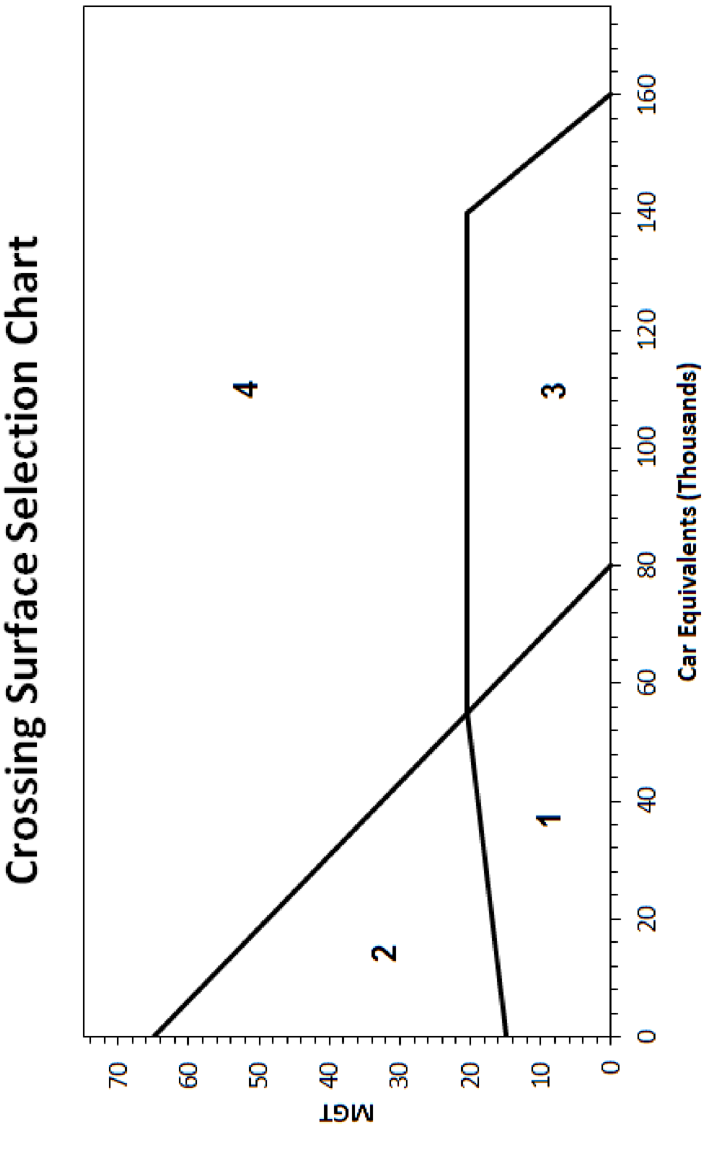
APPENDIX U – CROSSING SURFACES

Crossing Surface Type	Average Life Span (years)
Untreated Full Depth Planking	5
Bituminous (Asphalt)	6
Treated Sectional Timber	10
Precast Concrete Panels	15
Poured in Place Concrete	15*
Full Depth Recycled Rubber	15*
Sectional Steel Panels	18*
Full Depth Virgin Rubber	20
Steel Reinforced Virgin Rubber	20*

The above average crossing surface life spans are based on 3,000 to 5,000 vehicles per day and 120 to 175 GO trains per day over the crossing.
* Not typically used on GO Transit operated corridors.

The following chart for selection of crossing surfaces should be used as follows:

1. Obtain from the road authority the average daily vehicle count for the crossing involved. This count should include separate counts for the number of trucks and cars using the crossing on daily basis.
2. Multiply the average number of trucks per day by 100 and add to this number the average number of cars per day to obtain the number of car equivalents.
3. Determine the number of million gross tons over the crossing annually.
4. Enter the chart using the calculated car equivalents and the MGTs to determine the numbered area.
5. From the number area obtained from the chart, select a recommended crossing surface from those listed.


Crossing Surface Selection Chart
MGT
0
10
20
30
40
50
60
70
Car Equivalents (Thousands)
0
20
40
60
80
100
120
140
160
1
2
3
4

Area 1	• Full depth timber • Treated sectional timber • Full depth bituminous with rubber flange-ways • Full depth (virgin) rubber • Precast concrete panels with rubber flange-ways
Area 2	• Full depth (virgin) rubber • Precast concrete panels with rubber flange-ways
Area 3	• Full depth (virgin) rubber • Precast concrete panels with rubber flange-ways
Area 4	• Precast concrete panels with rubber flange-ways

* Other crossing surfaces may be used under the written permission from the CM Senior Manager of Track and Structures

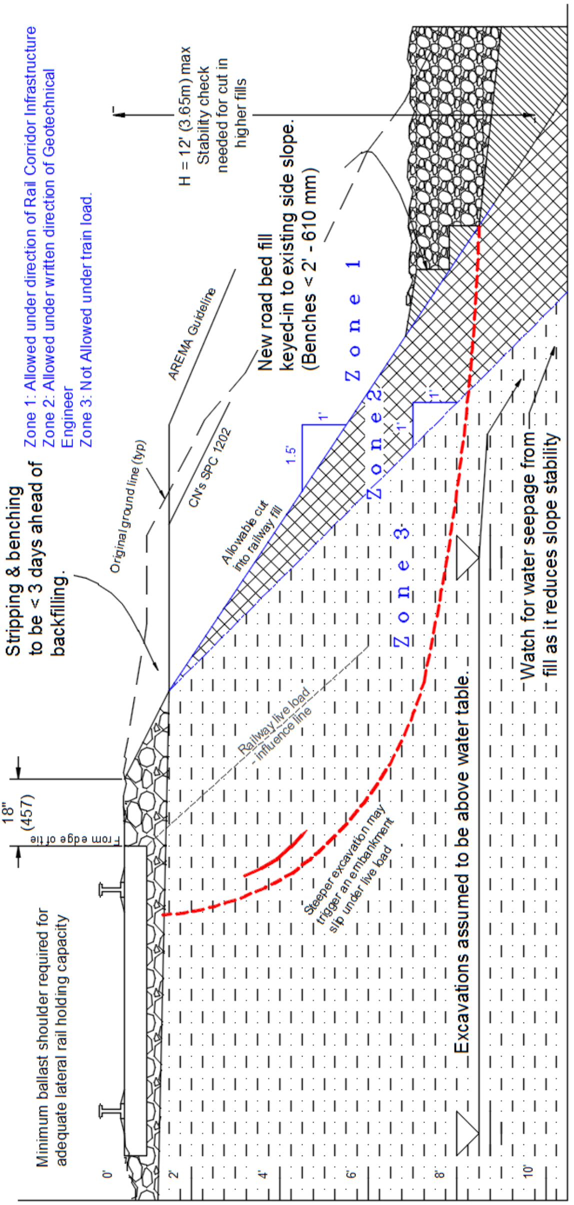
** Crossings located in curves may not be able to meet the requirements for crossing surfaces above. In this case, the CM Senior Manager of Track and Structures must be informed in writing, and the crossing surface shall be full depth bituminous with rubber flange-ways

***For tangent track crossings the preference is to use concrete crossing panels.

APPENDIX V – TEMPORARY CONSTRUCTION CROSSINGS

See Standard Plan GTS-2301 for details.

APPENDIX W – EXCAVATION LIMITS ADJACENT TO A RAILWAY



(GUIDELINES APPLY FOR COMPACTED DIRTY SAND & GRAVEL; INSTABILITY MAY DEVELOP IF EMBANKMENT IS MADE OF SOFT TO FIRM CLAY OR BUILT OVER MUSKEG OR IF WATER EMERGES FROM FILL)

ALL EXCAVATIONS ADJACENT TO THE RAILWAY **MUST** BE CHECKED BY A LICENCED GEOTECHNICAL ENGINEER PRIOR TO ANY EXCAVATION TAKING PLACE.

Notes:

Water Seepage from embankment

If seepage is noted, limit the excavation to above the water seepage zone and contact the geotechnical engineer for advice on how to proceed

Key-in Benching

Limit advanced excavation into the existing fill to only a few days in advance of road bed construction backfill (ideal <3 days). Only key in to the slope the thickness of the fill layer which is going to the placed (eg. 1 ft. (305 mm) thick layer of granular fill or 2 ft. (610 mm) layer of rock fill). Vertical faces for the benches should then be limited to < 2 ft. (610 mm) or as accepted in writing by the geotechnical engineer (depending on soil and slope stability conditions).

Base of excavation in soft ground such as silts and clays

After stripping; avoid running equipment over bottom of excavation. Place adequate granular fill layer before circulating over it. Dump trucks are only allowed to run over the compacted granular fill. If clean coarse rock is used for backfill, place a non-woven geotextile at the base of the excavation to prevent contamination and pumping of silt and clay up through the voids of the rock fill. The non-woven textile could be placed in addition to geogrd reinforcement which would be below the grid.

APPENDIX X – GO TRANSIT HEAVY RAIL CLEARANCE ENVELOPES

Figure 39. Standard Train Envelope

NOTE: for use with tangent track only. For curve corrections refer to Track Standards Section 19.3.3.

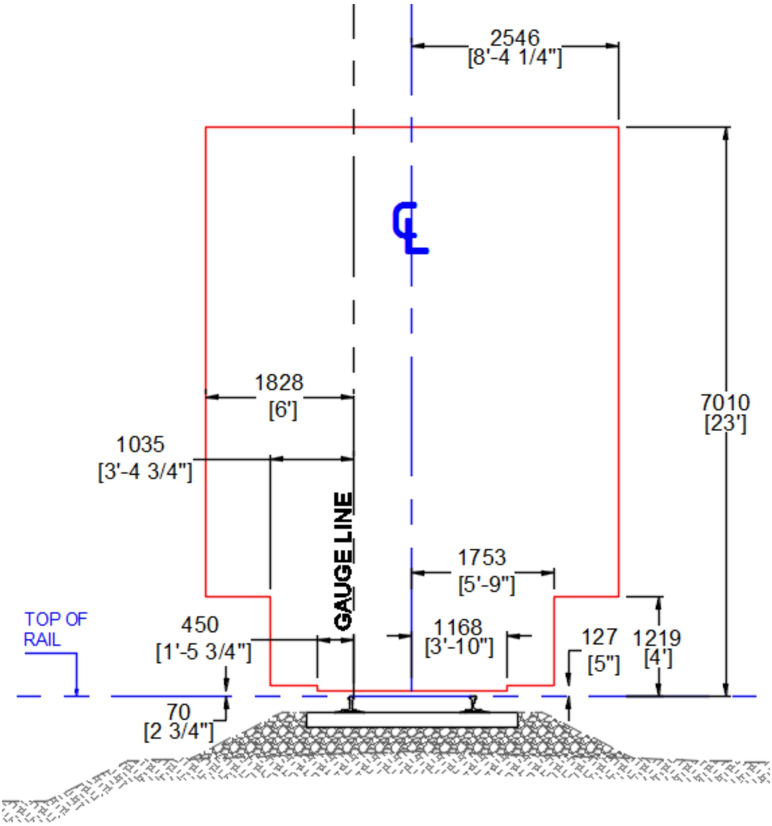


Figure 40. Train Envelope for Bridges and Structures

NOTE: For use with tangent track only. For curve corrections refer to Track Standards Section 19.3.3. Refer to [Metrolinx General Guidelines for Design of Bridges and Structures]() for full details on design requirements.

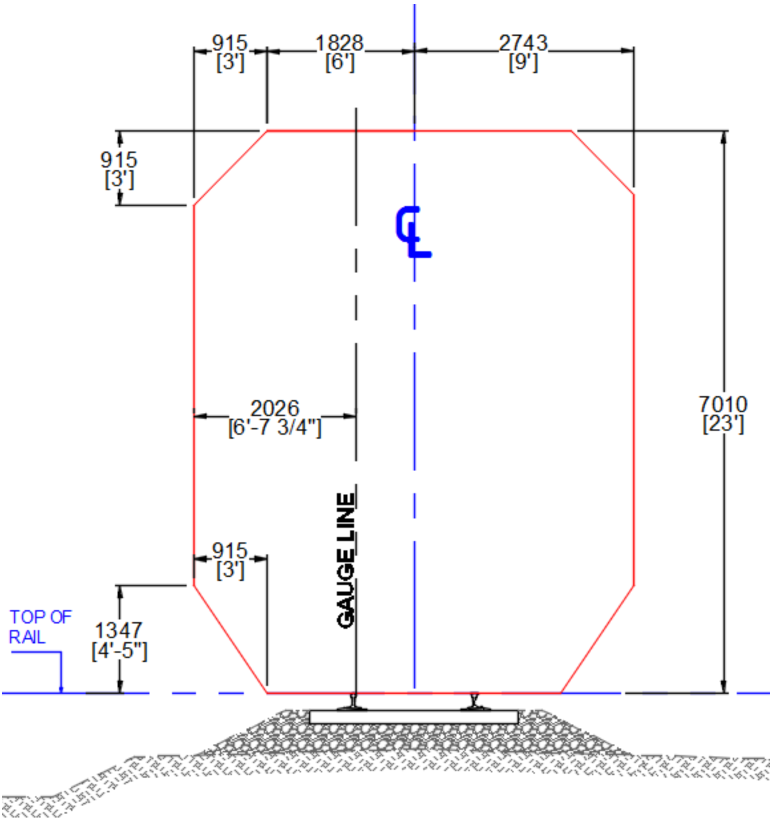


Figure 41. Clearance Diagram for Overhead Bridges

NOTE: For use with tangent track only. For curve correction, consult the CM Senior Manager of Track and Structures. Refer to [Metrolinx General Guidelines for Design of Bridges and Structures]() for full details on design requirements and tunnel clearances.

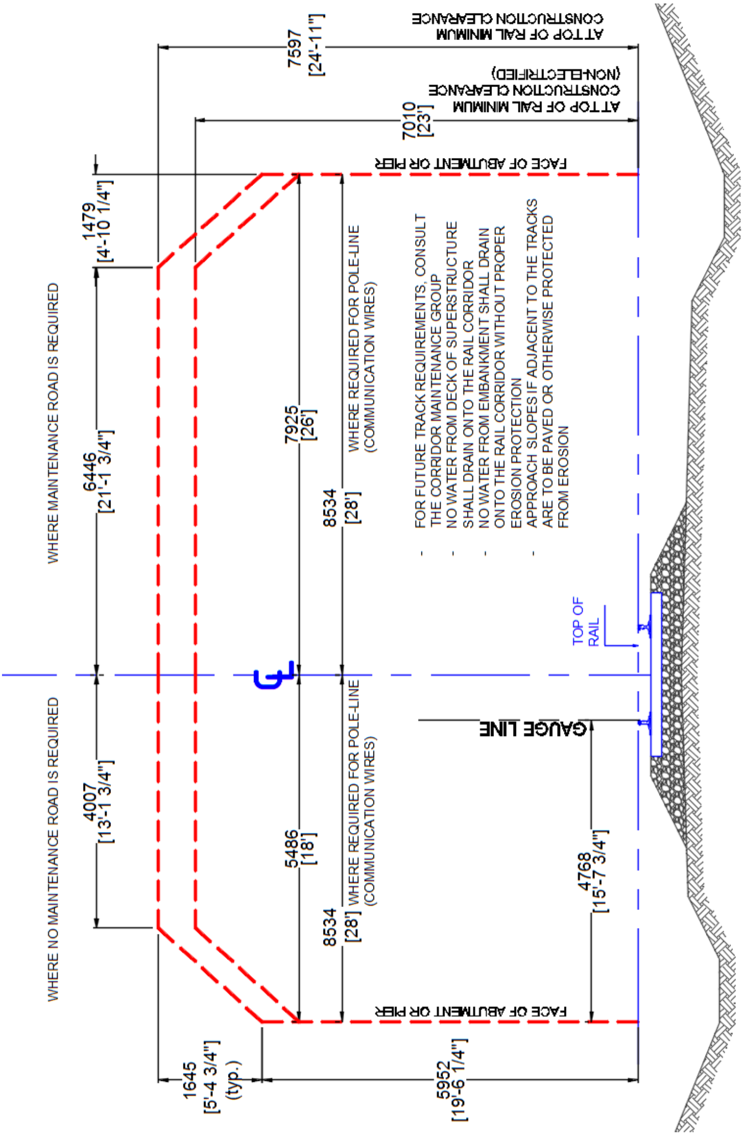
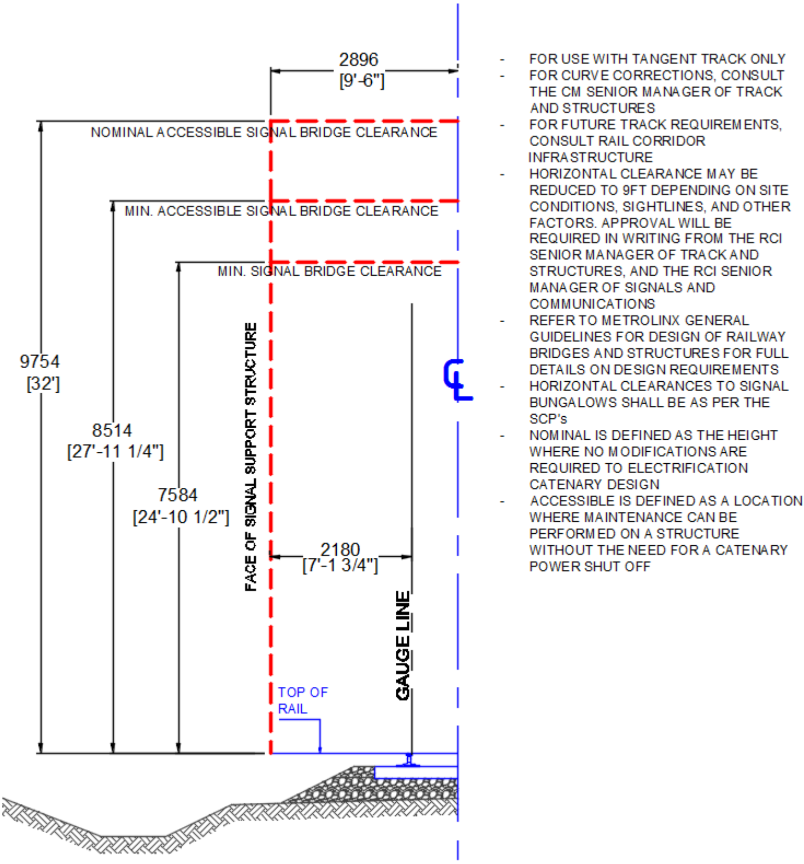
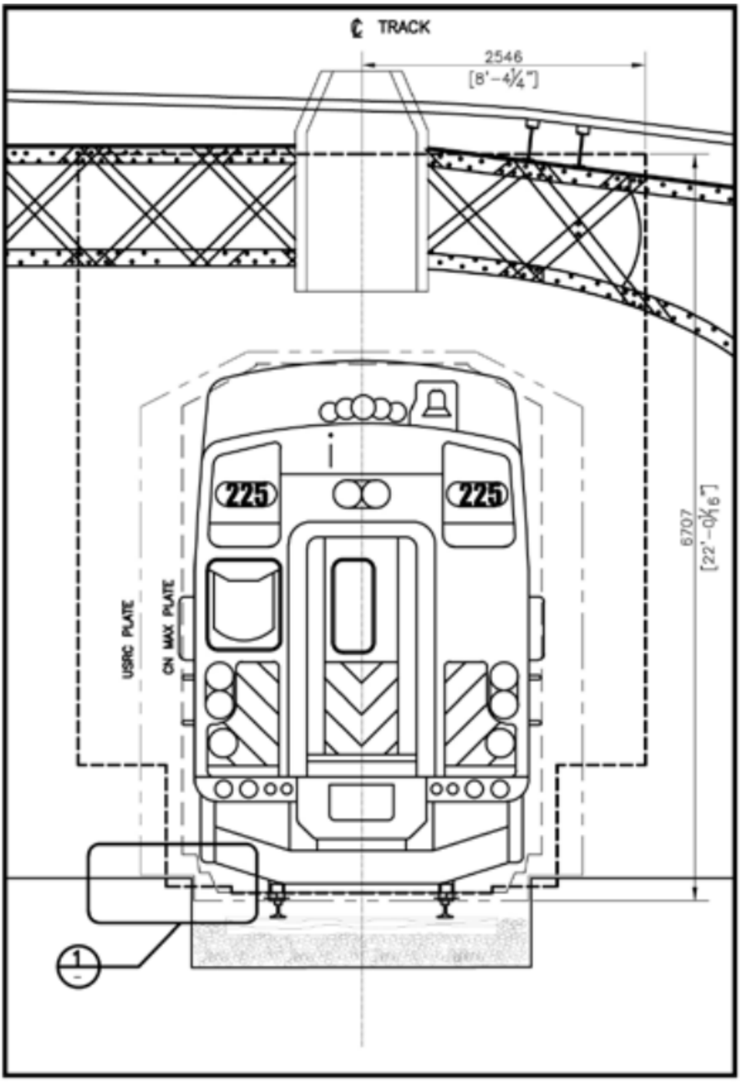


Figure 42. Clearance Diagram for Signal and Electrification Structures

NOTE: For use with tangent track only. For curve correction, consult the CM Senior Manager of Track and Structures. Refer to [Metrolinx General Guidelines for Design of Bridges and Structures]() for full details on design requirements. Horizontal clearances to signal bungalows shall be as per the current approved Metrolinx SCP.

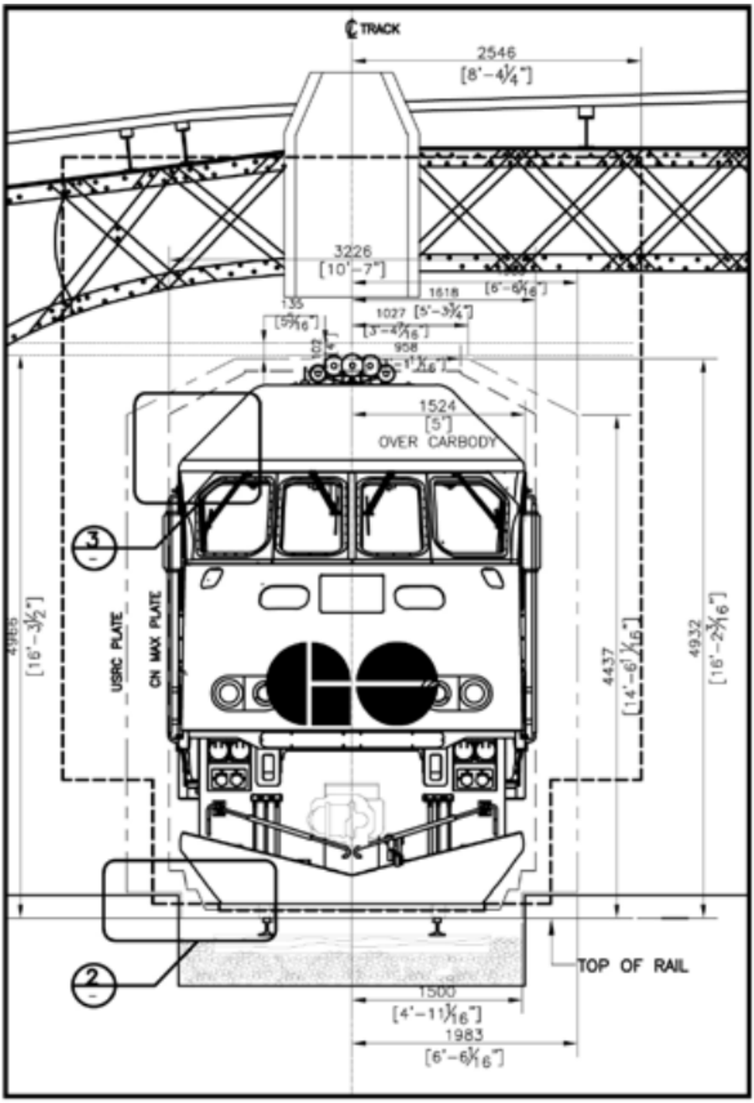


Union Station Clearance Envelope



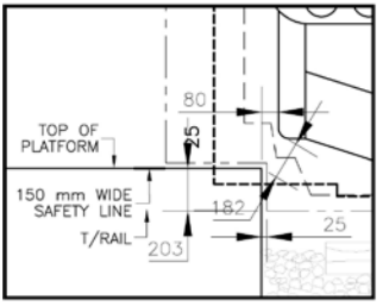
COACH ELEVATION

1:50

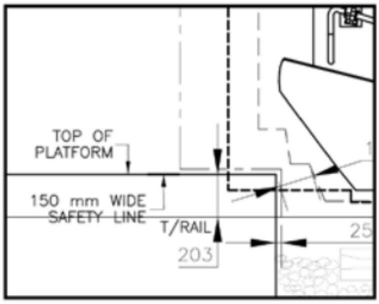


LOCOMOTIVE ELEVATION

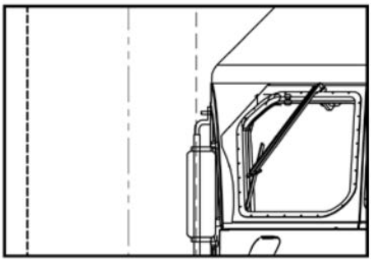
1:50



DETAIL 1
1:20



DETAIL 2
1:20



DETAIL 3
1:20

APPENDIX Y – GRAPPLE ABILITY BY MAKE AND MODEL

Make / Model	Ability to handle Ties (wood)	Ability to handle Rail by tine tips	Ability to handle Rail grasped in grapple arms	Maximum allowable load on grapple (lbs)	Maximum length of 136RE Rail approved for handling ft. (m)
Heiden HC20-B3	yes	yes	no	6000	39
Heiden HC20-B4	yes	yes	no	6000	39
Heiden HC20-A3	yes	yes	no	6000	39
Heiden HC20-AHR3	yes	yes	yes	6500	39
Heiden HC20-AHR4	yes	yes	yes	6500	39
Heiden HC20-BP-3	yes	yes	no	6000	39
Heiden HC20-BLT-3	yes	yes	no	6000	39
Kinshofer 632-2-R	yes	yes	yes	6600	50
Kinshofer 632-R	yes	yes	yes	6600	50
Kinshofer C12VE	yes	yes	yes	9900	50
Kinshofer C25VE	yes	yes	yes	9900	50
Moley MPB1	yes	yes	yes	4400	50
Moley MPB2	yes	yes	yes	4400	50
Moley MPB3	yes	yes	yes	4400	50
Moley MPB 1C	yes	yes	no	4400	50
Moley MPB 2C	yes	yes	no	4400	50
Moley MPB 3C	yes	yes	no	4400	50
Rotobec 4550RA-RT252	yes	yes	yes	32000	60
Rotobec 4642-RT252	yes	no	yes	25000	N/A
Rotobec 4642RA-RT252	yes	yes	yes	25000	60

Make / Model	Ability to handle Ties (wood)	Ability to handle Rail by tine tips	Ability to handle Rail grasped in grapple arms	Maximum allowable load on grapple (lbs)	Maximum length of 136RE Rail approved for handling ft. (m)
Rotobec 6007BT-RT142	yes	yes	no	14000	60
Rotobec 6007RA-RT222	yes	yes	yes	14000	60
Rotobec 6606HDRA-RT252	yes	yes	yes	21000	60
Rotobec 6806RA-RT142	yes	yes	yes	14000	60
Rotobec 5805BT- A	yes (individual)	yes	no	8800	60
Rotobec 5805RA	yes	yes	yes	8800	60
Rototilt MG60	yes	no	yes	18250	N/A
Rototilt MG80	yes	no	yes	26460	N/A
Serco 5006137	yes (individual)	yes	yes	16000	39
Serco 5006139	yes	yes	no	9000	39
Serco 5006141	yes	yes	no	16000	39
Serco 5013215	yes	yes	yes	16000	39
Serco 5013329	yes	yes	no	9000	39
Serco 5206 C/R S/P Log	yes	yes	no	32000	39
Serco 680A899	yes	yes	no	32000	39
Serco 5006143	yes	yes	no	9000	39
Serco 5006145	yes	yes	no	9000	39
Serco 5013255	yes	yes	no	9000	39

MISCELLANEOUS RECOMMENDED METHODS

Recommended Method 3708-1: Application of Granular Salt

1. When applying salt in signaled territory, use the following precautions:
    a. Use extreme care to avoid direct contact with tie plates, rails, clips or anchors.
    b. Salt applications should be coordinated with Signals forces to avoid track circuit failures.
    c. For salt applications in wood tie territory greater than 120 feet in any one track circuit or any application in concrete tie territory:
        i. Remove ballast from entire crib to a depth of approximately 3 inches below base of rail.
        ii. Apply salt as per this RM.
        iii. Replace ballast in accordance with Track Standard Section 11
2. Where salt is to be applied in the area of steel culvert cross-drains, it shall not be applied directly over the culvert or closer to the culvert than 30 feet along the track, if the depth of the top of the culvert is 6 feet or less below the base of the rail.
3. Track should not be treated with salt where the drainage is poor.
4. Salt shall be applied only at locations where the track has been previously inspected and marked for treatment. Inspections and marking shall be carried out when frost heaving is at its maximum.
    a. Marking for salt treatment shall be done for best future identification, using a paint stick on the web of the rail.
    b. Each location to be marked shall be sighted by eye along the top of the rail to determine whether a hump or a dip is present in the track. If a number of

humps or dips occur together, the marking should be done as for a continuous hump or dip from one end of the area to the other

c. Humps shall be marked at the peak of the hump.

d. Dips shall be marked 12 cribs from the lowest point in both directions.

e. Location and site description are to be recorded.

5. The salt shall be applied at such a time that it will receive at least 3 inches and not more than 6 inches of rainfall after application and before the arrival of freezing temperatures. The CM Senior Manager of Track and Structures should be consulted for the dates of application.

6. Before the salt is distributed along the right-of-way, an inspection shall be made during which time:

a. Any reference marks, which have been obliterated or displaced, shall be replaced.

b. The number of bags of salt required at each location shall be suitably marked on the track for reference when the salt is being unloaded. The number of 50-pound bags required for any location is equal to the total number of cribs to be treated divided by two, minus three. Distribution of salt along the right-of-way prior to application shall be as close to the time of application as possible to avoid deterioration.

7. Care must be exercised to insure that the correct amount of salt is applied. Salt shall be applied at each marked location as follows:

a. 12-1/2 pounds of salt shall be placed in each of the six cribs within each end of the marked location.

b. The remaining cribs within the marked location shall have 25 pounds of salt applied in each crib.

c. The salt shall be spread evenly on top of the ballast over the full length of the crib, but not beyond the ends of the ties. The ballast shall not be excavated but the salt may be worked into the top voids of the ballast to avoid caking.

8. The date of application of the salt shall be recorded along with the total amount of salt applied. The Track Supervisor will maintain all records of salt applications, and be sent to the CM Manager of Track.

9. Each salt application shall be made according to marks for the first application unless a ballast lift or other track work is believed to have influenced heaving. In this case no salt shall be applied until the track heaves and the new distribution of heaving can be marked.

10. Salt used for treatment shall be either Coarse Grade or Fine Grade Crushed salt (sodium chloride). In dry areas, Fine Grade quality is preferable. Salt should be supplied in 50-pound bags provided with a moisture barrier to prevent caking.

11. Salt as applied herein is normally effective for two winters in reducing track heaving. This shall be considered in planning the dates for salt application.

Recommended Method 1802-0: Covering the Acceptance of New Material and Conducting an In-Service Test of New Material

1. Before a new material is considered for an in-service test the manufacturer of the new material shall provide the following documentation for consideration:
   a. The material meets or exceeds the standards set out by AREMA including that the material was subjected to the testing requirements and procedure(s) described by AREMA;
   b. The Manufacturer shall submit in triplicate documentation from a certified testing laboratory that the material meets or exceeds the requirements stated in part a above; and,
   c. The Manufacturer shall submit in triplicate certified documentation from a field testing facility such as TTCI or other approved testing facility, that the material has been subjected to railroad loading, clearly stating the gross tonnage imposed and duration in months, and certifying in writing that the material may proceed to a field in-service test, complete with any limitations.
2. No new or modified materials may be considered for use as a standard without also being subjected to a service test unless authorized by the CM Senior Manager of Track and Structures
3. Service test requests may originate from Engineering – Track and Structure or CM Sr. Manager of Track and Structures Track
4. The CM Senior Manager of Track and Structures shall oversee all service tests
5. When a test is being considered, documentation of such should be forwarded to both the CM Senior Manager of Track and Structures and Engineering – Track and Structure, Sr. Manager of Track. The CM Manager of Track and Track Evaluation Officer will also be notified.
6. The location of the test must be carefully chosen in order to best suit the requirements of the test. The site should allow fair comparison of the new material to existing

standards as well as permit easy access and monitoring where practical.

7. A test file will be created and performed by the Track Standards Committee and must include:
    a. The purpose and description of test (including contact information for the manufacturer)
    b. Estimated costs
    c. Potential Benefits
    d. Location of Test
    e. Approximate duration; and
    f. Direct supervision
8. Where applicable the following will also be kept in the test file and forwarded to the Track Standards Committee:
    a. Laboratory testing
    b. Specification
    c. Installation instructions
9. A test protocol should be jointly created by the Track Standards Committee and the manufacturer to establish what measures will be used to evaluate the product, what targets will signify a successful test, and the frequency at which measurement will be taken.
10. The CM Senior Manager of Track and Structure will assign a responsible person to:
    a. Ensure proper installation
    b. Ensure proper maintenance
    c. Arrange for the collection of test data on a timely basis; and
    d. Forward all test data to the Track Standards Committee
11. Tests should not be disturbed, except in emergency, unless authorized by the CM Senior Manager of Track and Structures, or if a safety concern is found.

12. The Engineering – Track and Structure Sr. Manager will prepare and issue progress and final reports on all service tests.

13. Service tests will remain active until terminated by the Track Standards Committee.

CONVERSION TABLES FOR UNITS OF MEASURE

1 inch	=	25.4 mm
1 mm	=	0.0394 inch
1 m	=	3.28 ft.
1 ft.	=	304.8 mm
1 mi.	=	5280 ft.
1 mi.	=	1.6 km
1 m	=	1,000 mm
1 kg	=	2.2 lbs
1 ton	=	2,000 lbs
1 ton	=	907 kg
1 tonne	=	1,000 kg
1 tonne	=	2,200 lbs
1 tonne	=	1.1 ton
1 gal	=	3.78 L

Ballast

1 m^3 ≈ 1.71 tonnes

Degree of Curve to Radius:

$$R\ (ft) = \frac{50}{\sin\left({}^{D_c}/_{2}\right)} \qquad D_c = 2 \cdot \sin^{-1}\left(\frac{50}{R}\right)$$

DESIGNATED AUTHORITY

1. Areas of responsibility where the CM Senior Manager of Track and Structures has delegated authority are located in Table 58.

2. Table 58 indicates only the sections where authority has been delegated. For all other inquiries, the CM Senior Manager of Track and Structures is the designated authority.

Table 58 Table of Designated Authority

Position	Office	Delegated Authority
Manager of Track	Corridor Maintenance	• Crossing Surfaces • Construction Material Requirements • Routine / Regulatory Track Inspections • Geometry / Rail Flaw Testing • Track Inspection and Quality Control • Rail Break / Defects • Minimum Construction Standards and Construction tolerances
Track Evaluation Officer	Corridor Maintenance	• Rail Breaks / Defects • Geometry / Rail Flaw Testing
Track Specialist	Corridor Maintenance	• Track Inspection and Quality Control
Senior Manager of Track and their designates	Engineering – Track and Structure	• Review and recommend changes to the TS Plans • Review and recommend new / changes to standards, and materials • Review of CPG project designs for compliance with standards. • Electrification Related Track Standards • Construction Tolerances • Track Inspection and Quality Control • Steel tie requirements

NOTES