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**December 01, 2025**

**Addendum No. 04**

**File Reference Number: RFP 2025 093**

**Title: Engineering Services for Truck Shop Expansion**

**RE: Clarifications/Questions**

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**QUESTIONS/CLARIFICATIONS:**

**Item 1:** Can ONTC please clarify scope for the new road access? Is this part of the successful proponent's scope? Can ONTC please confirm extent of this work?

**Answer:** Requires an engineer to design a new road over the existing tracks and ditch. Culvert to be installed in this ditch. Any removed rail line must make way for a new dirt roadway at the back for trucks to drop off material. This all shall be included in the Phase 2 Construction phase of work. The rail track rerouted to the locomotive shop must be quoted and included in the Conceptual Design only.

**Item 2:** Is it possible to outline what the proponent's scope of work is regarding the existing rail lines? Will new switching be required? Will there be any need for signaling?

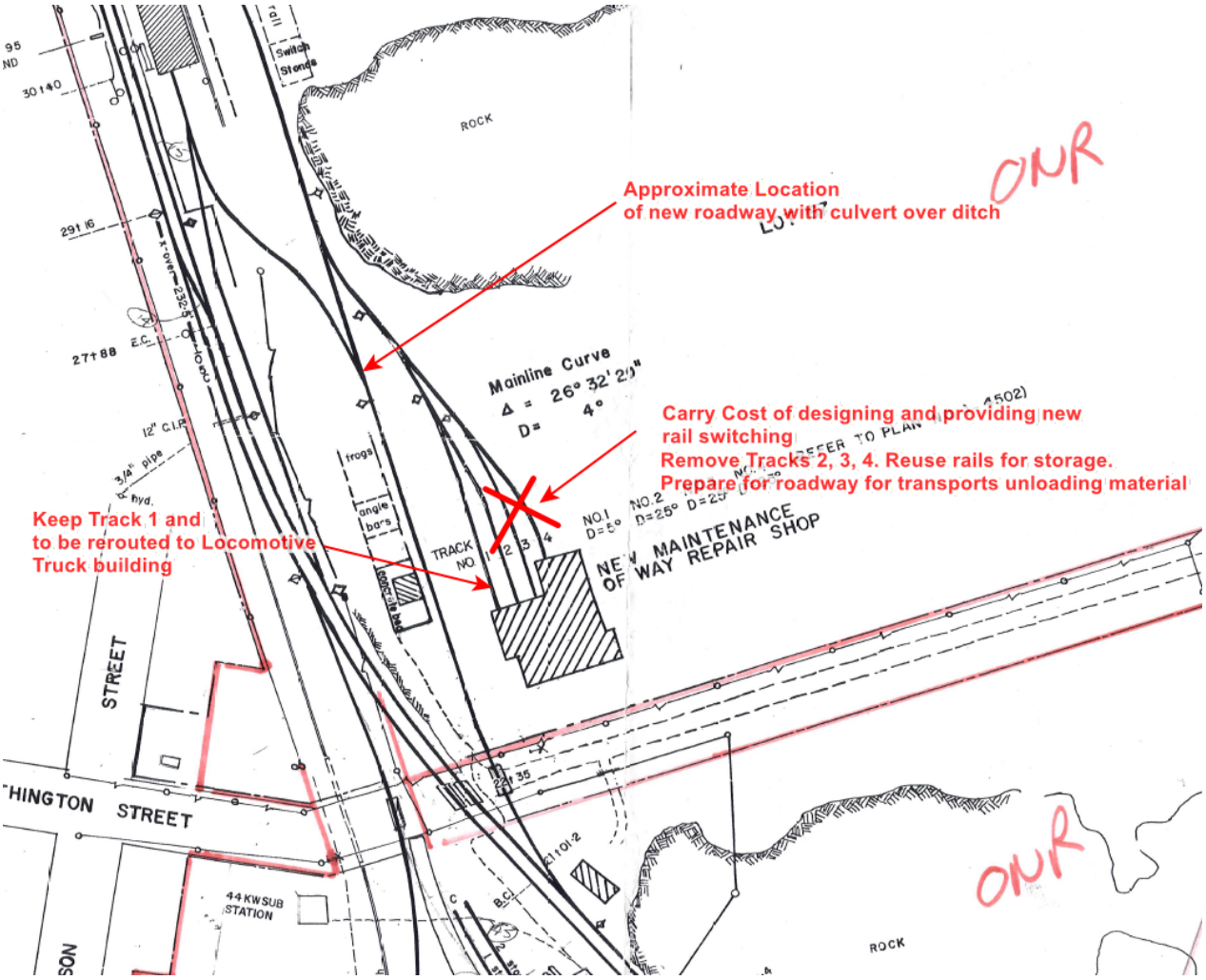
**Answer:** Scope of work as follows for the outside tracks:

a) Remove existing tracks. This would include proper disposal of scrap ties and scrap metal material (as indicated by ONTC).

b) Realign, or build new track into the new truck building, as per the engineered drawing.

c) If a new switch is required, the drawing will indicate the location of the new switch.

See Sketch for preliminary scope of work.




Tracks within the building shall be designed in accordance with the engineer's specifications and include appropriate structure.

**Note:** The scope of work of the tracks would be completed by a civil / track construction contractor, including the supply of ballast. ONTC would supply the track material. We could reuse the rails that will be removed to save some cost.

**Item 3:** Will ONTC be providing the specs and requirements for Railway Track realignment and Level Adjustments. (E.g. Base built up of Ballast, Sleeper spacings, Compaction requirements, Rail lengths & slope requirements, and Fishplates fittings etc.)?

**Answer:** ONTC can provide its track specifications as the track will need to be constructed or repaired as per ONTC's Manual of Track Requirements. The only specification we won't be able to provide on our side is for the fishplates fittings.

Please find attached MTR – Condensed Track Geometry and Construction Standards – 11-27-2025 at the end of this Addendum.

**Item 4:** Will railway track drawings be integrated in Civil Grading drawings?

**Answer:** This shall be incorporated into the civil grading drawings.

**Item 5:** Are there service/access pits in any of the expansion areas?

**Answer:** No pits shall be provided.

This Addendum hereby forms part of the RFP.

Regards,

Brinda Ranpura
Procurement Contracts Specialist
brinda.ranpura@ontarionorthland.ca

Ontario Northland

# MANUAL OF TRACK REQUIREMENTS

**Revision Date:** September 18, 2025

**Approved Date:** September 22, 2025

**Effective Date:** October 1, 2025

**Safety. Full Stop.**

Our Values

# Together, we better our workplace by demonstrating company values.

## 1 Safety. Full Stop.

Safety is core to everything we do. We do not settle for less, for our people or our customers.

## 2 Go Beyond

We take pride in serving our customers and communities. We seize every opportunity to exceed their expectations and to challenge the status quo, to meet their evolving needs.

## 3 Never Stop Caring

We care about each other, our customers, the work we do, and how we do it. We create a respectful environment where we can be ourselves, feel valued, and perform at our best.

## 4 Focus on the Path Ahead

We grow and innovate with intention. We align with government and MTO priorities and fulfil our commitments.

## 5 Lead the Way

We can all be leaders. We take responsibility, trust each other to do the right thing, and speak up to make things better.

# REVISION HISTORY

| Rev # | Year - Month | Description of Updates | Approved |
|---|---|---|---|
| 00 | 2008-03 | Hard Copy Manual – March 2008 Release | JLT |
| 01 | 2009-01 | Manual reformatted and updated | JLT |
| 02 | 2010-10 | Manual updated affecting various sections | RVB |
| 03 | 2012-04 | Manual updated affecting various sections | RVB |
| 04 | 2015-05 | Manual update affecting various sections | RVB |
| 05 | 2017-06 | Revision to Section 2.6 and Appendix A | RVB |
| 06 | 2018-01 | Manual reformatted in MS Word for use as electronic document | PAL |
| 07 | 2019-09 | Revision to Section 2.2.6.6. Switch Points | PAL |
| 08 | 2020-07 | Manual overhaul to implement updates to the Rules Respecting Track Safety including the Minister of Transport's Ministerial Orders; Sections formatted to correspond with Transport Canada's Rules Respecting Track Safety structure | GSB (P.Eng) |
| 09 | 2025-09 | Manual overhaul including,<br>- Certification language, additional Interpretations, Rail End Batter, Localized Surface Collapse, Crushed Head, Corrugation, Maximum Allowable Unbalanced Condition, Concrete Ties, Preferred Rail Laying Temperature and Range, Track Stabilization, Hot Weather Slow Order and Patrol Policy, Sightlines, Standard Signs, Abrasive Wheels Recommended Practices, Wayside Inspection System Track Standards Recommendation and housekeeping items (e.g., grammatical, hyperlinks and formatting) | PAL (internal)<br>TB (P.Eng)<br>  |
| | | | |
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The images and diagrams in this manual are for internal ONTC use only and cannot be distributed or published.

If the various links throughout this Manual do not work as intended, or you do not have permission, please inform your supervisor.

The most current version of the Manual of Track Requirements, and applicable documents including revisions and updates, shall be located on the *Maintenance of Way SharePoint (OneDrive)* within the folder Manual of Track Requirements and Supplementary Documents.

Maintenance of Way Support Documents Location:
https://ontarionorthland.sharepoint.com/:f:/r/teams/MaintenanceofWay/Support%20Docs/MoW%20Files?csf=1&web=1&e=ooLEfa

# SIGNALS AND COMMUNICATION SYSTEMS REMINDER

Various requirements are outlined throughout this Manual, including what must or must not be done when signals and communications' equipment or systems may be affected.

**THE FOLLOWING MUST ALSO BE ADHERED TO FOR SAFE OPERATIONS.**

**Under no circumstances** should work be performed within the vicinity of a crossing circuit, or other signals and communication systems, without communicating with the *Signals and Communications Department*. **Testing of the warning system, including the 'power off' light, must be performed** upon completion of work with any deficiencies reported to the *Signals and Communications Department* and *Rail Traffic Control* immediately.

**When planned work is expected to be performed** 96 hours' notice is required. If emergency work is required, the *Signals and Communications Department* must be notified immediately, in addition to *Rail Traffic Control*.

*Signals and Communications Department*, in addition to *Rail Traffic Control*, must be notified immediately, if there is **any damage or suspected damage to any signals or communications equipment**. If the safety of the road and / or train traffic is affected, then a qualified employee shall provide flagging protection.

**ESTABLISH PERSONAL CONTACT.**
**DON'T SIMPLY LEAVE A MESSAGE.**

**It is prohibited** to intentionally work within an automatic warning system circuit with uninsulated equipment. To **prevent nuisance ringing and mitigating against any complacency on behalf of the public at active crossings**, the crossing warning system must be deactivated by *Signals* personnel while MW or unattended Signals' work is being performed. Steps are to be taken to ensure trains are not operated unprotected over the crossing while the warning system is de-activated.

*This includes, but not limited to, active crossing warning systems (e.g., crossing box, masts, posts, etc.), hot wheel, high water and dragging equipment detectors, cable locates, markers, and so on)*

# PART II – TRACK SAFETY RULES

## SUB-PART A. CLASSES OF TRACK: OPERATING SPEED LIMITS

| TRACK CLASSES | | |
|---|---|---|
| **Class** | **Maximum Allowable Freight Train Speed** | **Maximum Allowable Passenger Train Speed** |
| 1 | 10 MPH | 15 MPH |
| 2 | 25 MPH | 30 MPH |
| 3 | 40 MPH | 60 MPH |
| 4 | 60 MPH | 80 MPH |
| 5 | 80 MPH | 95 MPH* |

**For LRC Trains, 100 MPH*

***Figure SUB-PART A – 1 – Track Classes***

# SUB-PART B. ROADBED – DRAINAGE AND VEGETATION

## 1. Ditches and Streams

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

b) Areas not draining properly are to be identified to the District Manager, so that ditching programs or other appropriate action may be taken,

c) Lateral ditches and streams are to be maintained to allow water to flow away from the roadway,

d) Beaver dams must be addressed in the early stages before the blockage becomes large,

e) When lowering a dam, only controlled amounts of water must be let go over a period of time to avoid degrading downstream embankments,

f) Make sure culverts along the path are clear prior to releasing water,

g) Work on ditches and streams located on private land are not to be carried out without the owner's consent,

h) Ditching around rock cuts is beneficial to catching falling rock so it may not foul the track.

## 2. Culverts

a) Culverts are to be monitored for signs of blockage,

b) Remove debris in a safe manner,

c) Heavy blockages are to be referred to the District Manager so that other resources can be assigned,

d) Particular attention should be taken during the spring runoff when culverts may be blocked with ice,

e) Assistance on ice blockages must be sought before the water rises above the top of the culvert so that resources can be assigned before banks become saturated,

f) Damaged culverts are to be brought to the attention of the Director, Rail Infrastructure for appropriate action.

## 3. Vegetation Control

a) Vegetation on railway property, which is on or immediately adjacent to roadbed, including around rock cuts, must be controlled so that it does not:

   i. become a fire hazard,

   ii. obstruct visibility of railway signs and signals,

   iii. interfere with railway employees performing normal track side duties,

   iv. prevent proper functioning of signal and communication lines; or

v. prevent railway employees from visually inspecting moving equipment from their normal duty stations.

b) Sight lines are to be maintained at road crossings as per Sub-Part E, Section 5.8 and *Transport Canada* rules,

c) Vegetation must not be controlled by burning,

d) Employees using power saws for removal of trees must be properly trained and qualified under the health and safety regulation,

e) The Superintendent, Maintenance of Way will arrange for vegetation control programs to address areas beyond the scope of track maintenance crews.

# SUB-PART C. TRACK GEOMETRY MANAGEMENT PLAN

## 1. Scope

a) The following prescribes the requirements for the gauge, alignment, and surface of track and the elevation of the outer rails and speed limitations for curved track.

## 2. Geometry Standards

a) All track must meet or exceed the track geometry standards defined in this *Manual* and the *Track Safety Rules*, for all track in Canada.

b) Track geometry standards are defined for five classes of track based upon maximum allowable operating speeds for freight trains and passenger trains.

   i. Figure Sub-Part A-1 in Part II – 1 – Classes of Track: Operating Speed Limits

c) The requirements specify limits of certain track conditions existing in isolation. A combination of track conditions, none of which individually amounts to a deviation from the requirements in these standards, may require remedial action to provide for safe operations over the track.

d) Track geometry can be measured by track geometry vehicles or by hand measurement. When unloaded track is measured to determine compliance, the amount of any rail movement that occurs while the track is loaded must be added to the measurements taken.

   i. Should any of the following symptoms occur in the track, assume rail movement will occur;

   - Hanging ties
   - Excess adzing
   - Tie plates nose-diving towards the field side
   - Loose or missing bolts
   - High, missing, bent or throat cut spikes
   - Batter or bent rail ends
   - Engine burns
   - Corrugated rail
   - Worn or missing tie plate shoulder, ice built up in plates
   - High water and clogged ditches and
   - Cluster of bad ties

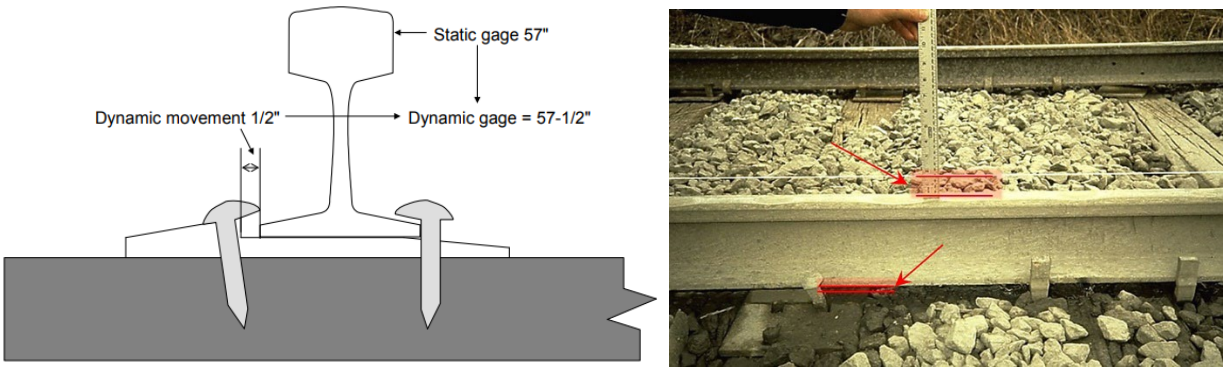



***Figure SUB-PART C – 1 – Examples of Rail Movement Affecting Gauge (left) and Affecting Surface (right)***

e) Locations where track measurements do not meet the track geometry standards for the class of track are considered defective. Track defects must be protected by speed restrictions and repaired as soon as possible.

## 3. Responsibility

a) The Track Supervisor (Inspector) is responsible for:

i. Checking deterioration in track geometry between track evaluation car tests,

ii. Ensuring that track geometry is maintained within the track geometry standards or providing appropriate track protection.

b) Track conditions must equal or exceed the track geometry standards for the class of track as laid out in this *Manual* and *Transport Canada's* *Rules Respecting Track Safety.*

c) Where conditions on track do not comply with these requirements action must be taken to:

i. Bring the track into compliance,

ii. Reduce speed to such that is in compliance,

iii. Halt operations over the track or,

iv. Operate under the authority of a qualified Track Supervisor (Inspector) or Manager

- Notwithstanding the above, in the case of Class 1 track that is not in compliance with these Rules, operation under the authority of a Track Supervisor (Inspector) for not more than 30 days. This does not apply where defective rails are involved.

## 4. Gauge

a) Gauge is measured between the heads of the rails at right angles to the rails in a plane 5/8" *(16 mm)* below the top of the rail head.

b) Standard gauge is 56 ½" *(1,435 mm)*.

c) Gauge must be within the limits prescribed in the following table:

| Class of track | The gauge must be at least *(inches and millimeters)* | But not more than *(inches and millimeters)* |
|---|---|---|
| Excepted track | N/A | 58 1/4" *(1,480 mm)* |
| 1 | 55 3/4" *(1,416 mm)* | 58" *(1,473 mm)* |
| 2 | 55 3/4" *(1,416 mm)* | 57 3/4" *(1,467 mm)* |
| 3 | 56" *(1,422 mm)* | 57 3/4" *(1,467 mm)* |
| 4 and 5 | 56" *(1,422 mm)* | 57 1/2" *(1,461 mm)* |
| Yard Track Category 1 & Category 2 | 55 3/4" *(1,416 mm)* | 57 3/4" *(1,467 mm)* |
| Yard Track Category 3 & Category 4 | 55 3/4" *(1,416 mm)* | 58" *(1,473 mm)* |

***Figure SUB-PART C – 2 – Gauge (inches and millimeters)***

d) Gauge at Wayside Inspection Systems (WIS) should be as tight as possible conforming to track standards. Maximum loaded gauge at WIS sites should not exceed 56 3/4" *(1,442 mm)*.

# 12. Curves

## 12.1 Curves – Easement, Elevation and Speed Limitations

a) The degree of a curve is determined by stretching a 62-foot 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.

- If a 31-foot chord is used, the mid-ordinate in inches must be multiplied by 4 to obtain the degree of curve.

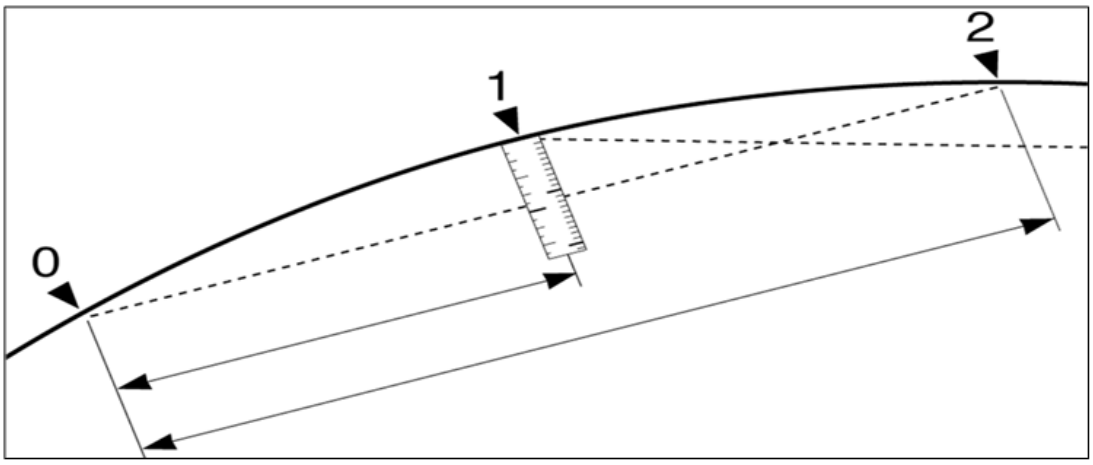



**Figure SUB-PART C – 51 – Degree of Curve Measurement**

b) On main tracks, spirals or curve easements must be installed between tangents and all curves of 1° and over, and between any two parts of a compound curve if these differ by 1° or more.

- Spirals provide a transition in both curvature and elevation.
- The length of the spiral between a tangent and a curve, or between two parts of a compound curve should be the length shown in the Curve Easement Table for each inch of curve elevation (taking into account the speed of the fastest train).

Refer to Figure Sub-Part C – 66 – Curve Easement Table

## 12.2 Curves – Determining Elevation

a) The Director, Rail Infrastructure is responsible for determining the proper elevation for each curve and curve elevations may only be changed on his authority,

b) Curve elevations are not permitted to be set to more than 5 inches *(127 mm)* installed, unless directed by the Director, Rail Infrastructure.

c) The maximum cross level on the outside rail of a curve may not be more than 7 inches *(178 mm)* on any track.

d) Curves exceeding 6 inches *(152 mm)* cross level must be monitored and have a remedial action plan to bring it back to 6 inches *(152 mm)* or less cross level.

e) The proper curve elevation for a particular curve is based on the degree of the curve and the maximum authorized speed of the fastest train on that curve.

f) The outside rail on a curve may not be lower than the inside rail except as provided by Figure Sub-Part C – 4 – URGENT Defects.

## 12.3 Curves – Using Curve Elevation Tables

a) The amount of elevation required is determined from the Curve Elevation Tables. These give the desired curve elevation for a given curvature and train speed, and alternatively, give the train speed for a given curvature and curve elevation.

b) In practice, railroads generally do not operate trains at balanced speed; that is, train speeds are set to move the resultant force toward the outer rail, resulting in an unbalance typically less than 3 inches.

c) Unbalance, or cant, deficiency is the theoretical amount of elevation that would have to be added to the existing elevation to achieve a balanced condition.

## 12.4 Curves – Maximum Allowable Speed ($V_{MAX}$)

a) The maximum allowable speed *($V_{MAX}$)* for any curve is calculated using:

$$V_{MAX} = \sqrt{(Ea + Eu) / 0.0007 \times Dc}$$

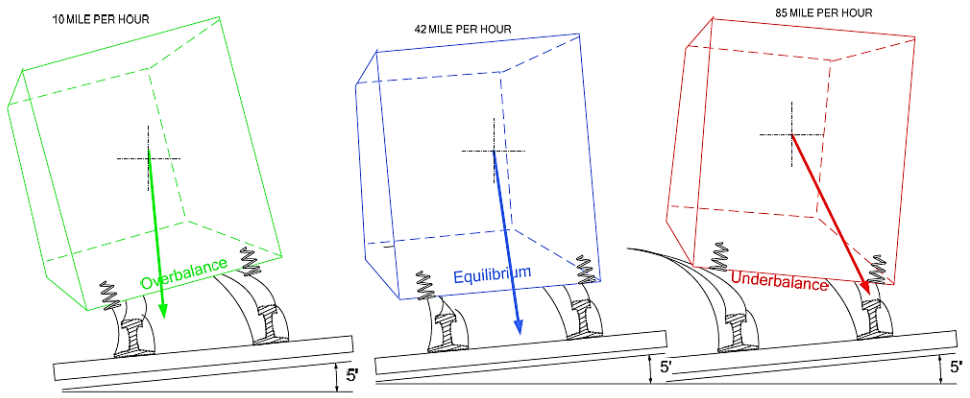
Where:

$V_{MAX}$ = Maximum allowable operating speed *(miles per hour)*
Ea = Actual elevation of the outside rail *(inches)*[1]
Eu = Maximum allowable unbalanced condition
Dc = Degree of curvature *(degrees)*[2]

*[1]To calculate $V_{MAX}$ only, Ea (actual elevation) for each 155-foot track segment in the body of the curve is determined by averaging the elevation for 10 points through the segment at 15.5-foot spacing. If the curve length is less than 155 ft, average the points through the full length of the body of the curve.*

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

The maximum Eu to use: Freight - 3 inches *(76 mm)*
Passenger - 3 inches *(76 mm)*




*4° Curve with 5" Superelevation*

***Figure SUB-PART C – 52 – Three Examples of Balance Conditions***

## 12.5 Curves – Balanced Elevation

- Balanced or equilibrium speed in mph for a given curve degree and elevation.
- Maximum elevation on a curve for a given timetable speed.

| Curve Elevation Balanced | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elevation of Outer Rail | | | | | | | | | | | | | |
| **Inches** | **0** | **½** | **1** | **1 ½** | **2** | **2 ½** | **3** | **3 ½** | **4** | **4 ½** | **5** | **5 ½** | **6** |
| ***Millimeters*** | ***0*** | ***13*** | ***25*** | ***38*** | ***51*** | ***64*** | ***76*** | ***89*** | ***102*** | ***114*** | ***127*** | ***140*** | ***152*** |
| **Degree of Curve** | **MAXIMUM ALLOWABLE OPERATING SPEED (M.P.H.)** | | | | | | | | | | | | |
| 0-30 | - | 38 | 54 | 66 | 76 | 85 | 93 | 100 | | | | | |
| 1-00 | - | 27 | 38 | 47 | 54 | 60 | 66 | 71 | 76 | 81 | 85 | 89 | 93 |
| 1-30 | - | 22 | 31 | 38 | 44 | 49 | 54 | 58 | 62 | 66 | 70 | 73 | 76 |
| 2-00 | - | 19 | 27 | 33 | 38 | 43 | 47 | 50 | 54 | 57 | 60 | 63 | 66 |
| 2-30 | - | 17 | 24 | 30 | 34 | 38 | 42 | 45 | 48 | 51 | 54 | 47 | 59 |
| 3-00 | - | 16 | 22 | 27 | 31 | 35 | 38 | 41 | 44 | 47 | 49 | 52 | 54 |
| 3-30 | - | 15 | 21 | 25 | 29 | 32 | 35 | 38 | 41 | 43 | 47 | 48 | 50 |
| 4-00 | - | 14 | 19 | 24 | 27 | 30 | 33 | 36 | 38 | 41 | 43 | 45 | 47 |
| 5-00 | - | 12 | 17 | 21 | 24 | 27 | 30 | 32 | 34 | 36 | 38 | 40 | 42 |
| 6-00 | - | 11 | 16 | 19 | 22 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 38 |
| 7-00 | - | 11 | 15 | 18 | 21 | 23 | 25 | 27 | 29 | 31 | 32 | 34 | 35 |
| 8-00 | - | 10 | 14 | 17 | 19 | 22 | 24 | 25 | 27 | 29 | 30 | 32 | 33 |
| 9-00 | - | 9 | 13 | 16 | 18 | 20 | 22 | 24 | 26 | 27 | 29 | 30 | 31 |
| 10-00 | - | 9 | 12 | 15 | 17 | 19 | 21 | 23 | 24 | 26 | 27 | 29 | 30 |
| 12-00 | - | 8 | 11 | 14 | 16 | 18 | 19 | 21 | 22 | 24 | 25 | 26 | 27 |
| 15-00 | - | 7 | 10 | 12 | 14 | 16 | 17 | 19 | 20 | 21 | 22 | 23 | 24 |

*Equilibrium speed on a curve is the speed at which the resultant of the weight and the centrifugal force is balanced resulting in equal vertical loads on the high and low rail.*

***Figure SUB-PART C – 53 – Curve Elevation Table – Balanced***

## 12.6 Curves – 1 Inch Underbalanced Elevation

- Preferred speed for freight trains in mph for a given curve degree and elevation.
- Preferred elevation on a curve for a given freight train timetable speed.

| **Curve Elevation 1" *(25 mm)* Underbalanced** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elevation of Outer Rail | | | | | | | | | | | | | |
| **Inches** | **0** | **½** | **1** | **1 ½** | **2** | **2 ½** | **3** | **3 ½** | **4** | **4 ½** | **5** | **5 ½** | **6** |
| ***Millimeters*** | ***0*** | ***13*** | ***25*** | ***38*** | ***51*** | ***64*** | ***76*** | ***89*** | ***102*** | ***114*** | ***127*** | ***140*** | ***152*** |
| **Degree of Curve** | **MAXIMUM ALLOWABLE OPERATING SPEED (M.P.H.)** | | | | | | | | | | | | |
| 0-30 | 54 | 66 | 76 | 85 | 93 | 100 | | | | | | | |
| 1-00 | 38 | 47 | 54 | 60 | 66 | 71 | 76 | 81 | 85 | 89 | 93 | 97 | 100 |
| 1-30 | 31 | 38 | 44 | 49 | 54 | 58 | 62 | 66 | 70 | 73 | 76 | 79 | 82 |
| 2-00 | 27 | 33 | 38 | 43 | 47 | 51 | 54 | 57 | 60 | 63 | 66 | 69 | 71 |
| 2-30 | 24 | 30 | 34 | 38 | 42 | 45 | 48 | 51 | 54 | 57 | 59 | 61 | 64 |
| 3-00 | 22 | 27 | 31 | 35 | 38 | 41 | 44 | 47 | 49 | 52 | 54 | 56 | 58 |
| 3-30 | 21 | 25 | 29 | 32 | 35 | 38 | 41 | 43 | 46 | 48 | 50 | 52 | 54 |
| 4-00 | 19 | 24 | 27 | 30 | 33 | 36 | 38 | 41 | 43 | 45 | 47 | 49 | 51 |
| 5-00 | 17 | 21 | 24 | 27 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 45 |
| 6-00 | 16 | 19 | 22 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 38 | 40 | 41 |
| 7-00 | 15 | 18 | 21 | 23 | 25 | 27 | 29 | 31 | 32 | 34 | 35 | 37 | 38 |
| 8-00 | 14 | 17 | 19 | 22 | 24 | 26 | 27 | 29 | 30 | 32 | 33 | 35 | 36 |
| 9-00 | 13 | 16 | 18 | 20 | 22 | 24 | 26 | 27 | 29 | 30 | 31 | 33 | 34 |
| 10-00 | 12 | 15 | 17 | 19 | 21 | 23 | 24 | 26 | 27 | 29 | 30 | 31 | 32 |
| 12-00 | 11 | 14 | 16 | 18 | 19 | 21 | 22 | 24 | 25 | 26 | 27 | 28 | 29 |
| 15-00 | 10 | 12 | 14 | 16 | 17 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |

*The recommended speed on a curve for freight trains, requiring 1" higher elevation for equilibrium.*

***Figure SUB-PART C – 54 – Curve Elevation - 1" Underbalanced***

## 12.7 Curves – 2 Inches Underbalanced Elevation

| Curve Elevation 2" *(51 mm)* Underbalanced | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elevation of Outer Rail | | | | | | | | | | | | | |
| **Inches** | **0** | **½** | **1** | **1 ½** | **2** | **2 ½** | **3** | **3 ½** | **4** | **4 ½** | **5** | **5 ½** | **6** |
| ***Millimeters*** | ***0*** | ***13*** | ***25*** | ***38*** | ***51*** | ***64*** | ***76*** | ***89*** | ***102*** | ***114*** | ***127*** | ***140*** | ***152*** |
| **Degree of Curve** | **MAXIMUM ALLOWABLE OPERATING SPEED (M.P.H.)** | | | | | | | | | | | | |
| 0-30 | 76 | 85 | 93 | 100 | | | | | | | | | |
| 1-00 | 54 | 60 | 66 | 71 | 76 | 81 | 85 | 89 | 93 | 97 | 100 | | |
| 1-30 | 44 | 49 | 54 | 58 | 62 | 66 | 70 | 73 | 76 | 79 | 82 | 85 | 88 |
| 2-00 | 38 | 43 | 47 | 50 | 54 | 57 | 60 | 63 | 66 | 69 | 71 | 74 | 76 |
| 2-30 | 34 | 38 | 42 | 45 | 48 | 51 | 54 | 57 | 59 | 61 | 64 | 66 | 68 |
| 3-00 | 31 | 35 | 38 | 41 | 44 | 47 | 49 | 52 | 54 | 56 | 58 | 60 | 62 |
| 3-30 | 29 | 32 | 35 | 38 | 41 | 43 | 46 | 48 | 50 | 52 | 54 | 56 | 58 |
| 4-00 | 27 | 30 | 33 | 36 | 38 | 41 | 43 | 45 | 47 | 49 | 50 | 52 | 54 |
| 5-00 | 24 | 27 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 45 | 47 | 48 |
| 6-00 | 22 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 38 | 40 | 41 | 43 | 44 |
| 7-00 | 21 | 23 | 25 | 27 | 29 | 31 | 32 | 34 | 35 | 37 | 38 | 40 | 41 |
| 8-00 | 19 | 22 | 24 | 25 | 27 | 29 | 30 | 32 | 33 | 35 | 36 | 37 | 38 |
| 9-00 | 18 | 20 | 22 | 24 | 26 | 27 | 29 | 30 | 31 | 33 | 34 | 35 | 36 |
| 10-00 | 17 | 19 | 21 | 23 | 24 | 26 | 27 | 29 | 30 | 31 | 32 | 33 | 34 |
| 12-00 | 16 | 18 | 19 | 21 | 22 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| 15-00 | 14 | 16 | 17 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |

***Figure SUB-PART C – 55 – Curve Elevation - 2" Underbalanced***

## 12.8 Curves – 3 inches Underbalanced Elevation

- Maximum permissible speed for trains operating speed in mph for a given curve degree and elevation. As per the *Rules Respecting Track Safety*, *Transport Canada* approval is required if the level of cant deficiency is greater than 3".

| **Curve Elevation 3" *(76 mm)* Underbalanced** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elevation of Outer Rail | | | | | | | | | | | | | |
| **Inches** | **0** | **½** | **1** | **1 ½** | **2** | **2 ½** | **3** | **3 ½** | **4** | **4 ½** | **5** | **5 ½** | **6** |
| ***Millimeters*** | ***0*** | ***13*** | ***25*** | ***38*** | ***51*** | ***64*** | ***76*** | ***89*** | ***102*** | ***114*** | ***127*** | ***140*** | ***152*** |
| **Degree of Curve** | **MAXIMUM ALLOWABLE OPERATING SPEED (M.P.H.)** | | | | | | | | | | | | |
| 0° 30' | 93 | 100 | 107 | 113 | 120 | 125 | 131 | 136 | 141 | 146 | 151 | 156 | 160 |
| 1° 00' | 66 | 71 | 76 | 80 | 85 | 89 | 93 | 96 | 100 | 104 | 107 | 110 | 113 |
| 1° 15' | 59 | 63 | 68 | 72 | 76 | 79 | 83 | 86 | 89 | 93 | 96 | 99 | 101 |
| 1° 30' | 54 | 58 | 62 | 66 | 69 | 72 | 76 | 79 | 82 | 85 | 87 | 90 | 93 |
| 1° 45' | 50 | 54 | 57 | 61 | 64 | 67 | 70 | 73 | 76 | 78 | 81 | 83 | 86 |
| 2° 00' | 46 | 50 | 54 | 57 | 60 | 63 | 66 | 68 | 71 | 73 | 76 | 78 | 80 |
| 2° 15' | 44 | 47 | 50 | 54 | 56 | 59 | 62 | 64 | 67 | 69 | 71 | 74 | 76 |
| 2° 30' | 41 | 45 | 48 | 51 | 54 | 56 | 59 | 61 | 63 | 66 | 68 | 70 | 72 |
| 2° 45' | 40 | 43 | 46 | 48 | 51 | 54 | 56 | 58 | 60 | 62 | 65 | 66 | 68 |
| 3° 00' | 38 | 41 | 44 | 46 | 49 | 51 | 54 | 56 | 58 | 60 | 62 | 64 | 66 |
| 3° 15' | 36 | 39 | 42 | 45 | 47 | 49 | 51 | 54 | 56 | 57 | 59 | 61 | 63 |
| 3° 30' | 35 | 38 | 40 | 43 | 45 | 47 | 50 | 52 | 54 | 55 | 57 | 59 | 61 |
| 3° 45' | 34 | 37 | 39 | 41 | 44 | 46 | 48 | 50 | 52 | 54 | 55 | 57 | 59 |
| 4° 00' | 33 | 35 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 55 | 57 |
| 4° 30' | 31 | 33 | 36 | 38 | 40 | 42 | 44 | 45 | 47 | 49 | 50 | 52 | 54 |
| 5° 00' | 29 | 32 | 34 | 36 | 38 | 40 | 41 | 43 | 45 | 46 | 48 | 49 | 51 |
| 5° 30' | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 41 | 43 | 44 | 46 | 47 | 48 |
| 6° 00' | 27 | 29 | 31 | 33 | 35 | 36 | 38 | 39 | 41 | 42 | 44 | 45 | 46 |
| 6° 30' | 26 | 28 | 30 | 31 | 33 | 35 | 36 | 38 | 39 | 41 | 42 | 43 | 45 |
| 7° 00' | 25 | 27 | 29 | 30 | 32 | 34 | 35 | 36 | 38 | 39 | 40 | 42 | 43 |
| 8° 00' | 23 | 25 | 27 | 28 | 30 | 31 | 33 | 34 | 35 | 37 | 38 | 39 | 40 |
| 9° 00' | 22 | 24 | 25 | 27 | 28 | 30 | 31 | 32 | 33 | 35 | 36 | 37 | 38 |
| 10° 00' | 21 | 22 | 24 | 25 | 27 | 28 | 29 | 31 | 32 | 33 | 34 | 35 | 36 |
| 11° 00' | 20 | 21 | 23 | 24 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 |
| 12° 00' | 19 | 20 | 22 | 23 | 24 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 |

*The maximum permissible speed on a curve for trains requiring 3" higher elevation for equilibrium.*

***Figure SUB-PART C – 56 – Curve Elevation - 3" Underbalanced***

## 12.9 Curves – 4 inches Underbalanced Elevation

- As per the *Rules Respecting Track Safety*, *Transport Canada* approval is required if the level of cant deficiency is greater than 3".

| Curve Elevation 4" *(102 mm)* Underbalanced | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elevation of Outer Rail | | | | | | | | | | | | | |
| **Inches** | **0** | **½** | **1** | **1 ½** | **2** | **2 ½** | **3** | **3 ½** | **4** | **4 ½** | **5** | **5 ½** | **6** |
| *Millimeters* | *0* | *13* | *25* | *38* | *51* | *64* | *76* | *89* | *102* | *114* | *127* | *140* | *152* |
| **Degree of Curve** | **MAXIMUM ALLOWABLE OPERATING SPEED (M.P.H.)** | | | | | | | | | | | | |
| 0° 30' | 107 | 113 | 120 | 125 | 131 | 136 | 141 | 146 | 151 | 156 | 160 | 165 | 169 |
| 1° 00' | 76 | 80 | 85 | 89 | 93 | 96 | 100 | 104 | 107 | 110 | 113 | 116 | 120 |
| 1° 15' | 68 | 72 | 76 | 79 | 83 | 86 | 89 | 93 | 96 | 99 | 101 | 104 | 107 |
| 1° 30' | 62 | 65 | 69 | 72 | 76 | 79 | 82 | 85 | 87 | 90 | 93 | 95 | 98 |
| 1° 45' | 57 | 61 | 64 | 67 | 70 | 73 | 76 | 78 | 81 | 83 | 86 | 88 | 90 |
| 2° 00' | 53 | 57 | 60 | 63 | 65 | 68 | 71 | 73 | 76 | 78 | 80 | 82 | 85 |
| 2° 15' | 50 | 53 | 56 | 59 | 62 | 64 | 67 | 69 | 71 | 73 | 76 | 78 | 80 |
| 2° 30' | 48 | 51 | 53 | 56 | 59 | 61 | 63 | 65 | 68 | 70 | 72 | 74 | 76 |
| 2° 45' | 46 | 48 | 51 | 53 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 | 72 |
| 3° 00' | 44 | 46 | 49 | 51 | 53 | 56 | 58 | 60 | 62 | 64 | 65 | 67 | 69 |
| 3° 15' | 42 | 44 | 47 | 49 | 51 | 53 | 55 | 57 | 59 | 61 | 63 | 65 | 66 |
| 3° 30' | 40 | 43 | 45 | 47 | 49 | 52 | 53 | 55 | 57 | 59 | 61 | 62 | 64 |
| 3° 45' | 39 | 41 | 44 | 46 | 48 | 50 | 52 | 53 | 55 | 57 | 59 | 60 | 62 |
| 4° 00' | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 53 | 55 | 57 | 58 | 60 |
| 4° 30' | 36 | 38 | 40 | 42 | 44 | 45 | 47 | 49 | 50 | 52 | 53 | 55 | 56 |
| 5° 00' | 34 | 36 | 38 | 40 | 41 | 43 | 45 | 46 | 48 | 49 | 51 | 52 | 53 |
| 5° 30' | 32 | 34 | 36 | 38 | 39 | 41 | 43 | 44 | 46 | 47 | 48 | 50 | 51 |
| 6° 00' | 31 | 33 | 35 | 36 | 38 | 39 | 41 | 42 | 44 | 45 | 46 | 48 | 49 |
| 6° 30' | 30 | 31 | 33 | 35 | 36 | 38 | 39 | 41 | 42 | 43 | 44 | 46 | 47 |
| 7° 00' | 29 | 30 | 32 | 34 | 35 | 36 | 38 | 39 | 40 | 42 | 43 | 44 | 45 |
| 8° 00' | 27 | 28 | 30 | 31 | 33 | 34 | 35 | 37 | 38 | 39 | 40 | 41 | 42 |
| 9° 00' | 25 | 27 | 28 | 30 | 31 | 32 | 33 | 35 | 36 | 37 | 38 | 39 | 40 |
| 10° 00' | 24 | 25 | 27 | 28 | 29 | 30 | 32 | 33 | 34 | 35 | 36 | 37 | 38 |
| 11° 00' | 23 | 24 | 25 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
| 12° 00' | 22 | 23 | 24 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 |

***Figure SUB-PART C – 57 – Curve Elevation - 4" Underbalanced***

## 12.10 Curves – 5 inches Underbalanced Elevation

- As per the *Rules Respecting Track Safety*, *Transport Canada* approval is required if the level of cant deficiency is greater than 3".

| Curve Elevation 5" *(102 mm)* Underbalanced | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elevation of Outer Rail | | | | | | | | | | | | | |
| **Inches** | **0** | **½** | **1** | **1 ½** | **2** | **2 ½** | **3** | **3 ½** | **4** | **4 ½** | **5** | **5 ½** | **6** |
| *Millimeters* | *0* | *13* | *25* | *38* | *51* | *64* | *76* | *89* | *102* | *114* | *127* | *140* | *152* |
| **Degree of Curve** | **MAXIMUM ALLOWABLE OPERATING SPEED (M.P.H.)** | | | | | | | | | | | | |
| 0° 30' | 120 | 125 | 131 | 136 | 141 | 146 | 151 | 156 | 160 | 165 | 169 | 173 | 177 |
| 1° 00' | 85 | 89 | 93 | 96 | 100 | 104 | 107 | 110 | 113 | 116 | 120 | 122 | 125 |
| 1° 15' | 76 | 79 | 83 | 86 | 89 | 93 | 96 | 99 | 101 | 104 | 107 | 110 | 112 |
| 1° 30' | 69 | 72 | 76 | 79 | 82 | 85 | 87 | 90 | 93 | 95 | 98 | 100 | 102 |
| 1° 45' | 64 | 67 | 70 | 73 | 76 | 78 | 81 | 83 | 86 | 88 | 90 | 93 | 95 |
| 2° 00' | 60 | 63 | 65 | 68 | 71 | 73 | 76 | 78 | 80 | 82 | 85 | 87 | 89 |
| 2° 15' | 56 | 59 | 62 | 64 | 67 | 69 | 71 | 73 | 76 | 78 | 80 | 82 | 84 |
| 2° 30' | 53 | 56 | 59 | 61 | 63 | 65 | 68 | 70 | 72 | 74 | 76 | 77 | 79 |
| 2° 45' | 51 | 53 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 | 72 | 74 | 76 |
| 3° 00' | 49 | 51 | 53 | 56 | 58 | 60 | 62 | 64 | 65 | 67 | 69 | 71 | 72 |
| 3° 15' | 47 | 49 | 51 | 53 | 55 | 57 | 59 | 61 | 63 | 65 | 66 | 68 | 70 |
| 3° 30' | 45 | 47 | 49 | 52 | 53 | 55 | 57 | 59 | 61 | 62 | 64 | 65 | 67 |
| 3° 45' | 44 | 46 | 48 | 50 | 52 | 53 | 55 | 57 | 59 | 60 | 62 | 63 | 65 |
| 4° 00' | 42 | 44 | 46 | 48 | 50 | 52 | 53 | 55 | 57 | 58 | 60 | 61 | 63 |
| 4° 30' | 40 | 42 | 44 | 45 | 47 | 49 | 50 | 52 | 53 | 55 | 56 | 58 | 59 |
| 5° 00' | 38 | 40 | 41 | 43 | 45 | 46 | 48 | 49 | 51 | 52 | 53 | 55 | 56 |
| 5° 30' | 36 | 38 | 39 | 41 | 43 | 44 | 46 | 47 | 48 | 50 | 51 | 52 | 53 |
| 6° 00' | 35 | 36 | 38 | 39 | 41 | 42 | 44 | 45 | 46 | 48 | 49 | 50 | 51 |
| 6° 30' | 33 | 35 | 36 | 38 | 39 | 41 | 42 | 43 | 44 | 46 | 47 | 48 | 49 |
| 7° 00' | 32 | 34 | 35 | 36 | 38 | 39 | 40 | 42 | 43 | 44 | 45 | 46 | 47 |
| 8° 00' | 30 | 31 | 33 | 34 | 35 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 |
| 9° 00' | 28 | 30 | 31 | 32 | 33 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 |
| 10° 00' | 27 | 28 | 29 | 30 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| 11° 00' | 25 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 |
| 12° 00' | 24 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 35 | 36 |

***Figure SUB-PART C – 58 – Curve Elevation - 5" Underbalanced***

## 12.11 Curves – 6 inches Underbalanced Elevation

- As per the *Rules Respecting Track Safety*, *Transport Canada* approval is required if the level of cant deficiency is greater than 3".

| Curve Elevation 6" *(102 mm)* Underbalanced | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elevation of Outer Rail | | | | | | | | | | | | | |
| **Inches** | **0** | **½** | **1** | **1 ½** | **2** | **2 ½** | **3** | **3 ½** | **4** | **4 ½** | **5** | **5 ½** | **6** |
| *Millimeters* | *0* | *13* | *25* | *38* | *51* | *64* | *76* | *89* | *102* | *114* | *127* | *140* | *152* |
| **Degree of Curve** | **MAXIMUM ALLOWABLE OPERATING SPEED (M.P.H.)** | | | | | | | | | | | | |
| 0° 30' | 131 | 136 | 141 | 146 | 151 | 156 | 160 | 165 | 169 | 173 | 177 | 181 | 185 |
| 1° 00' | 93 | 96 | 100 | 104 | 107 | 110 | 113 | 116 | 120 | 122 | 125 | 128 | 131 |
| 1° 15' | 83 | 86 | 89 | 93 | 96 | 99 | 101 | 104 | 107 | 110 | 112 | 115 | 117 |
| 1° 30' | 76 | 79 | 82 | 85 | 87 | 90 | 93 | 95 | 98 | 100 | 102 | 105 | 107 |
| 1° 45' | 70 | 73 | 76 | 78 | 81 | 83 | 86 | 88 | 90 | 93 | 95 | 97 | 99 |
| 2° 00' | 65 | 68 | 71 | 73 | 76 | 78 | 80 | 82 | 85 | 87 | 89 | 91 | 93 |
| 2° 15' | 62 | 64 | 67 | 69 | 71 | 73 | 76 | 78 | 80 | 82 | 84 | 85 | 87 |
| 2° 30' | 59 | 61 | 63 | 65 | 68 | 70 | 72 | 74 | 76 | 77 | 79 | 81 | 83 |
| 2° 45' | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 | 72 | 74 | 76 | 77 | 79 |
| 3° 00' | 53 | 56 | 58 | 60 | 62 | 64 | 65 | 67 | 69 | 71 | 72 | 74 | 76 |
| 3° 15' | 51 | 53 | 55 | 57 | 59 | 61 | 63 | 65 | 66 | 68 | 70 | 71 | 73 |
| 3° 30' | 49 | 52 | 53 | 55 | 57 | 59 | 61 | 62 | 64 | 65 | 67 | 69 | 70 |
| 3° 45' | 48 | 50 | 52 | 53 | 55 | 57 | 59 | 60 | 62 | 63 | 65 | 66 | 68 |
| 4° 00' | 46 | 48 | 50 | 52 | 53 | 55 | 57 | 58 | 60 | 61 | 63 | 64 | 65 |
| 4° 30' | 44 | 45 | 47 | 49 | 50 | 52 | 53 | 55 | 56 | 58 | 59 | 60 | 62 |
| 5° 00' | 41 | 43 | 45 | 46 | 48 | 49 | 51 | 52 | 53 | 55 | 56 | 57 | 59 |
| 5° 30' | 39 | 41 | 43 | 44 | 46 | 47 | 48 | 50 | 51 | 52 | 53 | 55 | 56 |
| 6° 00' | 38 | 39 | 41 | 42 | 44 | 45 | 46 | 48 | 49 | 50 | 51 | 52 | 53 |
| 6° 30' | 36 | 38 | 39 | 41 | 42 | 43 | 44 | 46 | 47 | 48 | 49 | 50 | 51 |
| 7° 00' | 35 | 36 | 38 | 39 | 40 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
| 8° 00' | 33 | 34 | 35 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 |
| 9° 00' | 31 | 32 | 33 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 |
| 10° 00' | 29 | 30 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 41 |
| 11° 00' | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 39 |
| 12° 00' | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 35 | 36 | 37 | 38 |

***Figure SUB-PART C – 59 – Curve Elevation - 6" Underbalanced***

## 12.12 Curves – Designing Elevations

a) Where there are adjacent tracks on a curve, the elevation on the outer track must not be more than the elevation on the inner track. The exception is if the distance between track centres have been increased to make up for the difference in curve elevation.

b) On a spiral or curve easement between a tangent and a curve, the elevation must increase uniformly (evenly) from the end of the tangent, where both rails are at the same level, to the beginning of the curve. On a spiral / easement between two parts of a compound curve, the elevation must increase uniformly from the end of the flatter curve to the beginning of the sharper curve.

c) Where a spiral or curve easement has not been installed between a tangent and a curve, the curve elevation must extend to the end of the curve. It must also decrease uniformly on the tangent until the opposite rails are at the same level. Where a spiral / easement has not been installed between two parts of a compound curve, the elevation for the sharper curve must extend to the point of connection with the flatter curve. It must also decrease uniformly until it reaches the proper elevation for the flatter curve.

d) Where possible, existing reverse curves should be separated by tangent of at least 78' *(23,774 mm)* in length, unless specially authorized by the Director, Rail Infrastructure. New designs should be separated by tangent of at least 100' *(30,480 mm)* in length.

e) Curve geometry must be maintained to comply with TC Rules Respecting Track Safety Sub-Part C – Track Geometry

f) Where the distance between adjacent curves is not large enough to meet the requirements of paragraphs 13.12 d) and e) that distance must be used to best advantage in proportion to the elevations of the adjoining curves. In certain instances, you may have to reduce the maximum permissible train speed so that you do not go beyond the maximum rate of change of elevation for any given speed.

g) Design rates of change in elevation are based on train encountering no more than 1-1/4" *(32 mm)* change in curve elevation per second of travel time. The minimum length of easement required for the above conditions is shown in Figure Sub-Part C – 66 – Curve Easement Table, below. Whenever possible, the length of easement for a 1" *(25 mm)* change of elevation should be extended to more than 39' *(11,887 mm)*.

h) Using a greater superelevation than required will result in the weight of slower trains being transferred to the low rail causing damage to the low rail.

i) Using a lesser superelevation than required will result in faster trains producing greater lateral forces through the curve. This can increase gauge widening and gauge face wear.

## 12.13 Curves – Rate of Change of Elevation

a) When redesigning or resetting a curve, and the resources to re-adjust are available, the rate of change of curve elevation must not be more than:

- 1" *(25 mm)* in 60' *(18,288 mm)* on all newly constructed tracks.
- 1" *(25 mm)* in 60' *(18,288 mm)* on all relocated tracks (where possible).
- 1" *(25 mm)* in 45' *(13,716 mm)* in all relocated tracks where 1" in 60' is not workable.
- 1" *(25 mm)* in 39' *(11,887 mm)* as an absolute maximum in all other tracks.

| CURVE EASEMENT TABLE | | | |
|---|---|---|---|
| **Speed in MPH** | **Length in Feet Required for Each Inch (mm) Change in Elevation** | | |
| | **1" in 60'** *(25 mm in 18,288 mm)* | **1" in 45'** *(25 mm in 13,716 mm)* | **1" in 39'** *(25 mm in 11,887 mm)* |
| 20 or lower | 60 | 45 | 39 |
| 25 | 60 | 45 | 39 |
| 30 | 60 | 45 | 39 |
| 35 | 60 | 45 | 41 |
| 40 | 60 | 47 | 47 |
| 45 | 60 | 53 | 53 |
| 50 | 60 | 60 | 60 |
| 55 | 65 | 65 | 65 |
| 60 | 70 | 70 | 70 |
| 65 | 76 | 76 | 76 |
| 70 | 82 | 82 | 82 |
| 75 | 88 | 88 | 88 |
| 80 | 94 | 94 | 94 |
| 85 | 100 | 100 | 100 |
| 90 | 106 | 106 | 106 |

***Figure SUB-PART C – 60 – Curve Easement Table***

*Easement lengths that are more than 60', 45' and 39' are based on a rate of change of elevation of 1-1/4" (32 mm) per second of time.*

# SUB-PART D. TRACK STRUCTURE

**Scope:** This subpart prescribes the requirements for ballast, tie, track assembly fittings and the physical conditions of rails.

## 1. Ballast

### 1.1 Ballast – Conditions

**a) Ballast: General**

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

- Restrain the track laterally, longitudinally, and vertically under dynamic loads imposed by railroad equipment and thermal stress exerted by the rails;
- Transmit and distribute the load of the track and railroad rolling equipment to the subgrade;
- Provide adequate drainage for the track; and
- Maintain proper track cross-level, surface, and alignment.

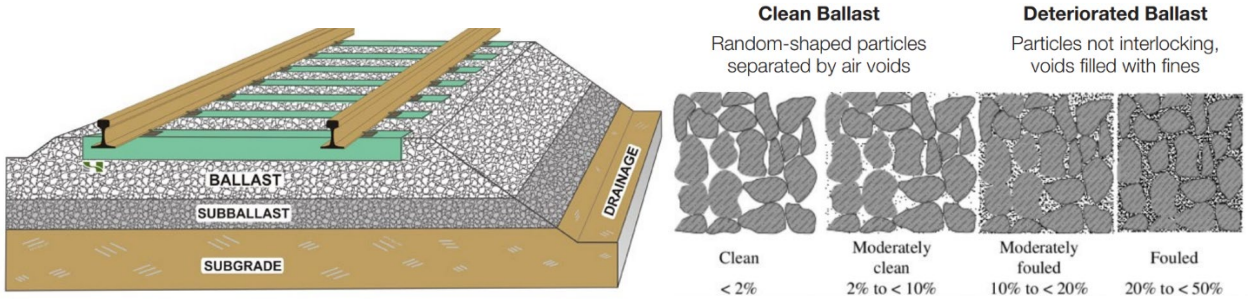



***Figure SUB-PART D – 1 – Sub-Grade, Sub-Ballast, Ballast, Drainage and Clean vs. Deteriorated Ballast***

**b) Track Construction**

i. For new construction use the Current Specification for Ballast to select and prepare ballast materials.

ii. For new construction ensure that the ballast section when complete conforms to design specifications.

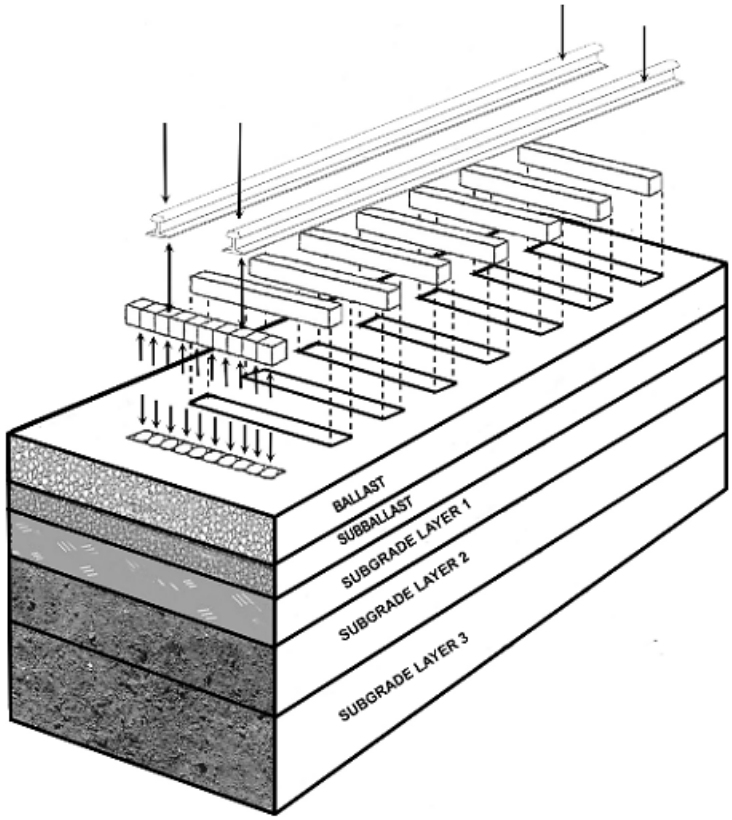



**Figure SUB-PART D – 2 – Materials of Sub-Grade, Sub-Ballast, and Ballast Layers**

**c) Contaminated Ballast**

i. Areas that have become contaminated so that they no longer allow water to freely drain must be identified so that they can be corrected,

ii. Each Fall, the District Manager may prepare a list of contaminated ballast areas in his territory. This list is to be forwarded to the Director, Rail Infrastructure who will determine the appropriate corrective action.

## 1.2 Ballast – Preparation

**a) Clearances**

i. Obtain approval from the Director, Rail Infrastructure for any planned ballasting operation that will reduce line clearances.

ii. Report to the Director, Rail Infrastructure all track raises or re-alignments that may affect line clearances.

**b) Bridges**

i. If bridges are within the section of track planned for re-ballasting, bridge spans must be raised, or plans made to undercut each bridge approach for a sufficient distance to permit a safe, smooth riding run-out. The Director, Rail Infrastructure must approve the course of action.

**c) Public Crossings**

i. At public crossings, re-ballasting must be done without risk or major inconvenience to the public.

ii. Advise the road authority of the nature and extent of the work to be done.

iii. Arrange for the installation of barricades, warning lights, and other safety devices to protect people and vehicles using the crossing.

- The Railway Association of Canada (RAC) Circular #13, located in your SharePoint ('OneDrive'), offers information on the proper steps in providing protection at crossings.

## 1.3 Ballast – Ballasting and Undercutting – Special Precautions

**a) Track Buckling**

i. Take all necessary precautions to avoid track buckling. Pay close attention to the temperature when planning to use under-track plows, sleds and undercutters. Fill cribs and restore shoulders with new ballast as soon as possible.

**b) Transitions / Run-Out Gradients**

i. The transition or run-out 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 run-out be more than that shown in table below:

| MAXIMUM TRANSITION OR RUN-OUT GRADIENT | |
|---|---|
| **Max. Permissible Train Speed** | **Rate of Run-out** |
| 90 miles per hour | One inch in 105 feet |
| 80 miles per hour | One inch in 95 feet |
| 70 miles per hour | One inch in 85 feet |
| 60 miles per hour | One inch in 70 feet |
| 50 miles per hour | One inch in 60 feet |
| 40 miles per hour | One inch in 45 feet |
| 30 miles per hour | One inch in 35 feet |
| 20 miles per hour | One inch in 25 feet |
| 10 miles per hour | One inch in 15 feet |

***Figure SUB-PART D – 3 – Run-Out Gradient***

**c) Ballasting Cross Sections**

i. Cribs filled to a minimum of 1" *(25 mm)* below the top of tie,

ii. No ballast left on top of ties, spikes, and tie plates,

iii. Shoulder ballast for jointed rail to be minimum of 6” *(152 mm)* out from end of tie before sloping,

iv. Shoulder ballast for CWR track and concrete tie track to be minimum of 12” *(305 mm)* out from end of tie before sloping.

v. Ballast for concrete tie track should be to a minimum depth of 12” *(305 mm)*.

**d) Track Geometry**

i. Throughout the entire process (the unloading of ballast, the first operation of trains, the final raising and tamping of the track, the return of traffic to normal track speed) the following track geometry must be maintained:

- The maximum cross level on the outside rail of a curve may not be more than 7 inches *(178 mm)* on any track.
- Curves exceeding 6 inches *(152 mm)* cross level must be monitored and have a remedial action plan to bring it back to 6 inches *(152 mm)* or less cross level.
- The difference in curve elevation between any two points 60 feet *(18,288 mm)* apart must not be more than 1 ½ inches *(38 mm)*, with the tie and rail taken into account.

**e) Unloading Ballast**

When unloading ballast:

i. Only the amount of ballast planned and required should be unloaded in the correct location minimize distribution required for ballast regulators.

ii. Unlock and break open doors only when the car is not moving.

iii. Cars should be unloaded to ensure even weight distribution in the car.

iv. In superelevated curves, ensure the cars are unloaded evenly to avoid overturning cars to the low side of the curve.

v. Ensure ballast does not contact the axles or truck frames of the cars or flows over the ball of the rail, lifting the car causing derailment.

vi. In the center of the track, a hardwood tie may be placed ahead of the leading axle of a loaded ballast car to plow off ballast.

vii. Remove ballast from switches and stock rails, cribs with switch rods and flangeways of frogs, crossings or guard rails which could impede passage of flangeways.

viii. Control ballast flow near road crossings or bridges.

ix. Cars must be completely empty and doors in the locked position before release.

- Inspect the inside of the car to ensure it is completely empty with no ballast on the hanging on the side slopes.
- Ballast attached to the sides of the car, or unevenly distributed in the car, requires load leveling or equalization before moving the car.
- Unevenly loaded cars can result in a possible walk off derailment.

x. Cars with doors that cannot be opened must be reported.

xi. Pushing imbalanced load(s) of a car(s), as a result of dumping rock on one side of the track or rock sticking to the side of a car(s), are to be avoided when going into or through a curve or turnout.

**f) Freshly Dumped Ballast**

i. Take care to ensure that freshly dumped ballast does not extend more than 2-1/2 inches *(64 mm)* above the top of the rail. This will prevent damage to equipment and reduce the risk of derailing light rail cars.

## 1.4 Ballast – Ballasting and Undercutting in CWR Territory

**a) Requirements**

i. Work requirements and speed restriction requirements associated with ballasting and undercutting in CWR territory are given in Sub-Part D – Section 7.8 – Prevention of Track Buckling.

# 2. Ties

## 2.1 Ties – Timber Ties in Track

a) Existing tie type, length, and spacing may remain in place until programmed tie replacement or ballast renewal is performed.

b) Installed centered with the track and square with the rail, with the end of the tie approximately 18 ½ inches from the field edge of the rail base.

c) Installed in tracks Class 2 and above at 20 3/8” *(518 mm)* centers

d) Installed at 21 1/4" *(540 mm)* centers in Class 1 tracks.

e) Prevented from becoming centerbound.

f) Surfacing on timber tie track must be in accordance with Sub-Part C – Section 14 – Surfacing and Lining.

## 2.2 Ties – Timber Tie Spacing during Bridge Work

a) Maximum clear span of ties on bridges with unsupported running rail*;

- 115 lb rail – 24” *(610 mm)*

**Smaller rail sections must be as per and approved by a Bridge Engineer*

## 2.3 Ties – Timber Tie Defects

a) Each 39’ segment of track must have a sufficient number of cross ties which in combination provide support that will hold gauge, surface, and alignment.

b) Defective ties (other than concrete) are defined as those that are:

i. Broken through,

ii. Split, or otherwise damaged, to the extent that it will allow the ballast to work through, or will not hold spikes or rail fasteners,

iii. Plate cut more than 2” *(51 mm)*,

iv. Tie cut more than 40% of tie thickness, or

v. So deteriorated that the tie plate or base of rail can move laterally 1/2" *(13 mm)* relative to the tie.

vi. Not holding surface, line, or gauge.

# 3. Tie Plates

## 3.1 Tie Plates – General

a) The use of new or second-hand tie plates shall be as directed by the Director, Rail Infrastructure, however;

i. Broken or damaged tie plates must not be reused,

ii. Tie plates with excessively worn spike holes or shoulders should not be reused.

- Square spike holes or round screw spike holes worn more than ¼”
- Tie plate shoulders worn more than ¼”

## 3.2 Tie Plates – Installation

a) Tie plates must be installed so that;

i. The plates have full, even bearing on the ties,

ii. The field side plate is square against the field side base edge of the rail,

iii. The plate is centered on the tie,

iv. The rail is canted toward the center of the track (if applicable),

v. Each plate has the same cant.

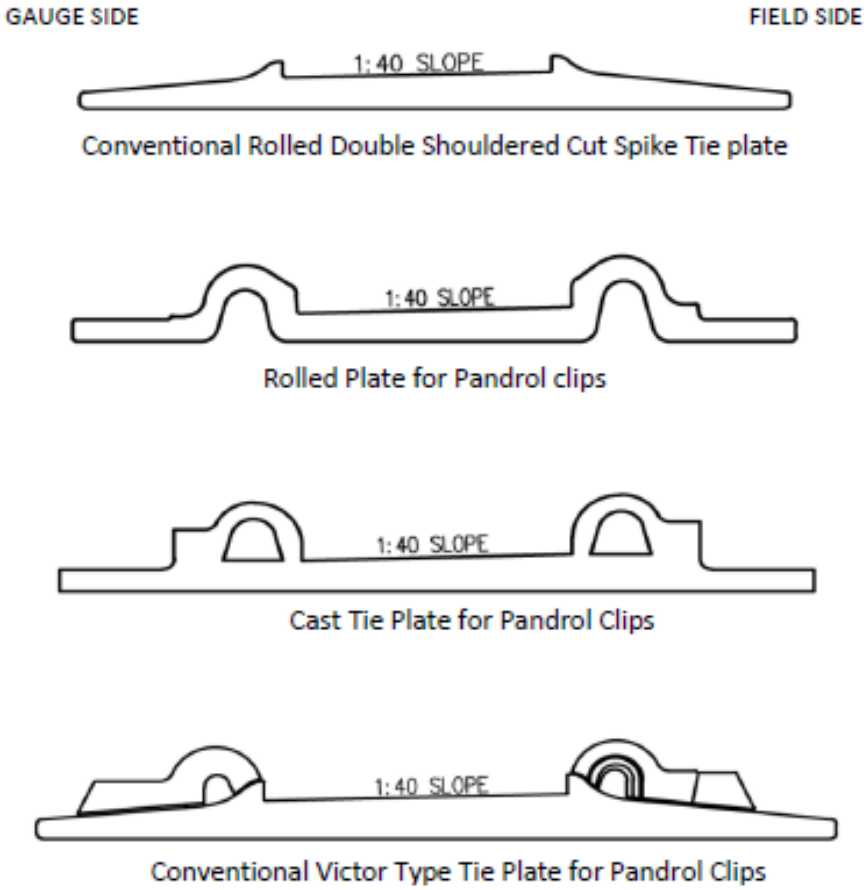



***Figure SUB-PART D – 12 – Various Tie Plates and Cant***

b) In Classes 3 through 5 tracks where timber crossties are used there shall be tie plates under the running rails on at least eight (8) of any ten (10) consecutive ties,

c) 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,

d) Torch cutting of tie plates is not permitted,

e) 14” tie plates shall be used with 115 lb rail on all main track curves in excess of 3°.

## 3.3 Tie Plates – Jointed Track

a) Replace missing or broken tie plates as necessary to effectively maintain gauge.

b) Existing tie plates may remain in place until a rail relay is performed.

# 4. Spikes

## 4.1 Spikes - Patterns

a) Each rail shall be spiked as per the appropriate spiking pattern,

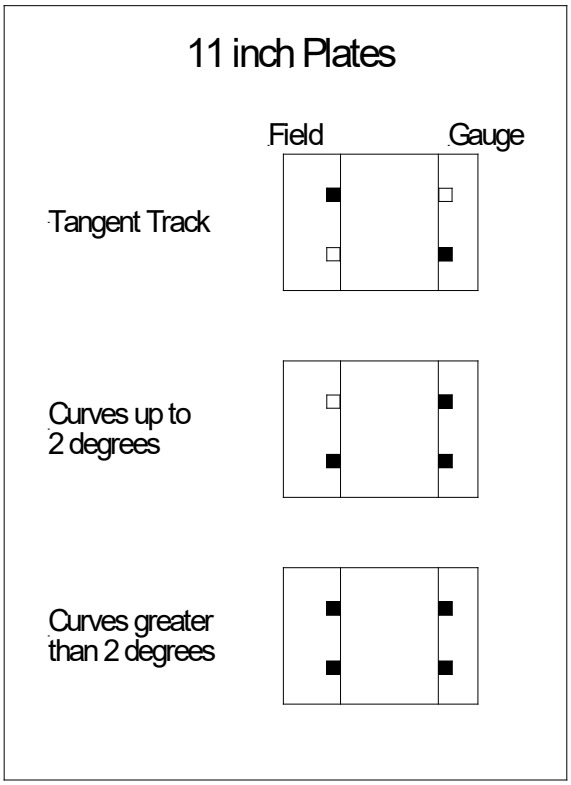



***Figure SUB-PART D – 13 – Spiking Patterns – 11" Plates***

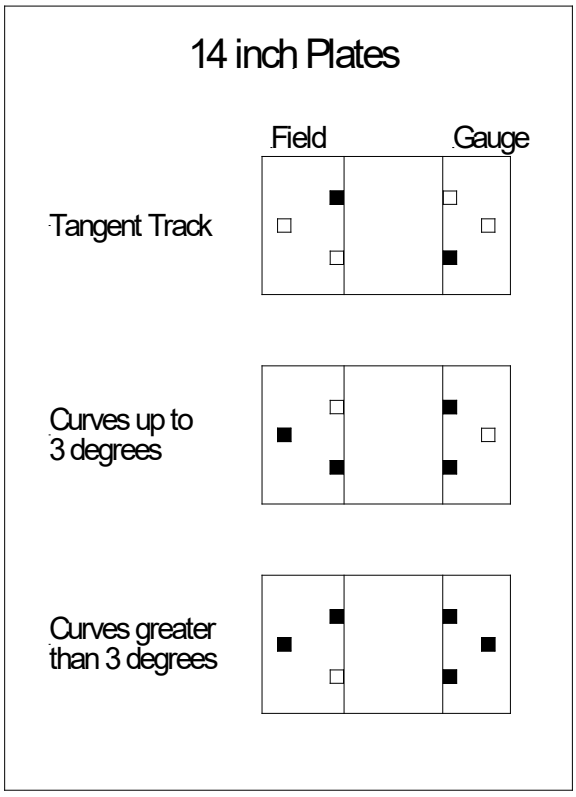



**Figure SUB-PART D – 14 – Spiking Patterns - 14" Plates**

b) Drive spikes vertically with the face of the spike in contact with the base edge of the rail, except spikes against insulated joints, which will be installed with heads turned away from the joint bar and not in solid contact with the joint bar.

c) No fastenings may be installed at insulated joints in a manner that may short circuit the track circuit,

d) Spikes will be driven to a depth such that the spike head is within 3/16" *(5 mm)* of top of the rail base. Every effort should be made not to overdrive spikes,

e) Spikes should not be driven at the ends of insulated joint bars in any manner that would cause the insulated joint bar to become electrically connected to the rail,

f) Spikes will be driven only with a standard spike maul, pneumatic or hydraulic spiking hammer or spiking machine,

g) Spikes will not be driven within 2 inches *(51 mm)* of the end of, or in the slots of, skirted (slotted) joint bars.

## 4.2 Spikes – Pulling

a) When pulling spikes, a spike lifter will be used when spikes cannot be loosened with a claw bar,

b) Spike between the running rail and guard rails, as well as spikes in tight areas around heel blocks and frogs will be removed using a four-ball spike puller and claw bar,

c) Claw bars will not be struck with mauls or other tools.

## 4.3 Spikes – Considerations in Jointed Track

a) Use spike lengths and spiking patterns that meet the ONTC standard.

b) When rails over 39' in length are laid on single-shoulder tie plates, use 6 spikes per tie, or preferably, use dual shoulder plates.

c) Replace missing and broken spikes as necessary to effectively maintain gauge.

d) Existing spiking patterns may remain in place until a rail relay or tie program is performed.

e) When broken spikes are found in curves, carry out an inspection of the whole curve and adjacent tangent to ensure that no dangerous spike condition exists. Special attention must also be paid to the condition of tie plates when performing the inspection. Unusual wear patterns and broken plates indicate other problems exist.

## 4.4 Spikes – Sizes for Shimming

a) 6 ½" spike for ½" shims

b) 7 ½" spike for 1 ½" shims

c) 8 ½ spike for 2 ½" shims

d) 9 ½" spike for 3 ½" shims

# 5. Anchors

A sufficient number of anchoring devices will be applied to provide adequate longitudinal restraint.

## 5.1 Anchors – General

a) Do not substitute alternate types of rail anchors unless the substitution is approved by the Director, Rail Infrastructure,

b) Only use rail anchors in the rail section for which they are intended. All rail anchor designs must be approved by the Director, Rail Infrastructure,

c) Use approved rail anchors that are all the same type when installing out-of-face. Anchors used to replace or support existing anchors should also be of the same type as those in the track section, if possible.

d) In all cases, at locations where track or rail movement occurs due to heavy traffic on grades, to train braking or to soft sub-grade, install additional rail anchors as required to restrict movement of the rail.

## 5.2 Anchors – Application

a) Anchors should be applied uniformly along the rail against ties,

b) To avoid tie skewing, anchors must be installed in the same direction against the same tie on the opposite rail. Ties should be at right angles to rail before applying anchors,

c) Anchors will be applied to the gauge side of the rail when practicable,

d) When it is necessary to adjust rail anchors by hand and if the anchor is 1” or less from its proper position, it can be driven along the rail. Otherwise, you must remove the anchor and reapplied.

e) When changing rail or renewing ties, all anchors removed must be reapplied,

f) Sprung or damaged rail anchors will not be installed,

g) Use only the proper tools or machines when applying or removing anchors in order to avoid damaging the anchor or the risk of injury. The use of spike mauls is prohibited. Anchors should be removed from the rail while the rail is still in track,

h) When installing anchors, ensure the anchor is fully engaged on the rail base, with the rail base inside the lip of the anchor. Rail anchors must not be overdriven,

i) Do not install anchors within 2” from the edge of any field weld to prevent nicks or gouges with the heat affected zone of welds,

j) Do not install anchors on the rail opposite joints,

k) Do not install rail anchors where they will interfere with bond wire, boot legs, insulated joints, or other signal or track appliance,

l) Rail anchors are not to be used on shimmed track. Anchors removed during shimming shall be replaced promptly when shims are removed

## 5.3 Anchors – Turnouts

a) Turnouts should be fully anchored to the extent possible in both jointed and CWR track.

## 5.4 Anchors – Requirements in CWR Track

a) In CWR track, rail anchors will be installed in a box pattern on every other tie except;

   i. At permanent joints within CWR (joints that will not be welded), then every tie will be box anchored for a minimum distance of 200’ each direction from the joint,

   ii. When jointed rail abuts CWR, a minimum of 200’ of rail on either side immediately adjacent to the joint will have every tie boxed anchored,

   iii. At turnouts, non-glued insulated joints and crossing frogs, every tie will be box anchored for a minimum distance of 200’ each way from the turnout or joint,

b) When CWR is installed on a bridge, the Director, Rail Infrastructure will provide an anchor plan for the bridge

## 5.5 Anchors – Requirements in Jointed Track

a) In jointed rail, the minimum number of evenly spaced anchors for restraint in both directions are;

| Class of Track | No. of Ties to Box Anchor (39’ or Shorter Rails) |
|---|---|
| 1 | Every 4th Tie |
| 2 and 3 | Every 3rd Tie |
| 4 and 5 | Every 2nd Tie |
| | |
| **No. of Ties to Box Anchor (40’ or Longer Rails)** | |
| Every 2nd Tie | |

***Figure SUB-PART D – 15 – Anchor Application Spacing***

b) At a joint, box-anchoring spacing may be adjusted to avoid box anchoring a tie adjacent to the joint.

c) When required, install additional anchors on the jointed track to prevent track movement.

d) When laying bolted rail do not allow trains to pass over unanchored track except in an emergency. Then, the following must be done before allowing a train to pass over the track:

   i. Inspect the track,

   ii. Place a speed restriction of not more than 10 mph, and

   iii. Advise train crews to not use dynamic braking during movement over the track.

e) Existing anchor patterns may remain in place until a rail relay or tie program is performed.

f) Replace missing or broken anchors as necessary to effectively control movement of the rail.

g) Re-apply or replace anchors removed during track maintenance work upon completion of the work.

h) Re-apply anchors after shims are removed from track.

i) At locations where track or rail movement occurs, for example due to heavy traffic on grades, train braking or soft sub-grade, install additional rail anchors to control movement of the rail.

## 5.6 Anchors – Requirements for Wayside Inspection Systems (WIS)

a) Every tie should be box anchored for a minimum distance of 100' *(30,480 mm)* on each side of the inspection system unless otherwise specified by standard plan.

# 6. Rail

## 6.1 Rail – General

a) Do not install rails shorter than 12 feet *(3,658 mm)* in length in main track unless authorized by standard plan.

b) Do not use rail or joint bars that have been cut with a torch or that has holes that have been made with a torch. Torch cut rail must be clearly marked.

c) Use a drill to make boltholes in the field. Never use a torch to burn boltholes.

d) When cutting rail for re-use, make the cut at least 6 inches *(152 mm)* from any torch mark on the rail.

e) Whenever possible, maintain a minimum stagger of 12 feet *(3,658 mm)* between bolted joints and/or the welds.

f) Replacement rails should be planned so there should be no more than 4 field welds on the same rail per 39' of track.

g) Lay rail to the standard gauge as per Sub-Part C, Section 2 – Gauge.

h) In order to maintain correct gauge, at least every fourth tie must be gauged on tangents and every third tie on curves.

i) Plug all spike holes properly.

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

k) When cutting rail, the saw cut must be made:

   i. With a saw properly secured to the rail,

   ii. Square and perpendicular to the rail axis with a variation not to exceed 1/8" *(3 mm)* and all burrs removed,

   iii. Centered in the crib, if possible, at least 4" *(102 mm)* from the side of the tie,

   iv. No closer than 3" *(914 mm)* to a plant weld or field flash butt weld,

   v. No closer than 6" *(1,829 mm)* to a thermite weld

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

m) Ensure the rail cut, and resultant joint, do not cause a joint tie defect per Sub-Part D, Section 2.7 – Joint Tie Requirements (Timber and Concrete).

## 6.2 Rail – Handling and Unloading

a) Dragging rail along the track is prohibited unless ALL of the following conditions are met:

   i. Dragging rail 80' *(24,384 mm)* or greater in length, shall be done only with appropriate rail handling devices;

   ii. When dragging continuous welded rail,

      - Maximise the use of rail dollies for continuously welded rail when possible;

      - When dragging on track place blocking to prevent impacting switches or road crossings.

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

- If during fire season, the most restrictive fire prevention protocol for the area(s) the rail is to be dragged must apply using the Industrial Operations Protocol

iv. If there is risk of fire (e.g., sparks from steel and rock or steel and steel contact),

- At least one employee will remain on site to monitor and patrol area of the site until they are certain there is no fire risk.
  * The employee(s) are equipped with a backpack pump and have means of communication (e.g., radio, cell);
  * In areas where the rail is to be dragged over more than one bridge and the bridges are in close proximity, one employee can be used to patrol the area if they are able to patrol actively and sufficiently both.
- Any open deck bridges will be wetted down prior to making the move;

v. The rail is not dragged faster than 5 mph and 3mph across open deck bridges; and

vi. Inspect for damage to track components (e.g., anchors, spikes, ties, plates, etc.) and crossings behind the movement, especially in curves and turnouts.

vii. Once at the install site, a thorough visual inspection of the entire length of the rail for any defects is conducted.

## 6.3 Rail – Protection of Worn Rail

a) Rail that reaches Line C wear in Appendix A – Rail Wear Limits & Rail Management Decision Zones must be removed from track, or train speed must be restricted to a speed as near as possible to equilibrium speed, while not exceeding the maximum allowable speed for the class of track, until the rail can be changed out. Note that if rail change-out cannot be done within 30 days, or within 60 days on Class 2 track that does not carry passenger or dangerous commodity traffic, then a further speed restriction to 10 MPH must be applied.

Refer to Line limits in Appendix A – Rail Wear Limits & Rail Management Decision Zones.

b) Where rail wear has resulted in joint bars being heavily impacted by wheel flanges, the joint must be welded, or a high clearance bar or compatible worn bar must be applied. Train speed must be restricted to a speed as near as possible to equilibrium speed until the joint is welded or a high clearance bar is applied.

## 6.4 Rail – Protection of Defective Rail

a) All rail defects noted in Sub-Part D, Section 6.5 – Rail – Defects and Protection Codes detected visually or by using rail flaw detector cars, including defects temporarily repaired by the application of joint bars, must be monitored within 30 calendar days of their detection and at least monthly thereafter, until change out of defective rail.

b) Rail defects noted in Sub-Part D, Section 6.5 – Rail – Defects and Protection Codes and Sub-Part D, Section 6.9 – Rail – Rail Surface Management Plan are considered Safety Critical Maintenance. Only Quality Assurance (QA) personnel, not involved with the repair, are to verify the repairs have been completed to standards.

## 6.16 Rail – Bolted

### 6.16.1 Rail Expansion

a) Make an expansion allowance at each rail joint for the changing length of the rail due to the changing rail temperature.

b) No expansion allowances are needed where bolted rail abuts continuous welded rail.

c) Measure the rail temperature of each rail laid with an approved thermometer.

ii. To measure the rail temperature, place the thermometer on the base of the rail near the web away from the wind and out of the direct rays of the sun.

iii. The use of an infrared temperature measurement tool is acceptable, hold the device 18” from the rail web.

d) Provide the proper space allowance for expansion by placing shims of metal, fiber, or wood between the ends of the adjoining rails as each rail is laid, except at insulated joints. These shims must be left in place until the line of rail is fully bolted and spiked. If rail anchors are provided, do not remove the shims until the rail line is anchored at least 10 rail lengths beyond the joint.

e) The following figure shows the expansion allowances for various lengths of rail at different rail temperatures (in degrees Fahrenheit):

| | **EXPANSION ALLOWANCE *(inches and millimeters)*** | | | | | |
|---|---|---|---|---|---|---|
| **LENGTH OF RAIL** | **0”** *0 mm* | **1/16”** *2 mm* | **1/8”** *3 mm* | **3/16”** *5 mm* | **1/4”** *6 mm* | **5/16”** *8 mm* |
| 30’ to 50’ | Above 85°F | 65° to 85°F | 40° to 64°F | 20° to 39°F | 0° to 19°F | Below 0°F |
| 51’ to 90’ | Above 85°F | 74° to 85°F | 61° to 73°F | 48° to 60°F | 35° to 47°F | Below 35°F |
| | **RAIL TEMPERATURE (Fahrenheit)** | | | | | |

***Figure SUB-PART D – 52 – Rail Expansion Allowance per Rail Temperature***

### 6.16.2 Rail End Mismatch

a) 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.

**Note:** Every effort should be made to avoid grinding and instead replace the worn rail (having it marked for restoration of rail profile by welding) or welded in track to restore the worn rail’s profile.

Except, joints to be thermite or butt welded will not be built up.

b) 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 the following table:

| 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 | 3/16" *(5 mm)* | 3/16" *(5 mm)* |
| 3, 4, and 5 | 1/8" *(3 mm)* | 1/8" *(3 mm)* |

***Figure SUB-PART D – 53 – Rail End Mismatch (inches and millimetres)***

### 6.16.3 Joint Securement

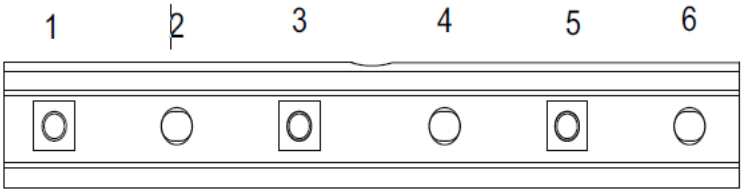



***Figure SUB-PART D – 54 – Example of 6-Hole Joint Bar Bolted***

a) Conventional Jointed Track: Each joint shall have at least 4 bolts and with at least 2 in each abutting rail in Classes 2 through 5 track and with at least 2 bolts in Class 1 track, with at least 1 in each abutting rail.

b) CWR Track: Each rail shall be bolted with at least 4 bolts at each joint and with at least 2 in each abutting rail.

c) Use standard, compromise, or high-relief six-hole joint bars for all rails over 39' unless otherwise specified.

d) Track bolts should be retightened after 1 to 3 months and as necessary thereafter.

e) Corrosion resistant lubricant should be applied to bolt threads prior to the application of the nuts. This will reduce the variation in thread friction and promote uniformity of tension obtained.

f) Bolts are to be applied from the middle going outward alternating sides of the joint. For a 6-hole joint back, tightening sequence would be as follows: 3 – 4 – 2 – 5 – 1 – 6 referencing the numbers noted in Figure SUB-PART D – 54 – Example of 6-Hole Joint Bar Bolted above.

g) When tightening bolts, ensure that the joint bars are seated properly and tighten bolts to proper specification.

h) Replace missing bolts as soon as conditions permit.

i) Existing joint bars may remain in place until a rail relay is performed.

j) 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,

k) Only joint bars of the correct design for the rail section, drilling pattern and bolt type will be used,

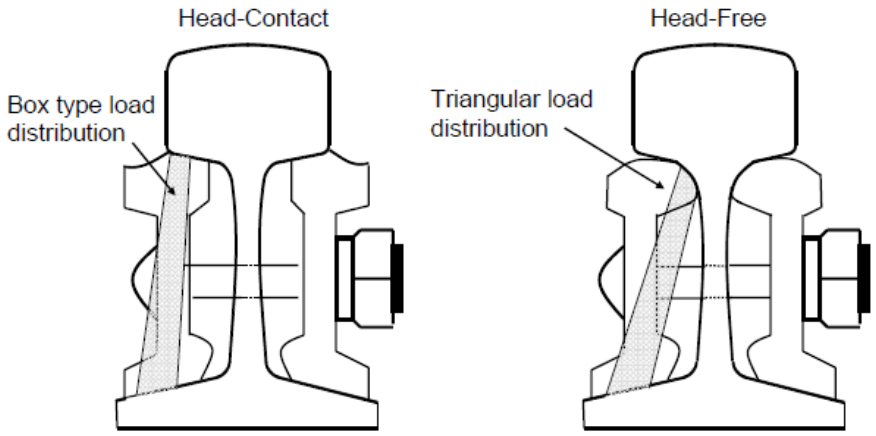



***Figure SUB-PART D – 55 – Conventional and Head-Free Joint Bar Design Load Difference***

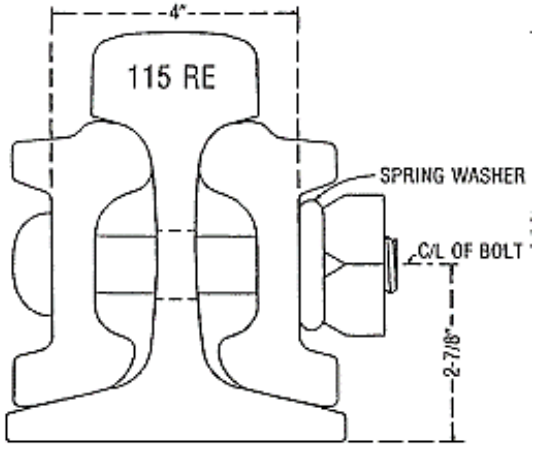



***Figure SUB-PART D – 56 – Joint Bar Assembly for 115 RE***

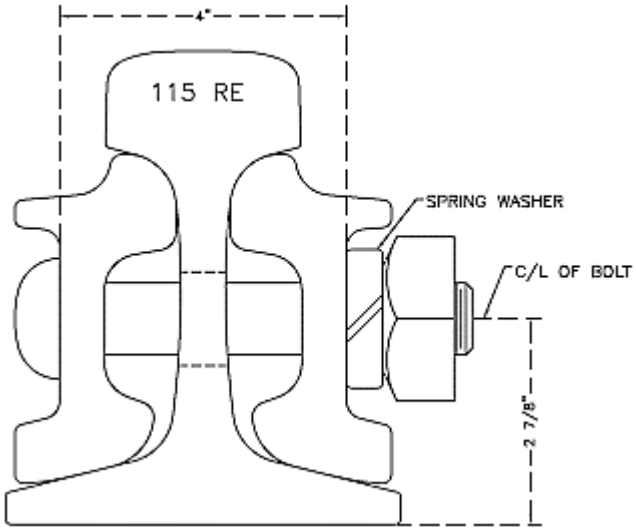



***Figure SUB-PART D – 57 – Clearance Joint Bar Assembly for 115 RE***

l) Rail flow at the bottom of the rail head, especially in curves, may need to be ground off prior to installing joint bars. Joint bars must not be ground.

m) All joints in must be inspected at a minimum frequency of that shown in Sub-Part F – Section 10,

n) Joint bars that are cracked or broken must be replaced.

   i. On the occasion that the bars cannot be immediately corrected then place a speed restriction of not more than 10 mph under the authority of a qualified person.

      Except, if a joint bar on Classes 3 through 5 track is cracked, broken, or because of wear allows vertical movement of either rail when all bolts are tight, it must be replaced.

   ii. Joint bars that are cracked or broken between the middle two bolt holes regardless of the class of track must be replaced immediately, or the Movement Over Rail Break Policy must be applied.

o) Rail joints should be slotted (e.g., straight slot then a 3 mm bevel) to prevent flowed rail and chipped joints,

p) Where 33-to-39-foot panels are installed and three or more consecutive square joints exist, speed will be limited to that of Class 3 track.

q) Use a drill to make boltholes in the field. Never use a torch to burn boltholes.

### 6.16.4 Insulated Joints

a) Defective insulated joints must be repaired or replaced promptly,

b) Signal forces must report defective insulated joints to track forces promptly,

c) Signal 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 Signals,

d) Encapsulated (coated) insulated joints are to be used in jointed rail sections,

e) Fibre bars may be used in light rail sections,

f) Plates must be used with all insulated joints on wood track ties. Insulated tie plates will be used on ties within 2" *(51 mm)* of the end post of an insulated joint,

g) Insulated joints should be suspended, that is, the end post should not be over a tie,

h) Rail ends where insulated joints are to be installed must conform to the following;

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

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

   iii. Batter shall not exceed 1/32 inch *(1 mm)*,

   iv. The heights of the adjacent rails shall not differ by more than 1/16 inch *(2 mm)*.

i) 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

j) 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 mm)* below,

k) Track near insulated joints shall be adequately anchored. Non-glued insulated joints will be considered as joints and will be anchored to the correct standard,

l) Rail anchors must not be applied on the sides of ties adjacent to bootlegs,

m) Rail end overflow must be removed at insulated joints by slotting. The gap should be filled with silicone sealer to prevent the influx of dirt and grinding material,

n) After welding, insulation must not be replaced until the rails have cooled,

o) Insulated joints no longer required must be removed from track as soon as possible.

### 6.16.5 Compromise Joints Bars and Compromise Rails

a) Compromise joint bars connect two rails of different weights together. They are constructed such that the bars align the running surface and gauge sides of different rails' sections.

b) There are two kinds of compromise joint bars:

- Directional (Right or Left hand) compromise bars are used where a difference in the width of the head between two sections requires the offsetting of the rail to align the gauge side of the rail.
- Non-directional (Gauge or Field Side) compromise bars are used where the difference between sections is only in the heights of the head or where the difference in width of rail head is not more than 0.125" at the gauge point. The gauge point is the point on the gauge side of the rail exactly 0.625" below the top of the rail.

c) To determine the hand of the joint, face the joint from the center of the track. When the larger rail section is on the left side of the joint, it is the left hand joint. When the rail of larger section is on the right, it is the right hand joint.

d) A compromise joint bar set consists of one gauge side and one field side bar.

e) The rail sections that the compromise joint bar will fit are indicated at each end of the bar.

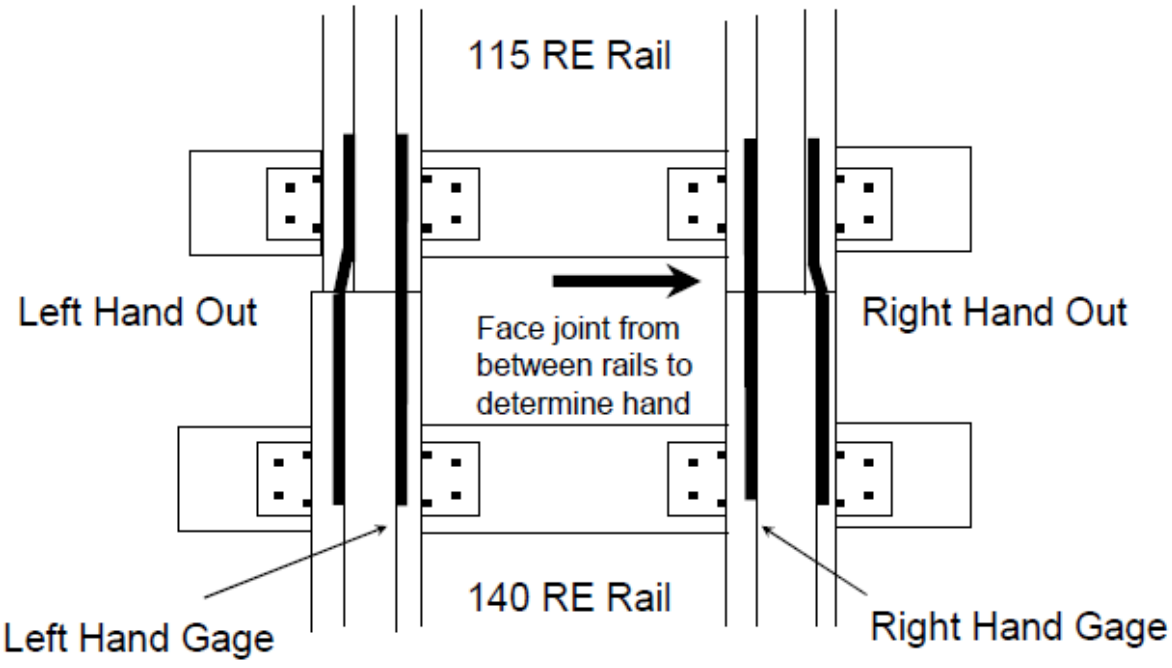



***Figure SUB-PART D – 58 – Compromise Joint Bars 115 RE Rail to 140 RE Rail***

f) Compromise joint bars must not be modified from its initial design to fit a different rail section.

g) Compromise joints bars should not be installed,

   i. In turnouts, or

   ii. Within 20 feet of an,

   - Open deck bridge,
   - Turnout,
   - Highway crossing, or
   - Railroad crossing.

h) Compromise joint bars must be painted blue for ease of recognition.

i) Compromise rails consist of a single piece of rail, with a forged transition from one rail section to another.

j) Compromise rails may be universal or “handed”, depending on the rail sections, and are identified just as a joint would be.

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

### 6.16.6 Use of Torch-Cut Rail – Emergency Only

a) If a torch-cut rail is used in the track in an emergency, use it for the passage of emergency equipment only.

   - A slow order of 10 miles per hour must be maintained until the rail is changed.

b) The torch-cut rail must be replaced before regular train operations can continue.

### 6.16.7 Work in Jointed Rail

a) To prevent track buckles in jointed rail, restrictions laid out in Sub-Part D – Section 7.9 are to be followed upon completion of work.

### 6.16.8 Weld Repair Bars

a) Wrap or weld repair bars are only to be used to temporarily bolt around a broken rail or failed or suspect weld.

## 6.17 Rail – Guard Rails

### 6.17.1 Installation of Interior Guard Rails

a) Guard rails must be installed at the following location;

   i. All bridges that have supporting structure extending above the top of the ties,

   ii. All bridges that have the underside supporting structure protruding beyond the deck of the bridge,

   iii. All bridges that cross major roadways (two lane paved highway or greater),

   iv. All bridges that cross commercially navigable waterways,

   v. All bridges longer than 100'.,

   vi. All bridges with curves 2° and over,

   vii. Any other locations designated by the Director, Rail Infrastructure.

b) Guard rails should be considered, where piers of overhead structures are within 17' of centerline of track, there are no crash walls, and the track speed is greater than 10 mph,

c) Existing guard rails that are not required per the above criteria, may not be removed without notifying the Director, Rail Infrastructure,

d) Guard rails shall be installed as per Standard Plans,

e) Guard rails will be spiked with two spikes per tie, without tie plates on every tie.

f) Guard rails should not be higher and no lower than 2" from the top of the running rail.

### 6.17.2 Temporary Removal of Guard Rails

a) Whenever guard rails are temporarily removed on main track to accommodate track or bridge work, a temporary speed restriction of 10 mph is required.

# 8. Turnouts and Track Crossings

## 8.1 Turnouts and Track Crossings – General

a) A turnout is a combination of a switch, a frog, the rails necessary to connect the switch and the frog, two guard rails (unless it is a self-guarded frog), and a switch stand for operating the switch.

b) A turnout begins with the switch and ends with the frog.

c) A turnout is usually referred to by its number (frog angle or number). For example, a #10 turnout uses a number 10 frog.

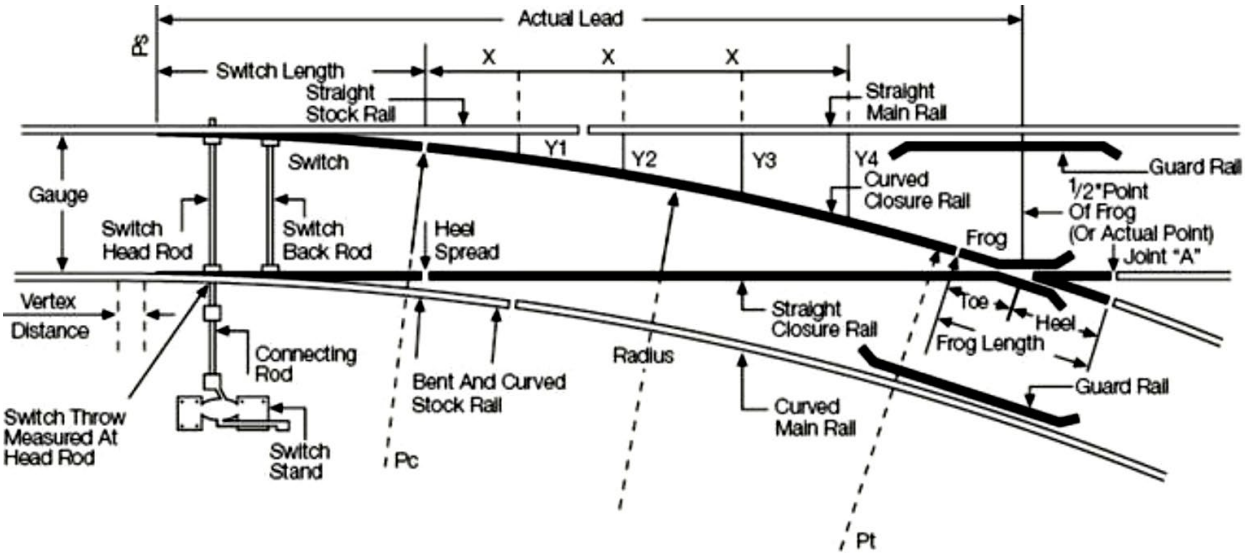



***Figure SUB-PART D – 68 – Turnout Components***

d) In turnouts and track crossings (diamonds), the fastenings must be intact and maintained so as to keep the components securely in place. Each switch, frog and guard rail must be kept free of obstructions that may interfere with the passage of wheels.

e) Turnouts are to be inspected in accordance with Sub-Part F, Section 11.

## 8.2 Turnouts and Track Crossings – Signals System

a) Care will be taken when working around turnouts to avoid interfering with Signals Systems:

i. 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 a track wrench, shovel, ballast fork, tie tongs or metal broom,

ii. At locations where snow-clearing devices are installed, use extra precautions because of the possibility of creating a short circuit through the metal ductwork.

## 8.3 Turnouts and Track Crossings – Installation

a) Turnouts must not be installed or renewed on main track curves, except in special cases as authorized by the Director, Rail Infrastructure,

b) Power, Dual Control, Spring and Electrically Locked switches shall be installed only at locations approved by the Director, Rail Infrastructure,

c) When turnouts are being constructed, trains should not be permitted to move in a facing point direction until;

i. The frog is properly protected by a guard rail,

ii. The main track switch point is lined and locked against the stock rail.

- If the points cannot be lined and locked, points must be secured with an approved switch point clamp and spiked.
  - When spiking a point, the gauge plate must have an appropriate hole intended for point securement.
  - The tie must be sound enough to secure the point.

d) <u>Switch stand requirements are as follows,</u>

i. Switch stands should be plumb and be securely spiked, bolted or lagged to the head block ties, stands on spring switches shall be securely bolted to the head block ties,

ii. Main track switch stands shall be of an approved rigid type,

iii. On other than main track, approved rigid, or safety stands may be used,

iv. Semi-automatic stands of an approved type may be used on yard tracks only where speeds do not exceed 15 MPH,

v. Approved rigid stands must be used with spring switches, or where operating stands are used with derails,

vi. New and rebuilt switch stands may be supplied with ergonomic switch handles,

vii. Switch stands must be located so as to conform to approved plans,

viii. Low stands must be used where stands are to be located between tracks having track centres 18’ or less,

ix. Switch stands and switch machines must be placed, wherever possible, on the closed point side of the track, so the connecting rod is in tension, when the switch is set for the normal position,

x. The handles on all high switch stands 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. When the switch is lined over for the diverging route the handle should move in the same direction as the points,

xi. When installing parallel or ground throw switch stands, the operating level must point toward the frog for normal position.

xii. Switch stands must be equipped with the proper reflectorized target according to CROR and be in an effective condition.

e) <u>Switch rods and connecting rod bolts requirements are as follows,</u>

i. Must be inserted with the nuts on the top side and secured with cotter pins,

ii. Ensure the connecting rod jaw openings, bolt holes and bolts correctly match the switch rods.

iii. The connecting rod bolt under the switch stand must be installed with the head of the bolt on the upper side,

f) Stock rails and switch points requirements are as follows,

i. Switch points shall fit snugly against the stock rails for the entire length of the planed portion.

ii. Turnout stock rails shall be horizontally bent as shown on the standard plan. An approved rail bender shall be used for bending rails.

iii. Stock rails are properly seated in the switch plate having no lateral movement in the plates and that switch plates have no movement on the ties.

iv. Care must be taken in adjusting braces to avoid over-driving and rotating the stock rails out of the rail seat of the plate.

v. Switch points must be installed directly opposite each other.

vi. Adequate rail anchors must be installed to resist rail movement.

vii. Switch points should not overhang the gauge plate nor be more than 1" *(25 mm)* back from the edge of the gauge plate.

g) Switch point protectors,

i. Switch point protectors or switch point guards of an approved type may be installed, to protect the switch point where the speed on any route through the turnout does not exceed 15 mph.


***Figure SUB-PART D – 69 – Examples of Switch Point Protector and Guard***

ii. Care must be taken when installing to ensure that the protector fits properly against the rail and that any flowed metal on the gauge side of the straight stock rail is ground off,

iii. Condition of switch point protector must be in serviceable condition. If you see contact on the switch point, this may be a sign that the protector needs repair or replacement.

iv. Switch point protectors that attach to the tip of the switch point (as shown in Figure Sub-Part D – 70) are no longer acceptable for use at ONTC.

***Figure SUB-PART D – 70 – Prohibited Switch Point Protector***

h) Ballast,

i. Will be cleaned from cribs to a depth adequate to prevent contact with rods and to facilitate winter switch maintenance and drainage.

i) Locks and keeper requirements are as follows,

i. All main track stands must be equipped with an approved switch lock in good working order and properly chained to the stand on high mast switch stands or to the ties on low mast switch stands.

ii. Switch stands on other than main tracks are to be equipped with a hook type keeper unless otherwise directed,

iii. On all main track hand operated switches, high security switch locks must be installed,

iv. At locations where vandalism is a concern, high security switch locks may also be installed as directed by the Director, Rail Infrastructure on the following,

- Hand operated switches on other than main tracks,
- Other devices such as derails, electric switch locks, foot pedals, push button operation panels, etc.

v. Switch Point Locks:

- Approved switch point locks must be installed on all manually operated main track switches (except spring switches) seen as facing points from a highway crossing at grade where all the following conditions exist;
  - The crossing is not protected by gates, and;
  - The train speed is 50 mph or faster (30 mph where sight lines are poor), and;
  - The switch is within 200 ft of the crossing.
- Where switch point locks are installed, the switch will be identified by painting the top of the switch stand castings white.

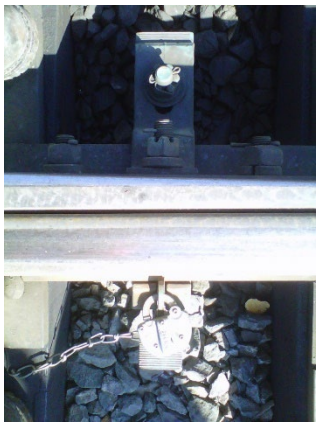


***Figure SUB-PART D – 71 – Switch Point Foot Pedal Lock***

## 8.5 Turnouts and Track Crossings – Railway Crossings at Grade (Diamonds)

### 8.5.1 Installation of Diamonds

a) Crossings will be installed according to the plans supplied for each crossing,

b) Avoid damage to crossing frogs when handling, placing, and lifting. When necessary to use jacks on crossings, they should be applied to the frog properly, not to the arm rails,

c) Installation of guardrails in advance of the crossing will be at the discretion of the Director, Rail Infrastructure.

### 8.5.2 Maintenance of Diamonds

a) Subgrade under crossings must be well drained.

b) 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.

c) Only approved ballast shall be used,

d) If the tread portion of a casting is worn down more than 3/8" *(10 mm)* below the original contour (below level corners where diamond crossing corner pads have been ground off), operating speed over that crossing may not be more than 10 mph.

e) Crossings must be fully bolted. All bolts will be provided with spring washers or hardened steel flat washers as indicated on the manufacturer's plan and will be kept tightened to the torque shown in Section 8.4.13. - Bolts

f) Reversible crossing inserts may be transferred between corners to equalize wear,

g) Movable point crossings will be adequately lubricated with an approved lubricant,

h) Crossings will be kept free of snow, ice, and other obstructions,

i) Crossing ties will be sound and firmly tamped for the entire length of the tie on both routes of the crossing,

j) All crossings will be adequately protected at all times with spare components to ensure continued operation.

# SUB-PART E. TRACK APPLIANCES, TRACK RELATED DEVICES AND RIGHT OF WAY

## 1. Derails

### 1.1 Derails – Installation

a) Derails must be installed;

   i. Where there is any possibility of equipment, which has been left standing on the tracks other than main tracks or sidings, being moved by gravity so as to obstruct a main track or siding,

   ii. 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 power will be specified by the Transportation Department,

   iii. At entrances and exits of Main and Running Repair Shops, the derail, when practicable, should never be located less than 40 feet from doors. Where further safety measures are required a derail pit may be installed,

   iv. On tracks on which an industry will move cars or equipment, and

   v. On mining and other bulk loading facility tracks where cars are dropped by gravity toward the main or other track that is to be protected.

b) Each derail must be clearly visible.

c) When in a locked position, a derail must be free of any lost motion which would allow it to be operated without removing the lock.

d) Derails shall only be installed or removed as directed by the Director, Rail Infrastructure,

e) Whenever operational changes so dictate, the Director, Rail Infrastructure must ensure that derails are installed in accordance with item Sub-Part E, Section 1.1 a)

f) Whenever new tracks are designed or constructed, the Director, Rail Infrastructure must determine if a derail is required in accordance with Sub-Part E, Section 1.1 a). The Director, Rail Infrastructure must ensure that required derails are installed prior to placing the track in service,

g) Consideration for the removal of derails will occur only upon written request from the Director, Transportation, the Director, Rail Infrastructure with a copy to the Vice-President, Rail Operations. The written request must include;

   i. Details of proposed operating conditions that will ensure protection from unattended movements,

   ii. Confirmation that these operating conditions are in place; and

   iii. Where necessary, operating simulations may have to be carried out to confirm that the derail is no longer required.

h) Only approved types of derails are to be installed. These are:

   i. Hinge Type Derail, Hayes Model EB,

   ii. Switch Point Derail,

   iii. Sliding Derail.

i) Older type Hayes cast derails of type A, AP, G, GP and D are not to be used on rail heavier than 85 lb.,

j) Power operated derails shall be installed and maintained in accordance with plans and instructions provided by the Signals department,

k) The Director, Rail Infrastructure will approve the derail selection for each installation,

l) Location of a derail is governed by location conditions such as grade and length of track, but when practicable should never be located less than 20 feet behind the fouling point and installed so as to derail cars away from the track being protected. Sufficient distance should be allowed so that the derailed car cannot continue to move and foul the track being protected,

m) 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,

n) Derails must be equipped with an approved switch lock that is chained to the derail or the derail operating stand,

o) On industrial track, a switch point derail will be installed where,

   i. The speed of the equipment to be derailed could exceed 15 mph,

   ii. A private locomotive is in use.

## 1.2 Derails – Identification

a) All derails not equipped with high operating stands shall have a derail sign mounted on a separate post,

b) All derails equipped with high operating stands shall have a derail switch target mounted on the mast of the operating stand,

c) 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,

d) When directed by Special Instructions, derails protected by signals or otherwise marked, will not require derail signs.

## 1.3 Derails – Maintenance

a) Derails and locks must be kept lubricated and adjusted to maintain ease of movement,

b) Ties to which derails are fastened must be sound and well tamped and have the top surfaces in the same plane. Hardwood ties should be used whenever practicable,

c) Sliding and hinge derails must be maintained at right angles to the rail. In new installations the derail should be fastened to the ties with 1” x 6-1/2” lag screws,

d) Derails must be fastened with all available holes (if possible),

e) Derails must have a detailed inspection by the Track Supervisor (Inspector) or other qualified personnel annually. Particular attention should be paid to spike, screw, and ballast condition. Check for any distortion, fractures or damage from derailments, accidents, or unusual wear on the derail.

f) 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,

g) A handle may be welded onto the body of a hinge derail to make operating the derail easier.

# 4. Signage

## 4.1 Signage

a) Signs are important to advise operating crews and maintenance personnel of specific locations, to provide advance notice of operating requirements and to warn the public of dangers,

b) Signs must be kept clear of vegetation or other obstructions,

c) Any sign that is damaged or missing is to be repaired as soon as practicable,

d) Care must be taken to place or replace signs in their proper location and at the proper height as per standard plans,

e) Emergency Notification Signs must be affixed at all crossings except restricted crossings.

f) Refer to Appendix H – Standard Signs for additional information.

# 5. Road Crossings

## 5.1 Road Crossings – General

a) This section covers the general installation and maintenance requirements for all road crossings at grade as required by type of use,

b) No crossing can be built, installed, widened, relocated, or removed without approval from the Director, Rail Infrastructure,

c) All crossings must be built and maintained in accordance with the appropriate standard plans or special plans issued and approved for a particular crossing,

d) All construction, repairs, re-construction, and maintenance of crossings must only be carried out under the supervision of a qualified employee.

## 5.2 Road Crossings – Regulatory Requirements

a) For crossings located in Canada, the regulations of *Transport Canada*, *Railway Safety Directorate of Transport Canada*, and the *Canadian Transportation Agency (CTA)* apply.

b) All crossings must be constructed, re-constructed, and maintained in accordance with current road crossing regulations.

c) All crossings must be approved by the proper authority before the crossing can be constructed or re-constructed. The Director, Rail Infrastructure must ensure that all the necessary agreements and orders have been received before they issue instructions to construct or re-construct a crossing.

d) The legal status and conditions of use of any crossing cannot change without appropriate orders or revisions to agreements. The Track Supervisor (Inspector) must advise the Director, Rail Infrastructure of any change in the use of the crossing, or of any developments that are likely to create a change.

e) Whenever there is a collision between a vehicle and a train or engine at a crossing, the District Manager must conduct a full investigation of the crossing in order to determine if sight line requirements were in place. If this has already been done, it is not necessary to do it again. The information collected must be documented in the applicable record.

f) Copies of the inspections may be given to *Transport Canada Rail Safety Inspectors* or other *Transport Canada* officers if they ask for this information.

   i. Requests by *Transport Canada* for any information relating to the physical characteristics of the crossing or relating to the accident must be referred to the Director, Rail Infrastructure.

## 5.3 Road Crossings – Construction

a) Install all new crossings at a location approved by the Director, Rail Infrastructure.

b) Construct and maintain every crossing to a safe standard and in accordance with the appropriate standard plans issued and approved for the crossing. The Director, Rail Infrastructure must approve any changes to these plans.

c) Locate all crossings in such The Director, Rail Inf must approve any exceptions.

d) If there is an alternative, do not install rail joints at or near crossings. Where workable, locate rail joints at least 10 feet from the end of the crossing. If necessary, achieve this distance by using rails welded in longer lengths.

e) Install insulated rail joints at crossings as directed by the Signals Manager.

f) When a road crosses more than one track, keep the elevation of the top of the rail on all tracks as close to the same elevation as possible.

g) The Director, Rail Infrastructure selects the type of crossing to be constructed, re-constructed, or maintained, and the materials to be used, based on the speed, type, and volume of traffic (both rail and vehicle) using the crossing. The following table shows the type of construction used for each crossing type:

| CROSSING CONSTRUCTION TYPE BY USE | |
|---|---|
| **Crossing Use** | **Type of Construction** |
| Restricted and infrequently used unrestricted crossings. | One plank on the inside and outside of each rail with a good quality gravel, slag or broken stone ballast used as fill between the inside planks. It's advisable to use planking on the full width of the crossing. |
| Light to medium vehicle traffic. | Fully planked, fully paved (asphalt) or other approved fully covered crossing. |
| Medium to heavily used unrestricted crossings with heavily loaded vehicles, or at other special locations where a heavy-duty crossing is required. | Asphalt fill, fully planked prefabricated timber, concrete slab, or other type of approved fully covered crossing. |

***Figure SUB-PART E – 8 – Crossing Construction Type***

h) At crossings with a very heavy volume of vehicle traffic or with heavy wheel loads, or where unsatisfactory foundation conditions exist, strengthen the crossing foundation with compacted granular fill. Or use other suitable procedures authorized by the Director, Rail Infrastructure.

i) Planking at crossings must be 5 to 6 inches in thickness, depending on the weight of the rail used. Do not use shims unless absolutely required.

j) At crossings carrying heavy vehicle traffic, the thickness of the planks must match the height of the rail (to a maximum of 6 inches).

k) Ballast fill used between the rails and on the road approaches to crossings must be crushed rock, or good quality gravel similar to the ballast used in the track. It must extend at least the full width of the track ballast section.

l) Roadway or vehicle crossing approaches must be constructed and maintained to a smooth and even grade. There must be no unexpected changes to slope or surface.

m) Track ties 9 feet 0 inches or longer must be used in all new construction and major re-constructions at heavily traveled crossings. These ties may also be used at other crossings as directed by the Director, Rail Infrastructure.

n) Carefully inspect the crossing location before constructing a new crossing, or during a major re-construction or major repair of an existing crossing. Replace any defective materials. For example,

   i. Fouled ballast,

   ii. Poor or defective ties,

   iii. Defective or worn rail and OTM / carefully assess the base of the rail for salt / calcium damage,

   iv. Jointed rail with welded rail as directed.

o) In addition:

   i. Make certain that all signs (for example: flanger signs, crossing signs, whistle posts, etc.) are properly installed in accordance with standard plans,

   ii. Attach the Emergency Notification Sign, at all public (and private if applicable) crossings, to one of the crossing posts or signs.

## 5.4 Road Crossings – Without a Warning System

a) A public (and private as applicable) grade crossing without a warning system must have a railway crossing sign. Requirements as follows,

   i. Be constructed as per Transport Canada Grade Crossing Standards. See Appendix H for more information, and

   ii. Located as shown in Figure Sub-Part E – 9,

      i. If Curb or Shoulder: The railway crossing signs must be located between,

         1. 0.3 m (12”) and 2.0 m (6 ½’) from the face of curb, or outer edge of road approach shoulder, and

         2. Located no closer than 3.0 m (9 ¾’) from the nearest rail

      ii. No Curb and No Shoulder: The railway crossing signs must be located between,

         1. 2.0 m (6 ½’) to 4.5 m (14 ¾’) from the edge of the travelled way, and

         2. Located no closer than 3.0 m (9 ¾’) from the nearest rail.

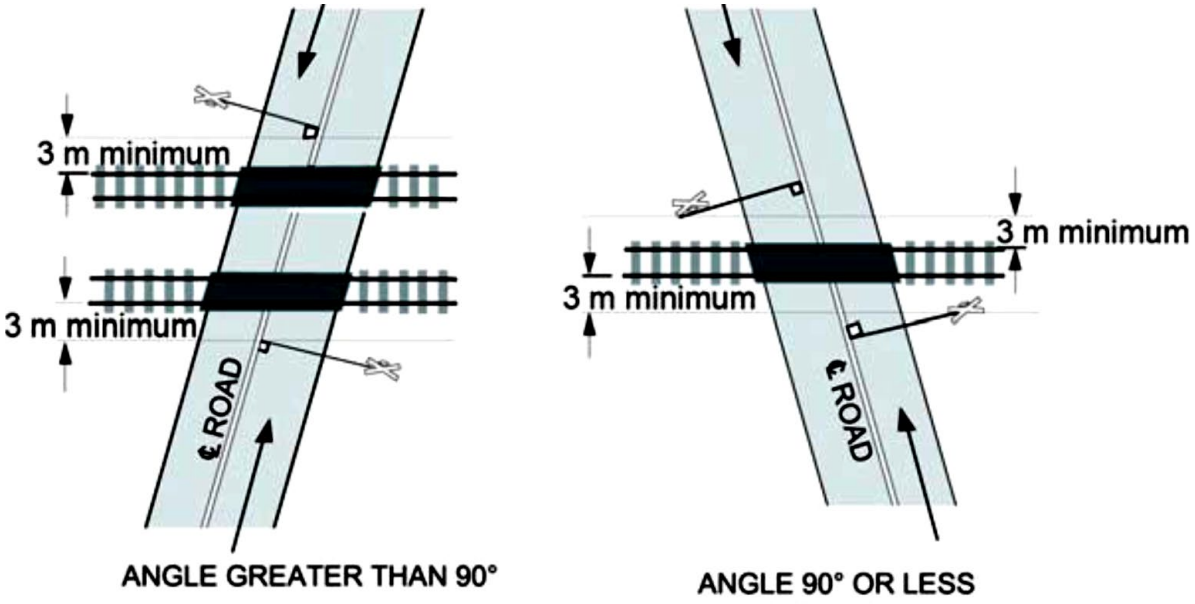



***Figure SUB-PART E – 9 – Location of Railway Crossing Signs***

iii. Must be clearly visible to persons approaching the grade crossing on the road approach,

iv. If there is a sidewalk, path or trail with its centreline more than 3.6 m (12') from a railway crossing sign supporting post beside a road approach for vehicle traffic must have separate railway crossing signs as shown in Figure Sub-Part E - 10.

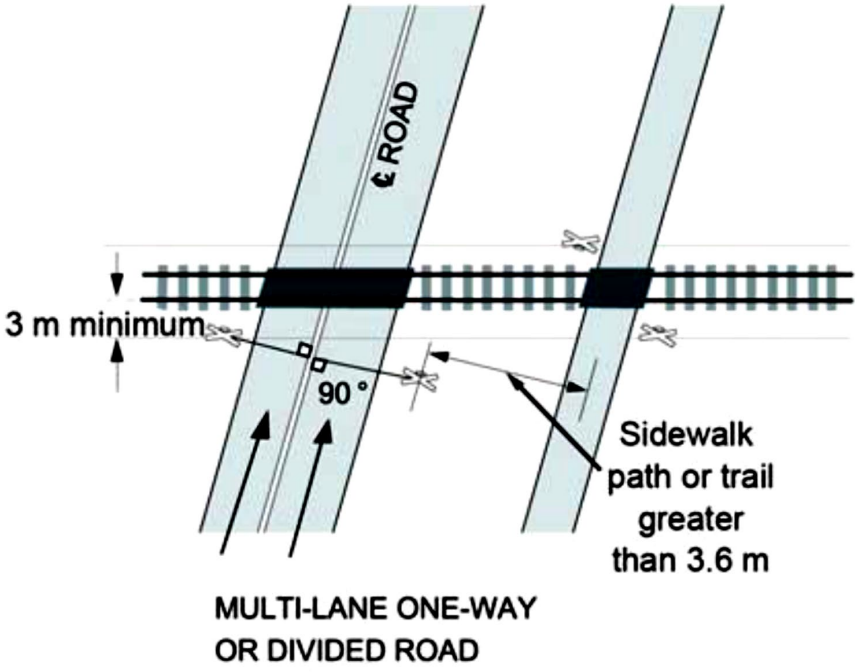



***Figure SUB-PART E – 10 – Location of Railway Crossing Signs (Sidewalk, Path, Trail > 3.6 m)***

v. Where there is more than one track at a grade crossing, an additional sign indicating the number of tracks to be crossed, must be installed on the supporting post of each railway crossing sign as shown in Figure Sub-Part E - 11.

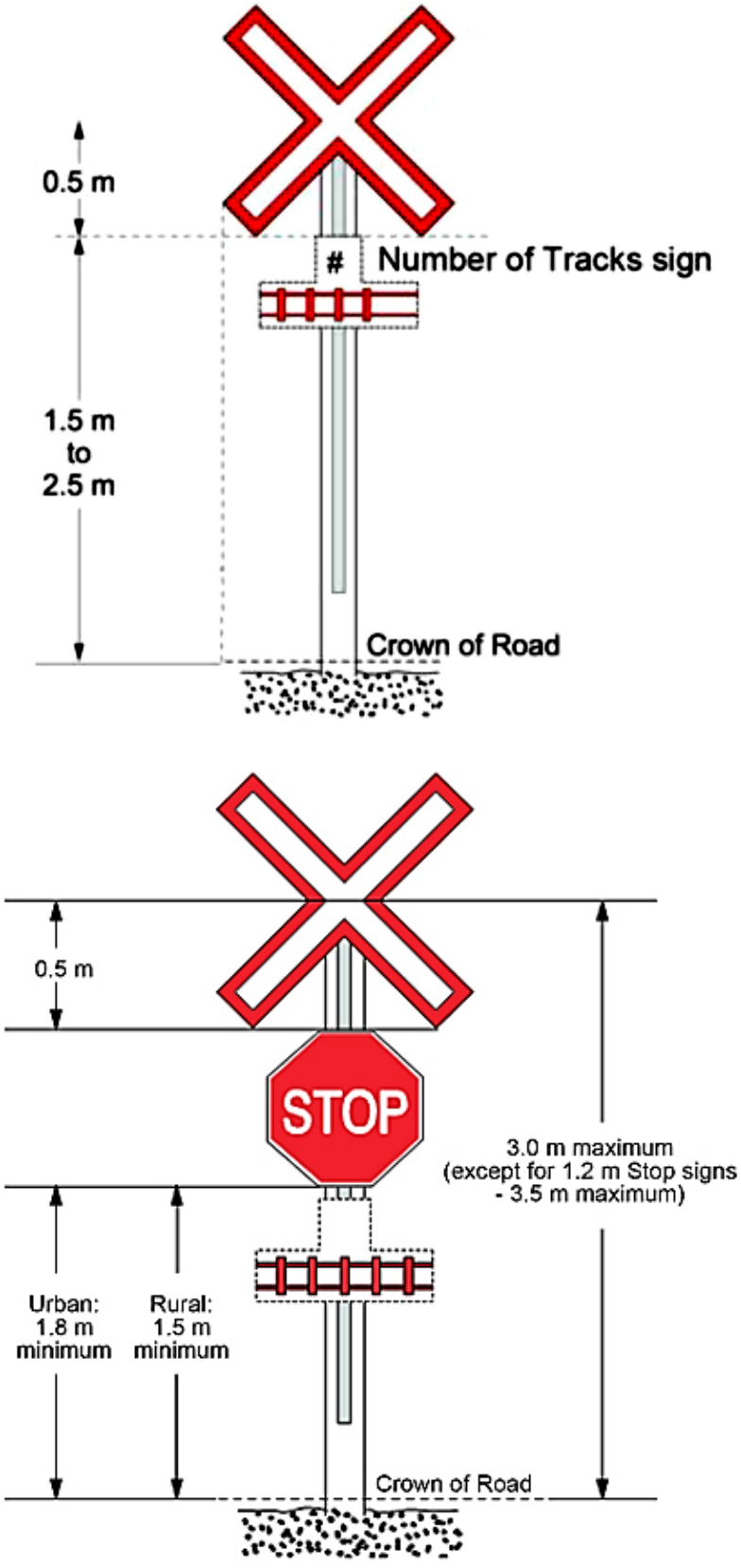



***Figure SUB-PART E – 11 – Rail Crossing Signs (# of Track)***

vi. Reflectorized crossing signboards and whistle posts must be maintained and must not be removed without approval from the Director, Transportation. If damaged or destroyed, they must be replaced promptly.

vii. Emergency Notification Signs must be installed parallel or perpendicular to the road, or on each side of the grade crossing, facing traffic approaching the grade crossing. This sign would indicate the location of the crossing and our emergency telephone number that is clearly legible.


***Figure SUB-PART E – 12 – Emergency Notification Sign Example***

## 5.5 Road Crossings – Maintenance

a) Some costs associated with the maintenance of the crossing may be recovered or shared depending on the Regulatory Order or Agreement.

b) Full details of all construction and maintenance work carried out on crossings, which is chargeable to persons or other parties, must be reported and processed promptly for billing.

c) Carrying Out Work:

When carrying out repair or maintenance work on a crossing, do so without risk to and at a minimum of inconvenience to the public and to crossing users.

i. When necessary, plan with the local road authority or crossing users well before the work is started.

ii. The local road authority and crossing users need to know the nature and extent of the work to be done and the kind of protection to be provided.

iii. If the crossing will be closed temporarily, decide to install barricades, warning lights, and other appropriate safety devices as required. These safety devices must be of the same quality and specifications as those used by the road authority.

iv. Crossing protection must be carried out as per the RAC Circular #13 found within the MW SharePoint ('OneDrive').

d) Drainage:

i. At all times, maintain proper track drainage at all crossings.

ii. Before it reaches the track, redirect surface water flowing along the roadway or on the approaches to the crossing.

e) Roadway Surface:

i. At public crossings, the Railway is responsible for maintaining the surface of the roadway between the rails and for a distance of 18" outside each rail.

ii. At private crossings, the Railway is responsible for maintaining the surface of the roadway for the entire right of way.

f) Track Structure:

i. Properly maintain track surface, line, and gauge at crossings at all times.

ii. Unless otherwise directed, keep flangeways at crossings clear of dirt, sand, snow and ice and other blockages at all times. The use of salt to melt snow in flangeways in signal territory is strictly forbidden.

iii. Crossing rails, planking, spikes, etc. must be checked periodically to make sure they do not present a danger to the roadway or to railway traffic. If a danger exists, appropriate action must be taken to correct the condition.

## 5.6 Road Crossings – Unrestricted (Public)

a) The Director, Rail Infrastructure must approve the construction, widening, and re-location of all unrestricted crossings. The appropriate environmental and regulatory requirements must also be met in addition to the following,

i. Flangeway:

- Must be provided between the gauge side of the rail and the planking or other surface material used for the crossing surface. It must be,
  - 1-7/8 inches *(48 mm)* to 3 inches *(76 mm)* deep, and
  - 2-1/2 inches *(64 mm)* to 4-3/4 inches *(121 mm)* wide.

ii. Road Crossing Surface:

- The planking and/or other road surface used between the rails, and for a distance of at least 18 inches *(457 mm)* on the outside of each rail, must not be less than 26 feet *(7,925 mm)* in length (measured at right angles to the center line of the roadway).
- Length of planking and/or other road surface material (along the track) of the crossing varies with the angle of the highway to the railway. The Director, Rail Infrastructure must indicate the length of planking and/or other road surface to be installed. This information may also be obtained from the plan or drawing approved for the crossing.

- No Shoulders: The planking, and/or other road surface of the crossing must be centered on the traveled portion of the roadway. This surface must extend at least 18" *(457 mm)* beyond and on both sides of the traveled portion of the roadway (measured at right angles to the roadway) as shown in Figure Sub-Part E – 10.

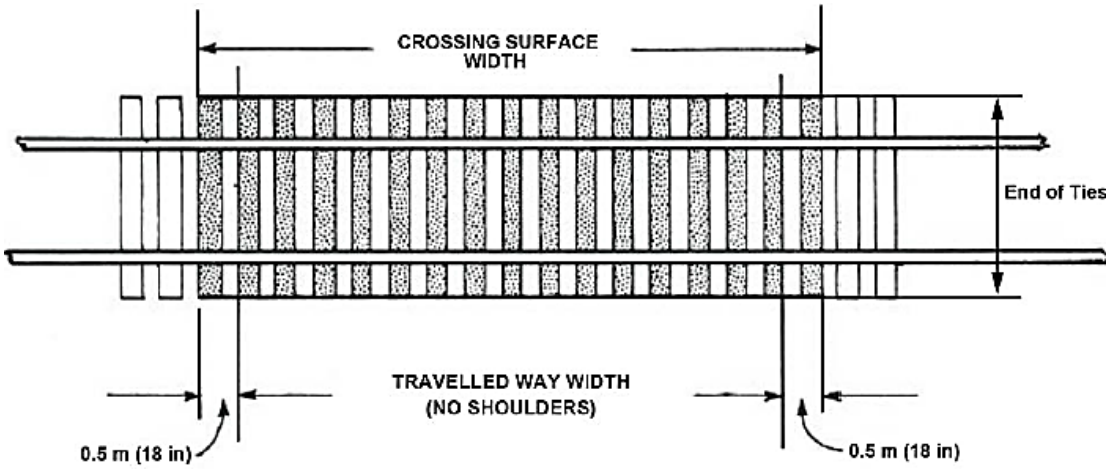



***Figure SUB-PART E – 13 – Crossing Surface with No Shoulders***

- With Shoulders: On unrestricted roads with shoulders, the planking, and/or other road surface of the crossing must extend the full width of the shoulders on both sides of the crossing and an additional 18" *(457 mm)* as shown in Figure Sub-Part E – 11.

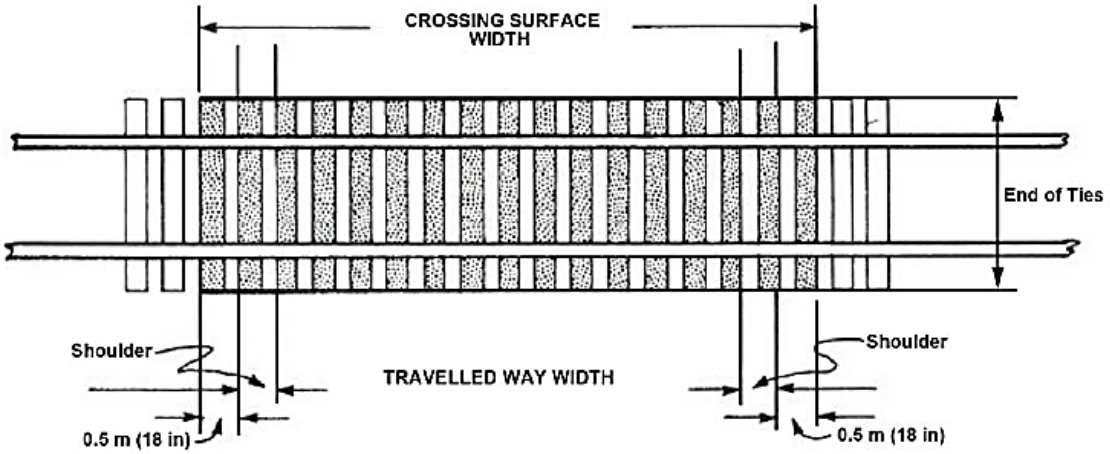



***Figure SUB-PART E – 14 – Crossing Surface with Shoulders***

- With Sidewalk: Where there is a sidewalk within 3' *(914 mm)* of the vehicular portion of the roadway or the shoulder of the vehicular portion of the roadway (with or without curbs) then the crossing surface must extend 18" *(457 mm)* beyond the sidewalk on both ends of the crossing.
- Roadway Surface and Top of Rails: Heavily used (paved or hard surfaced) unrestricted crossings having high-speed vehicle traffic, the top of the roadway surface should be even with the top of the rails throughout the crossing. At other

unrestricted crossings, the top of the roadway surface must not be more than 1" *(25 mm)* higher or lower than the top of the rails throughout the crossing.

- Approach Grade: Unrestricted crossings must have a level section extending 25' from the outside rail, with an approach grade not greater than 5% (1' of rise or fall for every 20' of horizontal length of approach).

iii. Signage: Unless otherwise directed by the Director, Transportation, when a new unrestricted crossing is constructed, install whistle posts and crossing signs (in accordance with standard plans) before the crossing may be opened for use.

iv. Sightlines: Minimum crossing sight lines must be preserved in accordance with the sight line guidelines shown in the Appendix D.

## 5.7 Road Crossings – Restricted (Private)

a) Additional or new restricted crossings, either temporary or permanent, must not be established across any track operated by the Railway without approval from the Director, Rail Infrastructure. New restricted crossings must meet government safety standards.

b) All requests for new restricted crossings must be reviewed to ensure that there is not already safe and convenient access to the property available. This review should consider options such as combining adjacent restricted crossings on a mutual property line.

c) Requirements include,

i. Access Barriers / Gates:

- Restricted crossings, as well as farm gates and other approved access barriers, must be located and installed as directed by the Director, Rail Infrastructure. They must also meet government safety standards.
- Gates on all restricted crossings must be kept closed when not in use.
- Gates frequently left open must be reported to the supervisor.

***IMPORTANT:*** Gates must be locked on crossings where planks have been removed for the season.

ii. Design:

- Restricted crossings must be located at right angles to the track which they cross. Where this is not possible, the Director, Rail Infrastructure must approve a different crossing angle.
- If there is concern about the safety of a crossing, contact the District Manager so the concern may be discussed with The Director, Rail Infrastructure, Signals, and Transportation.

iii. Signage:

- If signage is installed at the restricted crossing, it must meet the Grade Crossing Standards.
- Whistle posts must not be installed at restricted crossings unless, in the opinion of the Director, Rail Infrastructure or Director, Transportation, they make the crossing safer.
- When signs and other forms of grade crossing protection are damaged, they must be promptly repaired or replaced.

iv. Road Crossing Surface:

- For restricted crossings used by slow moving vehicles may only be a maximum of 3" *(76 mm)* below or 1" *(25 mm)* above the top of the rails throughout the crossing.
- At restricted crossings, which are not used during the winter months and where the planks on the inside of the rails are less than 3" *(76 mm)* below the top of the rails, one of the following must be done:
  - The planks must be removed in the fall to permit the operation of snowplows,
  - Flanger signs must be put up along the track on both sides of the crossing.
  - Crossing planks that have been removed from restricted crossings must be replaced in the spring (after snowplows are no longer required).

## 5.8 Road Crossings – Sight Lines

a) Sight line requirements apply to all grade crossings: Public, Farm, Private, and company crossings.

b) Sight lines are the lines of sight between a person on a grade crossing or its road approaches and

i. The grade crossings,

ii. Crossing warning sign signals,

iii. Approaching trains.

c) Assessment of sight lines requires an examination of the road, and knowledge of the types of vehicles using the road and the speed of the trains operating on the tracks.

d) Where heavy vehicles operate on long descending approaches, increase stopping sight distances and sightlines.

e) Minimum sight line requirements must be preserved as per Transport Canada's Grade Crossing Standards.

## 5.9 Road Crossings – Manual Protection

a) It is prohibited to intentionally work within an automatic warning system circuit with uninsulated equipment.

b) To prevent nuisance ringing and mitigating against any complacency on behalf of the public at active crossings, the crossing warning system must be deactivated by Signals personnel while MW or unattended Signals' work is being performed.

i. Steps are to be taken to ensure trains are not operated unprotected over the crossing while the warning system is de-activated.

c) If work is done within the activation range of an automatic warning system due to an emergency or warning system malfunction and Items 5.9 a) and b) previously noted, were not possible, a person or persons with the appropriate training and high visibility vest must be positioned at the grade crossing to advise drivers or pedestrians whether or not it is safe to travel across the railway line since the work may cause the warning signal to go off when no train is approaching or to fail when a train is approaching.

d) Employees shall be governed by procedure and R.A.C. Circular #13 when work is to be performed within the limits of the circuit for a public crossing, the R.A.C. Circular provides clear direction on how that work is to be protected.

e) If the rail crossing warning system fails to operate or does not operate properly,

   i. Traffic at the crossing must be protected by [1]flagging immediately. If the warning device is for more than four tracks, two flagmen shall be used for flagging protection.

   ii. Arrangements must be made by any means available, to advise the Rail Traffic Controller and Signal Maintainer as quickly as possible.

[1]Warning System Fails to Deactivate: To mitigate against complacency of road traffic that may be caused by the unnecessary activation of all or part of the warning system (e.g., lights, bells, and/or gates remain active), flagging must remain in place until the warning system has been deactivated by a Signal Maintainer, even if the Rail Traffic Controller and Signal Maintainer have been notified.

[1]Warning System Fails to Activate: If the entire warning system fails to operate (e.g., lights, bells AND gates are not functioning), flagging at the crossing may be ceased only upon permission of the Rail Traffic Controller and Signal Maintainer and a GBO is placed which provides protection at the grade crossing.

# 6. Clearances

## 6.1 Clearances – Track Centres

a) For new construction, track centres shall comply with the following minimum distances between track centre lines:

| Track Types | Canada |
|---|---|
| Adjacent Main Tracks | 14 ft. |
| Main Track and Siding | 14 ft. |
| Yard Tracks | 14 ft. |
| Passenger Stations Tracks Without Platform in Between | 14 ft. |

***Figure SUB-PART E – 15 – Track Centres***

b) The minimum distance between track centre lines shall be increased to account for curvature and superelevation as follows;

   i. By adding 2” per degree of curve or 12” whichever is the lesser,

   ii. Where superelevation of the outer track exceeds the superelevation of the inner track by adding an additional 2.5” per 1” of difference in curve superelevation.

c) Should it not be possible to construct to the above measurements, the Director, Rail Infrastructure should ensure the proposed encroachment does not impact railway safety and that the Transportation Department is advised of the less than standard centres.

## 6.2 Clearances – Construction

a) A full list of our obstructions can be found in Appendix L of this *Manual* accurate to the date noted.

b) Track center distance must not decrease without authority of the Director, Rail Infrastructure,

c) Existing track centers between the main line and existing adjacent tracks must be maintained to a minimum centerline to centerline distance of 14’ track centers measuring less than 13’ in any location should immediately be reported to the Director, Rail Infrastructure. The clearances for railway bridges and overhead timber bridges shall meet or exceed dimensions on Standard Plans,

d) The Director, Rail Infrastructure shall approve clearances less than those indicated on Track Standard Drawings,

e) For new construction of structures over or beside main tracks the railway requirement is as follows;

   i. Vertical clearance: 23’ 0” (clear headway above the top of the highest rail),

   ii. Horizontal clearance: 9’ 0” (as measured from centerline of track), or as per instructions from the Director, Rail Infrastructure,

   iii. Vertical clearance for overhead wire as per instructions from the Director, Rail Infrastructure.

f) The clearance for industrial and private sidings over which the railway operates shall meet or exceed AREMA Chapter 28, Part 1 Clearance Diagrams – Fixed Obstructions.

## 6.3 Clearances – Maintenance

a) When surfacing or lining track where overhead or lateral clearances are involved (for example, at approaches to the ends of bridges, or alongside signals, fuelling stations and platforms), the general level of the track, its alignment, its curve elevation, and the distance from adjacent tracks must not be changed without the authority of The Director, Rail Infrastructure. Where permanent reference points are situated to indicate the location and elevation of the track, they must be adhered to,

b) In rock cuts, fallen rock can reduce clearance and impact the handling of dimensional traffic. Fallen rock affecting lateral clearance must be removed. If the fallen rock cannot be removed immediately, it must be reported to the Director, Rail Infrastructure and protected against. Ditching programs should also be considered to catch fallen rock.

# Appendix D. Guidelines for Determining Minimum Sightlines at Grade Crossings

**ALWAYS REFER TO TRANSPORT CANADA'S GRADE CROSSING STANDARDS**

The minimum sightline requirements enable grade crossing users to safely see and react to an oncoming train. These requirements apply to all public and private grade crossings.

They are to be measured from a point 1.05 m above the road surface to a point 1.2 m about top of the lowest rail.

The 5 m mentioned in upcoming figures is to allow for different lengths of motor vehicle front ends.

For the purpose of defining sightlines, every crossing has four quadrants created by the angle formed by the intersection of the road and the track. You must determine minimum sightlines for all four quadrants of the crossing so crossing users can see an oncoming train from both road approach directions while they are in the 'approach' and the 'stop' positions.

It is encouraged to provide sightlines above and beyond the minimum requirements.

In addition to establishing unobstructed sightlines, you must:

- Keep sightlines clear of trees, brush and stored materials to protect the visibility of the grade crossing, railway crossing warning signs, signals, and approaching trains; and
- Ensure that highway traffic signs, utility poles and other roadside installations do not obstruct the view of railway crossing signs, signals and warning systems.

In some cases, increasing minimum sightlines to account for factors affecting the acceleration or deceleration of vehicles using the road may be required. Such factors include road gradient and surface condition as well as vehicle weight, length and power.

Notes:

- If the road crossing design speed or the railway design speed differs on either side of the grade crossing, you must make stand-alone calculations for each quadrant.
- Take sightlines for drivers stopped at a grade crossing from a position no closer than 5 metres from the nearest rail, measured from the driver's position in the vehicle.

The railway company is responsible for providing the road authority with its railway design speeds and train volumes.

- The road authority is responsible to provide the railway company with the road crossing design speeds and the design vehicle using the grade crossing.

Since both the railway company and road authority are responsible for providing and maintaining adequate sightlines for their infrastructure, it is very important that both:

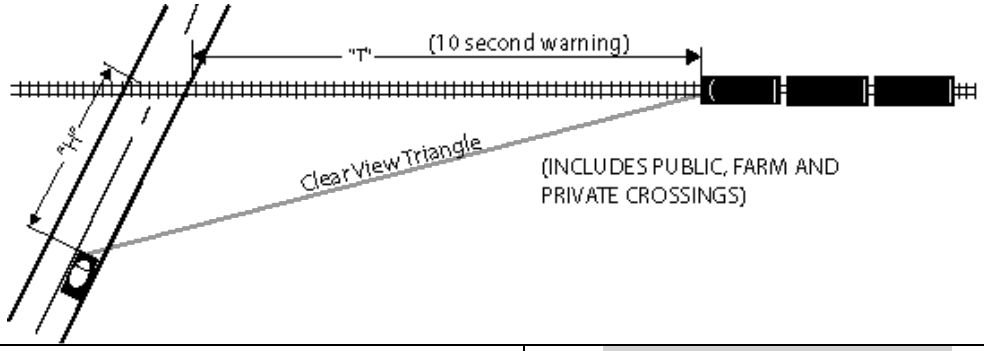
- Are aware of all factors affecting sightlines and ensure that any changes to these are relayed to either party immediately.

**Exceptions and Additional Sightline Requirements:**

Sightline requirements vary depending on the safety attributes at the grade crossing:

- Public or Private grade crossing with a Warning System with Gates:
    - Sightline requirements do not apply but the warning system must be visible throughout the Stopping Sight Distance (SSD).
- Public or Private grade crossing with STOP sign or Warning System:
    - Sightlines are required from the 'stop' position only. The STOP sign and Warning System must be visible throughout the SSD.
- Private grade crossing where the railway design speed is 25 km/h (15 mph) or less and access to the road leading to the grade crossing is controlled by a locked barrier, or the grade crossing is for the exclusive use of the private authority and is not used by the public:
    - Sightline requirements do not apply (however, it is strongly encouraged to provide sightlines at all times); and
- Public or private grade crossing being operated under manual protection (where the road users are stopped by a flag person and the railway equipment must STOP and Proceed at the crossing):
    - Sightline requirements are limited to visibility of the grade crossing throughout the SSD.

**Minimum Sightline Requirements for All Grade Crossings without Automatic Warning Devices**




| Road Traffic – "H" Value | | Rail Traffic – "T" Value (≤ 10 second SSDT) | |
|---|---|---|---|
| **Maximum Vehicle Speed (km/h)** | **Minimum Distance "H" metres *(feet)*** | **Maximum Train Speed (MPH)** | **Minimum Distance "T" metres *(feet)*** |
| Stop or Pedestrian | 5 *(17)* | Stop | 30 *(100)* |
| 20 km/h | 15 *(50)* | 20 m/h | 91 *(300)* |
| 30 km/h | 20 *(66)* | 30 m/h | 136 *(450)* |
| 40 km/h | 35 *(115)* | 40 m/h | 182 *(600)* |
| 50 km/h | 50 *(165)* | 50 m/h | 227 *(750)* |
| 60 km/h | 70 *(230)* | 60 m/h | 273 *(900)* |
| 70 km/h | 90 *(295)* | 70 m/h | 318 *(1050)* |
| 80 km/h | 120 *(394)* | 80 m/h | 364 *(1200)* |
| 90 km/h | 145 *(476)* | 90 m/h | 409 *(1350)* |
| 100 km/h | 175 *(575)* | 100 m/h | 455 *(1500)* |

***Figure Appendix D – 1 – Minimum Sightlines Along Rail Line and Roadway***

** To be increased as required by Notes 3 and 4 below.*

**To Establish Required Clear View Area**

1. Use maximum allowable train and vehicle speeds.
2. View between 1.1 m above road (eye level) to track level.
3. Where gradients within 8 m of rail exceed 5% or heavy or long vehicles regularly cross, clear view from a vehicle stopped at the crossing must also extend a minimum of 50% beyond "T", and more if necessary, so stopped vehicles have sufficient time to start up and cross safely.
4. Where heavy vehicles operate on long descending approaches, increase "H" to 'stopping sight distances'.
5. If clear view cannot be achieved for existing speeds, reduce speed of vehicles or trains until such time as an automatic warning system can be installed.

**ALWAYS REFER TO TRANSPORT CANADA'S GRADE CROSSING STANDARDS**