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North Bay, Ontario
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April 22, 2026

Addendum No. 01

File Reference Number: RFP 2026 028

Title: North Bay Wheel Storage, RIP Track and Adjacent Facilities Upgrade

RE: Clarifications/Questions

CLARIFICATIONS:

Item 1: Please be advised that the following documents and drawings have been added under Appendix I – Reference Reports and Documents of the RFP and are attached at the end of this Addendum as Appendix A.

No.	Description	Date
Reference Reports		
H375313-1000-230-242-00010001	Performance Specification Seacan Storage Container and Shelter	2025-10-21
Reference Drawings		
107-0003	Improved Fair Rail Anchors	2017-02-07
Rail – 115 LB AREMA		
Rail – 90 LB ARAA		
TS – 1325 Spikes	Track and Shimming – Spikes – For Standard Gauge	June 1991
TS – 501 Tie Plates	Tie Plates – Double Shoulder – For 100, 115, 132, 136 LB Rail	March 1991
Reference Documents		
ONTC: Tie Manufacture Specification – Cross and Switch		
ONTC: Manual of Track Requirements		February 01, 2026

This Addendum hereby forms part of the RFP.

Regards,

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

“Appendix A”

Performance Specification
Seacan Storage Container and Shelter

H375313-1000-230-242-00010001

			[p.p] Singh, Harshdeep		Singh, Harshdeep	
2025-10-21	B	Issued for Tender	L. Chen	A. Middleton	H. Singh	Z. Chowdhury
Date	**Rev.**	**Status**	**Prepared By**	**Checked By**	**Approved By**	**Approved By**
HATCH						**Client**

Table of Contents

1. Introduction

1.1 General

This document sets forth the technical and performance specifications for the design, supply, and installation of a tensioned fabric shelter structure, supported by two parallel 40-foot seacan containers, at ONTC facilities in North Bay, Ontario. The solution aims to provide protected exterior parking for vehicles and equipment, with utility accommodations integrated into the seacans.

1.2 Scope of Work

The supplier shall provide two 40-foot seacan containers arranged parallel to one another, with modifications and utilities as specified, and a weather-resistant, tensioned fabric shelter spanning the inter-container space. Deliverables include all engineering, drawings, site-specific load calculations, fabrication, delivery, and (optionally) on-site assembly supervision.

1.3 Definitions

Term	Definition
Owner	The final end user of the building, namely Ontario Northland Transportation Commission (ONTC).
Consultant	The company appointed by the Owner to complete and oversee the project design, namely Hatch Ltd.
Vendor	Modular building company contracted to supply components and services specified in the Package.
Site	The geographical location and geometry of the land upon which the modular building will be built.

1.3.1 Seacan Container: 40-foot ISO steel shipping container, modified as per requirements.

1.3.2 Fabric Shelter: Pretensioned, durable architectural fabric membrane, covering the plan area between seacans, anchored to containers and/or ground.

1.3.3 Parking Area: The covered space between two parallel containers where vehicles and equipment are stationed.

1.4 Abbreviations

Abbreviation	Description
OBC	Ontario Building Code
CSA	Canadian Standards Association
CEC	Canadian Electrical Code
HVAC	Heating, Ventilation, Air Conditioning
ULC	Underwriters Laboratories of Canada1.5 Applicable Codes and Standards

Abbreviation	Description
OBC	Ontario Building Code including Supplementary Standards SB-1, SB-10
CSA S16	Steel Structure Design
CSA A660	Steel Building System Certification
CSA C22.1	Canadian Electrical Code
NBC	National Building Code of Canada

1.5 Applicable Codes and Standards

1.5.1 Ontario Building Code (OBC, current edition), including Supplementary Standards SB-1, SB-10.

1.5.2 CSA S16 (Steel Structure Design); CSA A660 (Steel Building System Certification); CSA C22.1 (Canadian Electrical Code); CAN/ULC fire standards as applicable.

1.5.3 National Building Code of Canada (NBC) for reference and cross-check.

1.5.4 Local municipal and provincial regulations, including snow and wind load requirements for North Bay, ON.

1.5.5 ASHRAE guidelines for insulation and energy efficiency.

1.5.6 Manufacturer’s installation instructions and best practices for tensioned fabric systems.

1.5.7 The Vendor shall be responsible to ensure that the design will meet the standards requirements not limited to above.

1.6 Units of Measure

1.6.1 All calculations, dimensions, and material sizes included in design briefs and on drawings are to be in metric units (SI units) unless specifically noted otherwise.

2. Design Requirements

2.1 Overview

2.1.1 The structure shall operate year-round in North Bay, Ontario, and accommodate extreme temperatures (37°C Summer, -30°C winter), local wind/snow loads, accessibility, and safe operation for Ontario Northland.

2.1.2 Refer General Arrangement Drawing: H375313-1000-230-0006.

2.1.3 The Vendor shall be responsible to validate all the modifications and dimensions in the General Arrangement Drawing - H375313-1000-230-0006.

2.2 Seacan Containers

2.2.1 *Structural Arrangements*

- Vendor shall supply two new, structurally sound 40-foot containers, placed parallel, spaced 6.13 m clear span, and properly leveled and anchored to resist wind uplift and snow drift as per OBC and site conditions.
- Containers shall act as the main lateral and vertical supports for the fabric shelter superstructure.

2.2.2 *Modifications*

Each container shall include:

- Semi-heated internal space: Electric convection or baseboard heaters sized for freeze protection per OBC SB-10 and ASHRAE recommendations, approved by owner.
- Doors and Windows: Roll-up doors and one operable window per long side of each seacan, positioned for cross-ventilation and user access. All windows to be insulated, lockable, and weather sealed.
- Exhaust Fan Opening: Outer wall of each container equipped for exhaust fan (wall sleeve/ducted with insulated dampers) to maintain Seacan areas under negative pressure relative to their surroundings as per ANSI/ASHRAE Standard 62.
- Electrical Service: Refer to electrical requirements section.
- Exterior Finish: Surface protection for northern Ontario weather (industrial enamel or equivalent, anti-corrosive).
- All hardware shall be heavy duty, commercial grade hardware.

2.2.2.1 Compressed Air Connection

Mechanical drawing (H375313-1000-240-270-0001) shows the approximate location of one Utility Post (Details on Drawing H375313-1000-240-260-0002). One container shall include a rigid, labelled, supported pipe consisting of the following:

- DN20 exterior Chicago fitting for hose connection to exterior utility post.
- DN20 interior ball valve for isolation.
- DN20 interior Chicago fitting for hose connection to small, compressed air equipment.

Exact compressed air connection location shall be coordinated with mechanical contractor and client, based on exterior utility post connection. Compressed air connection penetration shall be adequately insulated/flashed.

2.3 Fabric Shelter System

2.3.1 *Structural Fabric Design*

- Membrane: High-tensile PVC-coated polyester fabric, minimum 610 g/m², UV-resistant, flame retardant to CAN/ULC-S109 or equivalent; 15 years pro-rated warranty.

- Support Structure: Hot-dip galvanized or powder-coated steel arch or rigid frame, designed for snow and wind loads per OBC/NBCC for North Bay, Ontario.

- Fabric to be tensioned over/between the seacan roof rails with steel/aluminum extrusion or proprietary attachment system, sealed against water/snow ingress at all connection lines.

2.3.2 *Doors and Openings*

- Vehicle Access Roll-up Door: One full-width roll-up motorized door.

- Personnel Door: Minimum one lockable man-door in fabric wall or seacan end, clearly marked for egress.

- Back Fabric Wall: Opposite end fully covered with fabric, tensioned and fixed to prevent snow/rain ingress but allow pressure equilibration; sealed to containers/sill.

2.3.3 *Coverage and Weather Protection*

- Shelter footprint to span full clear area between, above, and slightly beyond exterior faces of the containers.

- Integrated water drainage system (gable or arch) to direct runoff away from container sides and parking bay.

2.4 Shelter/Parking Area Requirements

- Minimum unobstructed bay width and length to allow entry, parking, for ONTC's largest equipment/vehicles (supplier to coordinate dimensions).

- Electrical Service: Refer to electrical requirements section.

2.5 Safety and Fire Protection

2.5.1 *Floor Assemblies*

Seacan floor finish: heavy duty non-slip coating.

2.5.2 *Roll up Doors*

2.5.2.1 Metal Finishes: Free from defects, clean and unstained, and of uniform colour.

2.5.2.2 Supply hardware complete with all necessary screws, bolts and other fastening of suitable size and type to anchor the hardware in position neatly and properly in accordance with best practices and to the Owner's approval.

2.5.2.3 Warrant work against defects in materials and quality of performance for a period of 5 years.

2.5.3 *Personnel Door Hardware*

2.5.3.1 Metal Finishes: Free from defects, clean and unstained, and of uniform colour.

2.5.3.2 Supply hardware complete with all necessary screws, bolts and other fastening of suitable size and type to anchor the hardware in position neatly and properly in accordance with best practices and to the Owner's approval.

2.5.3.3 Doors shall have glass view panels.

2.5.3.4 Personnel door shall be heavy duty metal doors.

2.5.3.5 Warrant work against defects in materials and quality of performance for a period of 5 years.

2.5.4 *Windows*

Windows shall be operable triple glazed units in thermally broken vinyl frames, complete with low E argon filled cavities. Frame Colour: White.

2.6 Structural Requirements

2.6.1 *General*

2.6.1.1 The proposed structures shall meet the requirements of the OBC.

2.6.1.2 The structure shall be of modular construction to minimize construction work on site.

2.6.1.3 These structures shall be designed for rigging, lifting, transportation, erection, and installation on a site built permanent foundation.

2.6.1.4 The Vendor shall be responsible for all structural design to be carried out in accordance with the OBC and the related structure design codes and standards and as noted in this specification.

2.6.1.5 The Vendor shall provide all the structural members, connections, fasteners as required to resist all the loads from the occupancies and equipment and other loads based on the OBC. Special loads other than those listed in the OBC will be provided during the design process as required.

2.6.1.6 The Vendor shall be responsible for the rigging, lifting and transportation design of the modular building to ensure that the building structure is capable of resisting all loads during rigging, lifting and transportation.

2.6.1.7 The Vendor will be responsible for the layout planning and anchorage design of the connections of the prefabricated units to the foundations. The Vendor shall provide the structural system between underside seacan to foundation pad. The Vendor shall provide the required foundation layout and the foundation loads for all the structure design loads to the Consultant for pad design. The foundations for the main lateral load resisting systems shall be clearly marked on the foundation layout drawing.

2.6.1.8 The vendor shall provide the proposed design live loads and live load breakdown for all floor and roof areas, for review and agreement prior to the structural design.

2.6.1.9 The structure and components and their anchorages (electrical, mechanical etc.) shall be designed to meet the seismic requirements in the OBC.

2.6.2 *Design Loads*

2.6.2.1 The structure and all parts shall be designed and constructed to support safely all loads and load combinations defined, according to OBC. The buildings shall be designed according, but not limited, to the following loads:

- Importance category: Normal.
- Live loads shall be according to OBC, but not less than following:
  - Equipment loads, including piping and electrical components.
  - Roof Live Load: 1.5 kPa (minimum) and equipment load as applicable.
  - Seacan Container floor occupancy Live Load: 6 kPa.
- Seismic loads: building and components shall be designed for seismic forces as per OBC for Site Class D.
- Snow load shall be according to OBC. If Part 4 snow load is used, then refer to site layout for adjacent roof structures.
- All anticipated forces during load-out, rigging, lifting, and transportation of modules.
- Concrete slab (supplier responsible for specifying all structural load requirements).

2.6.3 *Material*

2.6.3.1 Steel framing members with infills shall be designed as per OBC and CSA-S16.

2.6.3.2 When welded steel structures form part of the structures of these buildings; the manufacturer will be required to obtain certification from the Canadian Welding Bureau (CWB) to the requirements of CSA W47.1 standard.

2.6.3.3 Clean, prepare surface, shop prime and finish coat structural steel in accordance with CAN/CSA-S16.

2.6.3.4 Shelter fabric to meet flame-retardancy requirements per regulatory standard.

2.6.4 *Submission*

2.6.4.1 Construction and manufacturing shop drawings shall be prepared and stamped by engineer registered in the province of Ontario and submitted for approval to the Owner prior to construction or fabrication.

2.6.4.2 Shop drawings shall show all modules in plan, elevation, and section, including details, attachments to other work and joint details to be performed on site.

2.6.4.3 Structural drawings showing details of roof including arrangement of secondary members shall be provided.

2.6.4.4 Structural drawings showing details of columns, truss, joist, anchor bolts, and connections shall be supplied by manufacturer and stamped by an engineer registered in the province of Ontario.

2.6.4.5 Structural drawings shall include a table with reaction forces under ULS and SLS load combinations at support locations to be used for foundation design.

2.7 Fire Protection Requirement

2.7.1 *Fire Suppressions Requirements*

2.7.1.1 Design, supply, installation and testing of fire protection systems shall comply with the requirements of the OBC and NFPA. All equipment shall be ULC listed, and FM approved.

2.7.1.2 The fire protection system, structure, and components shall meet the seismic requirements OBC.

2.7.1.3 Portable fire extinguishers shall be provided for all areas (Seacans and Parking) in accordance with OFC and NFPA 10, Standard for Portable Fire Extinguishers

2.7.2 *Fire Detection and Alarm Requirement*

2.7.2.1 Fire detection and alarm system shall be designed, supplied, and installed in all areas (Seacans and Parking).

2.7.2.2 All components including detectors, pull station and horns and strobes shall be provided.

2.8 Electrical Requirements

2.8.1 Buildings (Seacans and Parking area) within this Package shall be provided with electrical power, lighting, grounding, and services in accordance with Ontario Building Code (OBC), Ontario Electrical Safety Code (OESC), and the Canadian Electrical Code CSA C22.1, Workplace Electrical Safety (CSA Z462), and other applicable codes/standards.

2.8.2 The building shall contain 480/277V panel board, and all services downstream, supplied by others, as indicated on the Site Layout drawing. The vendor shall be responsible for providing load calculations for the building to assist with sizing the transformer. The vendor shall provide all power services except the content defined on the Site Layout drawing and provide electrical connections (120/208V and 480/277V) to the associated panels in the building.

2.8.3 The building shall comply with Ontario Building Code (OBC) requirements for life safety emergency exiting, including but not limited to:

- Exit signage.
- Emergency lights.

2.8.4 A sufficient number of electrical services and process receptacles shall be provided in all areas where applicable.

2.8.5 The Vendor shall include the details of the proposed lighting system (lighting fixtures, lighting switches, conduits/wiring, etc.) and illuminance in each building area for review by the Owner, the lighting requirements to comply with Illuminating Engineering Society of North America Lighting Handbook (IESNA). Lighting fixtures shall be LED throughout.

2.8.6 A grounding system and a means of protection for the Structure shall be provided for personnel, equipment, and the electrical power system inside the Seacan.

2.8.7 All equipment provided shall be CSA approved, and large equipment shall bear the CSA label.

3. Execution

3.1 Design and Drawings

3.1.1 Supplier must provide stamped engineering drawings and site-specific load/calculation data for approval by ONTC or their consultant prior to manufacture.

3.2 Fabrication

3.2.1 The buildings in this Package shall consist of prefabricated, modular units, complete with finishes, fixtures, as necessary.

3.2.2 The prefabricated, modular units shall be constructed and delivered to allow for suitable access to building areas, including ceiling space, where significant Site installation work is required.

3.2.3 Preassembly at factory (if feasible); site works include final anchoring, tensioning, and fit-up.

3.2.4 All fittings, mechanical equipment, electrical devices, fixtures, and equipment used shall be CSA approved.

3.3 Painting and Surface Protection

3.3.1 The Vendor shall provide surface preparation and painting systems including all labour, supervision, tools, equipment, cleaning and paint materials and all other materials required to provide an effective protection against corrosion of all supplied equipment.

3.3.2 The Vendor shall submit to the Owner, for approval, a painting specification for all components, including sub-supplied equipment.

3.4 Inspection and Testing

3.4.1 *General*

3.4.1.1 The Vendor shall supply their standard inspection and test plan (ITP), according to the relevant construction codes, to the Owner for review and approval. ITPs shall be provided for all key activities and tasks.

3.4.1.2 The Owner and Vendor shall jointly develop and agree on the acceptance criteria for the factory acceptance test (FAT).

3.4.1.3 The Vendor shall perform all tests and inspections necessary to ensure that the material and workmanship conform to Owner's requirements, design, and codes of construction. The Vendor is responsible for ITP on all equipment, including sub-supplied equipment. All inspection reports shall be made available to the Owner for review, if requested.

3.4.1.4 Acceptance of shop tests shall not constitute a waiver of requirements to meet the field performance under specified conditions, nor does inspection in any way relieve the Vendor of his responsibility.

3.4.1.5 Vendor shall carefully and continuously control and test the quality of the materials and the manufacturing operations during the production of the equipment, in order to ensure that the equipment will comply with the requirements of the purchase order and code of construction.

3.4.1.6 The Owner's inspector shall have the right to request additional inspection or examination if required to ensure that the equipment complies with the relevant specification and codes.

3.4.1.7 The Vendor is responsible for notifying all sub-suppliers of the inspection and testing requirements. No material or equipment shall be sent to the Site until the Owner has issued a release note for shipment.

3.4.2 *Rejection*

3.4.2.1 The Owner's inspector has the authority to request repairs or alterations, if in his/her opinion the materials or workmanship do not meet the required specifications.

3.4.2.2 Equipment, parts, or materials indicating a defect originating in Vendor design, materials, and workmanship, or being in conflict with requirements of this document, will be subject to rejection.

3.4.2.3 The Vendor shall not prepare the rejected equipment for shipment until approval has been granted by the Owner.

3.5 Marking, Packaging and Shipping

3.5.1 The building components shall be delivered in the minimum economic number of assemblies. Each assembly shall be complete, tested, and pre-commissioned in accordance with the requirements in the contract document, taking due account of preservation and transport requirements.

3.5.2 The Vendor shall be responsible for prevention of any possible damage of the structure components during shipment.

3.5.3 It is the Vendor's responsibility to ensure that proper transport is utilized to deliver the building components to Site.

3.5.4 The Vendor shall provide marking, packing, and shipping procedure(s), including sample packing slip, for Owner review and approval.

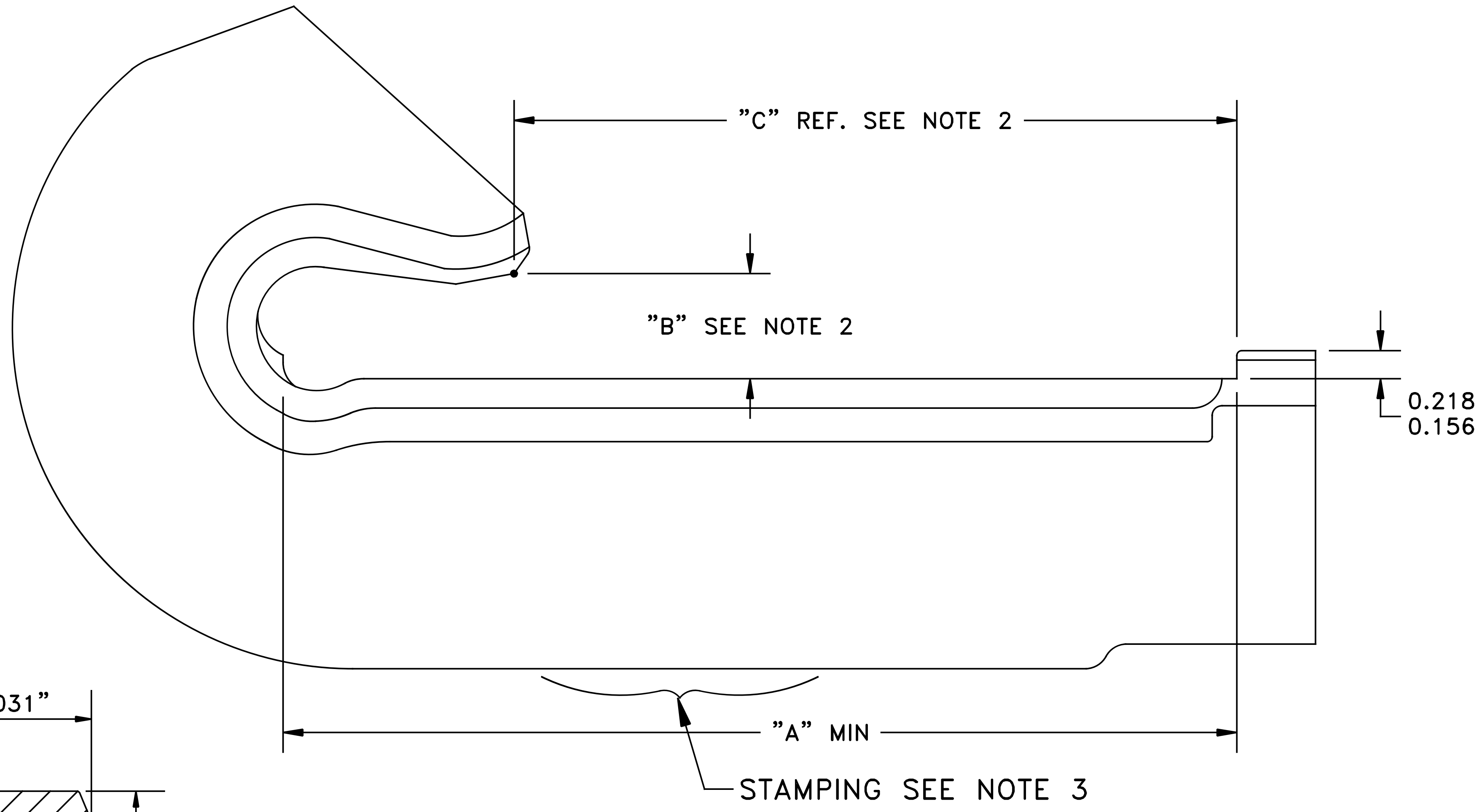
3.5.5 The building components may be stored outside in northern winter conditions. It is the Vendor's responsibility to ensure it's packed for that, cover all opening to stop dust and dirt from entering and snow from entering if transported in winter months. cap all electrical in a way that it can be reconnected. ensure all door, windows are locked. send pictures once shipment is ready for being loaded and once loaded for approval.

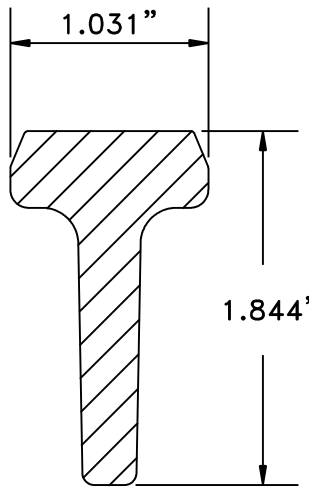
3.5.6 The modules dimensions and structural loads shall comply with the Truck Weight Classifications and Restrictions in Ontario.

END OF SECTION

RAIL SECTION	DIMENSIONS "A"	"B"max	"B"min	"C"	PART NUMBERS IMPROVED FAIR
132-6 RE	6.062	0.692	0.652	4.594	600-026XX-01
130 REHF	6.062	0.723	0.683	4.594	600-038XX-01
130 PS	5.562	0.819	0.779	4.094	600-035XX-01
127 DUD	6.312	0.630	0.590	4.844	600-046XX-01
115 RE	5.562	0.692	0.652	4.094	600-070XX-01
105 DUD	5.562	0.546	0.506	4.050	600-094XX-01
100 RA	5.562	0.630	0.590	4.094	600-124XX-01
100 CPRE	5.437	0.645	0.605	3.969	600-130XX-01
100 RE	5.437	0.645	0.605	3.969	600-130XX-01
90 RA	5.187	0.614	0.574	3.719	600-160XX-01

RAIL SECTION	DIMENSIONS "A"	"B"max	"B"min	"C"	PART NUMBERS IMPROVED FAIR
85 STD	5.062	0.630	0.590	3.594	600-178XX-01
85 ASCE	5.250	0.552	0.512	3.782	600-168XX-01
85 RA	4.937	0.677	0.637	3.469	600-196XX-01
80 ASCE	5.062	0.526	0.486	3.594	600-202XX-01
80 CNOR	5.062	0.558	0.518	3.594	600-206XX-01
80 RA	4.688	0.677	0.637	3.219	600-216XX-01
80 ABS	4.688	0.587	0.547	3.219	600-753XX-01
75 ASCE	4.876	0.549	0.509	3.407	600-228XX-01
75 OBS	4.875	0.562	0.522	3.147	600-766XX-01
65 OBS	4.500	0.532	0.492	2.833	600-765XX-01





AS ROLLED SECTION
(FOR REFERENCE ONLY)

NOTES:

1. ALL DIMENSIONS IN INCHES.
2. DIMENSIONS "B" AND "C" ARE VERIFIED BY THE USE OF THE RAIL ANCHOR GAUGE.
3. RAIL ANCHORS TO BE STAMPED WITH THE RAIL SECTION AND YEAR OF MANUFACTURE.
4. PART NUMBERS SHOWN ARE FOR BASE UNIT "XX" IS FOR PACKAGING. CALL FOR OPTIONS

SPECIFICATIONS:

MATERIAL: A.I.S.I. C-1060 STEEL
HARDNESS RANGE: 311-401 BRINELL
HOLDING POWER AS PER AREMA SPECIFICATIONS

ISSUE	DATE	REVISION	BY
5	FEB. 07, 2017	TABLE AND SPECS CHANGED	SAS
4	MAR 24, 2016	ADDED 65 OBS UPDATED 75 OBS	RGA
3	JUN 16, 2015	ADDED RAIL SECTIONS	RGA
2	DEC. 4, 2014	REVISED PART NUMBERS	RGA
1	DEC. 3, 2014	ISSUED	RGA

LBFoster
Rail Technologies

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:
DECIMALS .XX± ——— .XXX± ———
ANGLES ±——— FRACTIONS ±———

NAME
IMPROVED FAIR®
RAIL ANCHORS

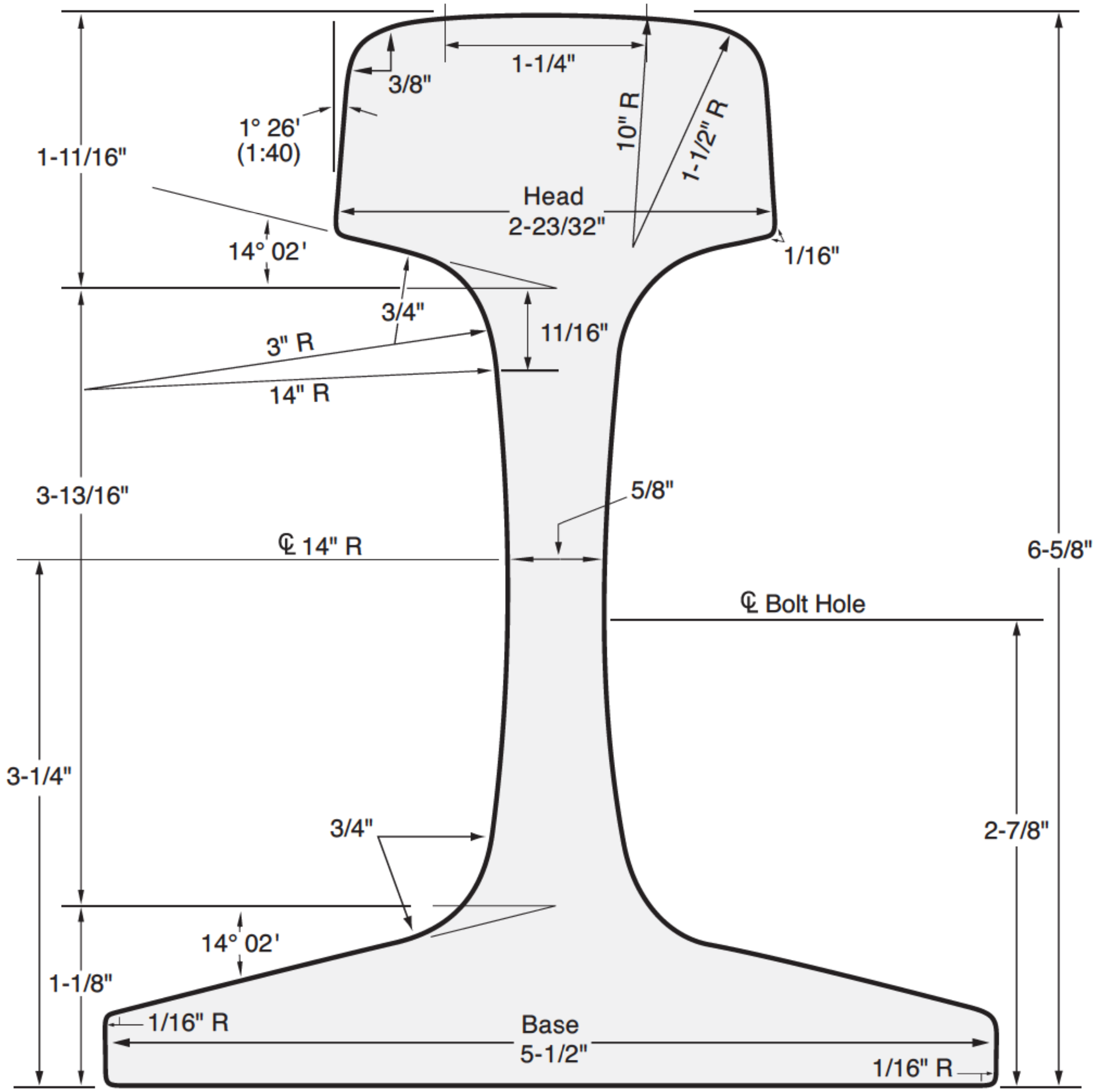
DR. RGA | CK. GB | AP. | DATE DEC. 4, 2014 | DWG. NO 107-0003 | ISSUE 5

DO NOT SCALE DRAWING | SCALE NONE | SIZE B

\DWG\ANCHOR\CUSTOMER\107-0003.DWG

115–lb. AREMA

Shown Actual Size



Rail Type:	115 RE
Section Number:	11525
Nominal Weight:	115 lbs/yd
Standard Length:	39', 80'
Standard Drilling:	3-1/2" X 6" or 3-1/2" X 6" X 6" with 1-1/8" dia. holes
Joint Bar Length:	24" or 36"
Joint Bar Weight:	**4-Hole bars:** 68 lbs/pr **with hardware:** 76 lbs/pr
	6-Hole bars: 102 lbs/pr **with hardware:** 110 lbs/pr
Track Bolt:	1" X 6"

Area in^2: 11.25

Section Modulus in^3:
Head: 18.0
Base: 22.0

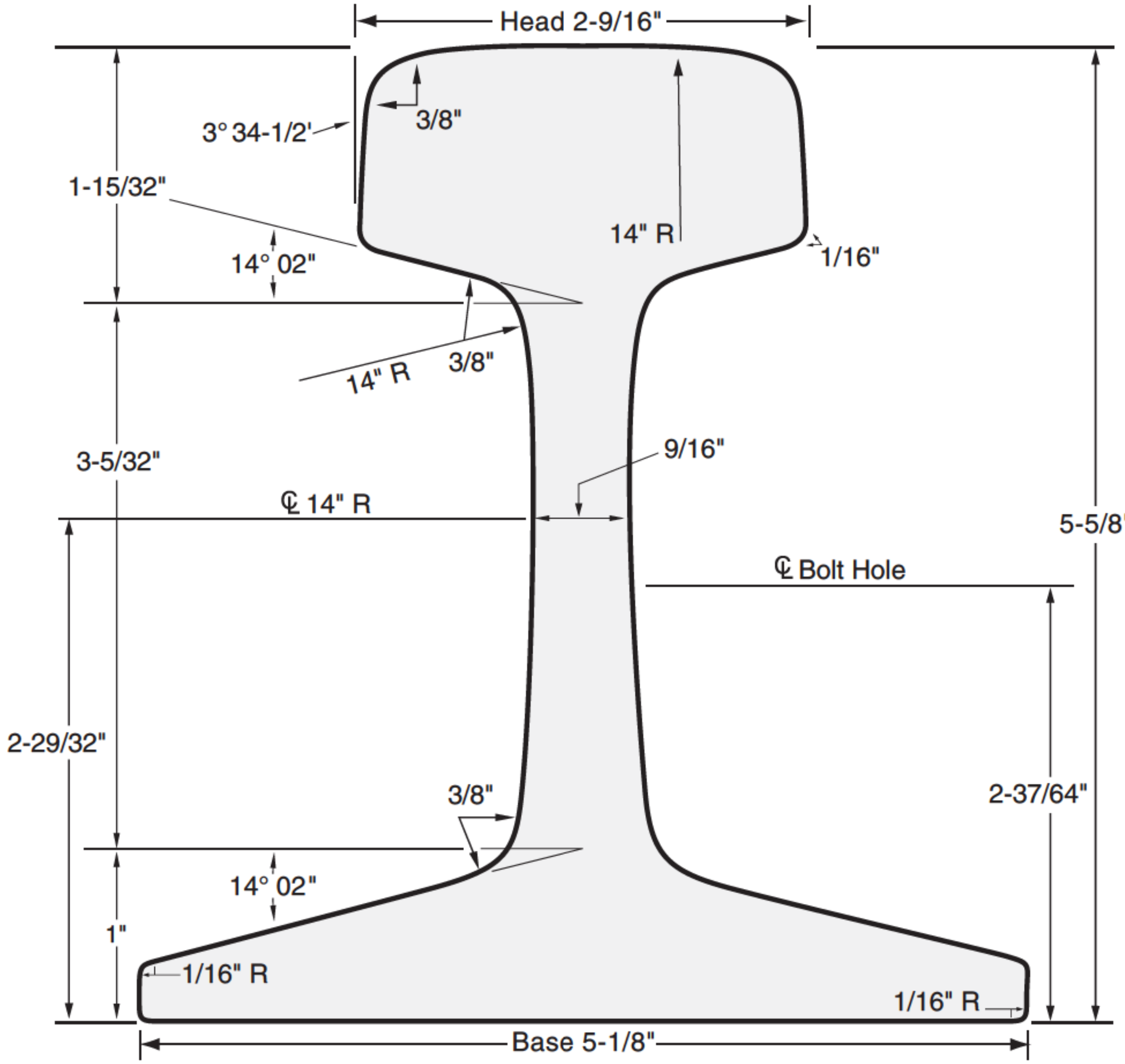
Moment of Inertia in^4: 65.6

BOLT SIZE MAY VARY DEPENDING ON BAR MANUFACTURE & TYPE OF WASHER USED.

www.HarmerSteel.com sales@harmersteel.com (503) 286-3691 FAX (503) 286-2097

90–lb. ARA–A

Shown Actual Size



Rail Type:	90 RA
Section Number:	9020
Nominal Weight:	90 lbs/yd
Standard Length:	39’
Standard Drilling:	2-11/16” X 5-1/2” with 1-1/8” dia. holes
Joint & Angle Bar Lgth:	24”
Angle Bar Weight:	60 lbs/pr **with hardware:** 67 lbs/pr
Joint Bar Weight:	46 lbs/pr **with hardware:** 53 lbs/pr
Track Bolt:	7/8” X 5”

Area in^2: 8.82
Section Modulus in^3:
Head: 12.6
Base: 15.2
Moment of Inertia in^4: 38.7

BOLT SIZE MAY VARY DEPENDING ON BAR MANUFACTURE & TYPE OF WASHER USED.

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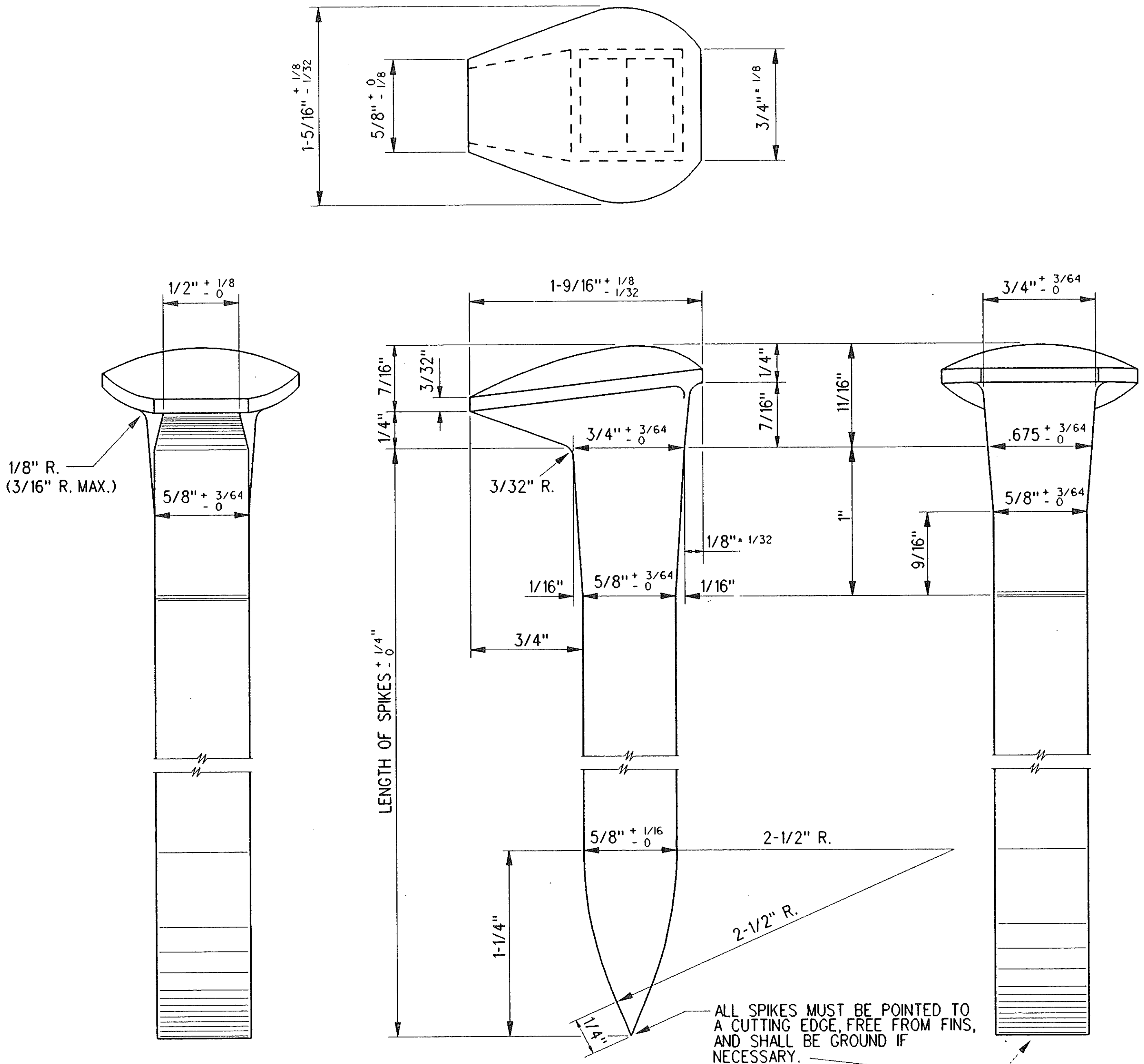
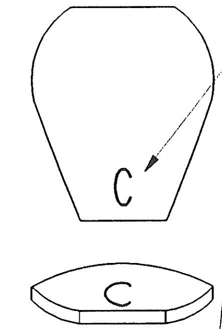
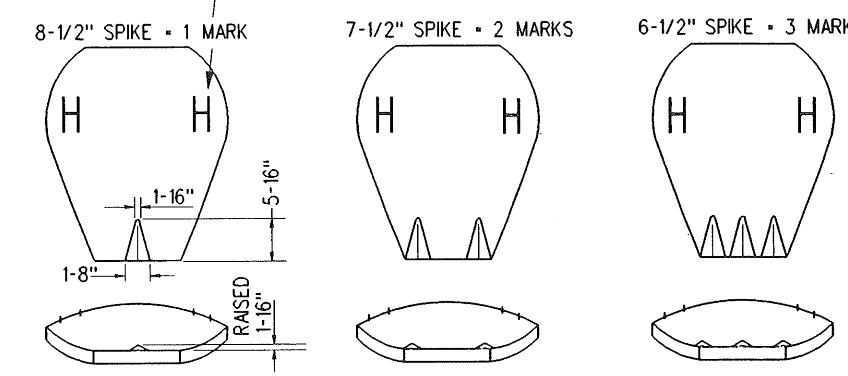




THE MANUFACTURER'S IDENTIFICATION LETTER MUST APPEAR CLEARLY ON ALL SPIKES IN POSITION SHOWN. LETTERS TO BE 1/4 " HIGH AND RAISED 1/32 ".

C - DOMINION STEEL & COAL CORP. LTD.
E - PREMIER STEEL PRODUCTS LTD.
H - STEEL COMPANY OF CANADA LTD.
V - PACIFIC BOLT MAN-WESTERN CAN. STEEL.
- NORTRAK LTD.

IDENTIFICATION MARKINGS FOR TRACK SPIKES



IDENTIFICATION MARKINGS FOR SHIMMING SPIKES

NOTES

- ALL SPIKES TO BE MANUFACTURED IN ACCORDANCE WITH SPECIFICATION 12-6 LATEST DATE.

THIS DRAWING SUPERSEDES DRAWING NO. S10C-8.1 DATED NOV. 15, 1962 & S10C-8.2 DATED FEB. 1, 1962

No.	Date	Revision
4	JUNE'91	"DISPONIBLE EN FRANCAIS" ADDED.
3	APR.'90	V CHANGED TO PACIFIC BOLT MAN-WESTERN CAN. STEEL.
2	JAN.'89	NOTES REVISED, MARKING UPDATED.
1	JAN.'74	TOLERANCES ALTERED.

Standard / Norme

TRACK & SHIMMING
SPIKES
FOR STANDARD GAUGE

Drawn / Dessin MR.C. Checked / Verification G.W.M. Approved / Approbation [signature] Chief Engineer

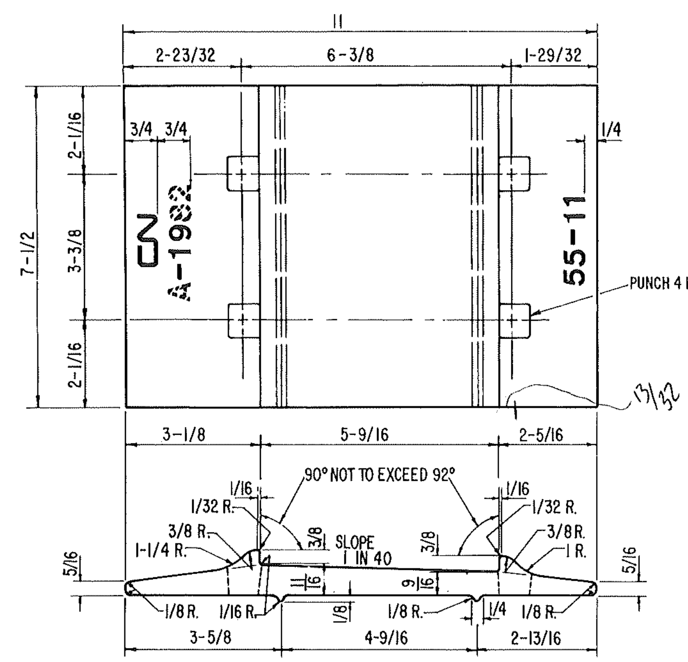
Office of Chief Engineer
Bureau de l'Ingenieur en Chef

Date SEPT.'73 Plan Number / Dessin numero TS - 1325

ITEM	LENGTH	STOCK NUMBERS		WEIGHT
		NEW	PARTLY WORN	
TRACK SPIKE	5-1/2	01-03-012	01-03-013	0.750 LB.
TRACK SPIKE	6	01-41-014	01-41-015	0.813 LB.
SHIMMING SPIKE	6-1/2	01-03-018	01-03-019	0.875 LB.
SHIMMING SPIKE	7-1/2	01-03-021	01-03-022	1.000 LB.
SHIMMING SPIKE	8-1/2	01-03-024	01-03-025	1.125 LB.

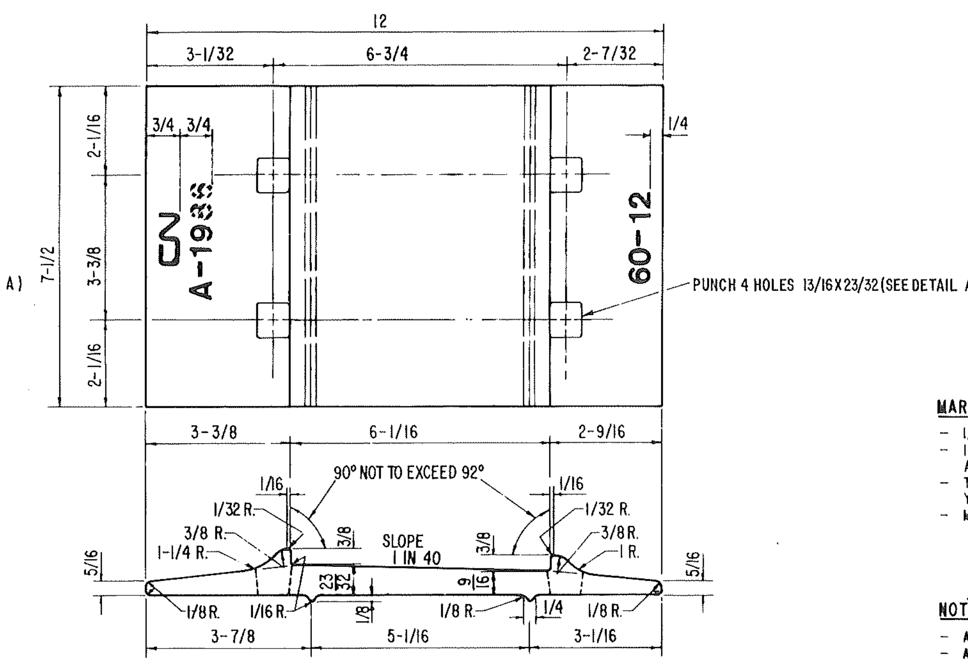
DISPONIBLE EN FRANCAIS

FILE: 1325.ts



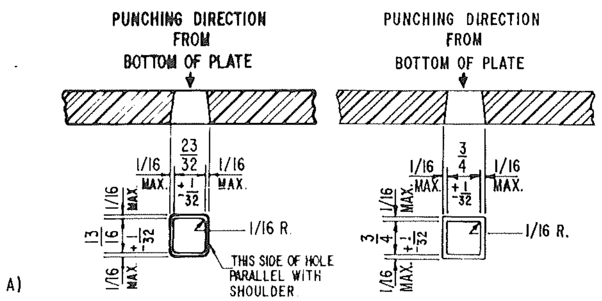
WEIGHT: 13.12 LBS/PLATE — STOCK NUMBER: NEW 01-24-036, P/W 01-24-037

11" TIE PLATE FOR 100/115 RAIL-5-1/2" BASE WIDTH



WEIGHT: 14.57 LBS/PLATE — STOCK NUMBER: NEW 01-24-033, P/W 01-24-094

12" TIE PLATE FOR 130/132/136 RAIL-6" BASE WIDTH



DETAIL A — DETAIL B

TOLERANCE DETAILS OF SPIKE HOLES

MARKINGS:

- 1/2" CN SYMBOL TO BE BRANDED PLAINLY ON EACH PLATE.
- 1/2" MIN. PLATE IDENTIFICATION CHARACTERS TO BE BRANDED PLAINLY AS SHOWN.
- THE MANUFACTURERS IDENTIFICATION LETTER AND THE FIGURES OF THE YEAR TO BE BRANDED PLAINLY IN 1/2" MIN. CHARACTERS ON EACH PLATE.
- MANUFACTURERS IDENTIFICATION LETTERS:
  - A – ALGOMA STEEL CORPORATION, LTD.
  - H – STEEL COMPANY OF CANADA, LTD.
  - D – SYDNEY STEEL CORPORATION
  - S – ARKANSAS STEEL ASSOCIATES (SUMITOMO)

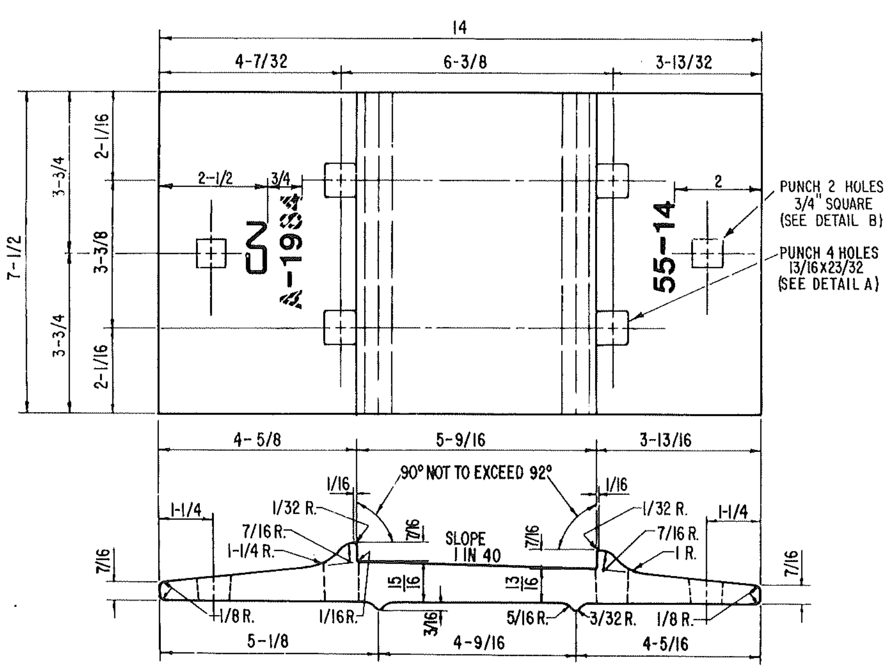
  ALL CHARACTERS SHALL BE RAISED. 1/32"

NOTES:

- ALL PLATES TO BE IN ACCORDANCE WITH LATEST C.N.R. SPECIFICATION 12-2.
- ALL DIMENSIONS ARE IN INCHES.

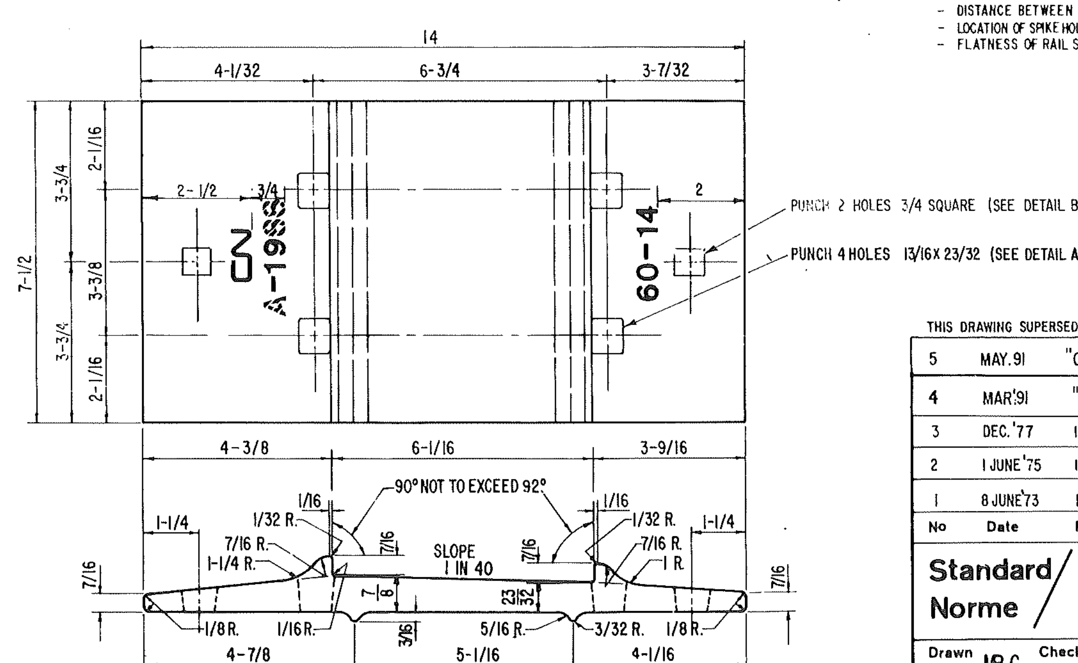
TOLERANCES

	OVER	UNDER
– THICKNESS	1/32	1/32
– ROLLED WIDTH	1/8	1/8
– SHEARED LENGTH	3/16	3/16
– DISTANCE BETWEEN SHOULDERS	1/16	0
– HEIGHT OF SHOULDERS	1/64	1/32
– SIZE OF SPIKE HOLES	1/32	1/32
– DISTANCE BETWEEN SPIKE HOLES	1/32	1/32
– LOCATION OF SPIKE HOLES FROM GAUGING SIDE	1/32	1/32
– FLATNESS OF RAIL SEAT	0.025	0.025



WEIGHT: 22.22 LBS/PLATE — STOCK NUMBER: NEW 01-24-091, P/W 01-24-110

14" TIE PLATE FOR 100/115 RAIL-5-1/2" BASE WIDTH



WEIGHT: 20.[illegible] LBS/PLATE — STOCK NUMBER: NEW 01-24-090, P/W 01-24-109

14" TIE PLATE FOR 130/132/136 RAIL-6" BASE WIDTH

THIS DRAWING SUPERSEDES DRAWING NOS. S-13C-5.1, -45.1, -45.2, -46.1, -46.2

No	Date	Revision	
5	MAY.91	"C.N.R." CHANGED TO "CN"	(JM)
4	MAR.'91	"S" MARKING ADDED.	(JM)
3	DEC.'77	136 LB. RAIL ADDED.	
2	1 JUNE '75	14" TIE PLATES WERE PUNCHED 8 HOLE – NOW 6 HOLES.	
1	8 JUNE '73	14" TIE PLATES WERE PUNCHED 6 HOLE – NOW 8 HOLES.	

Standard / Norme

TIE PLATES
DOUBLE SHOULDER
FOR 100, 115, 132 AND 136 LB. RAIL

Drawn / Dessin: M.R.C. — Checked / Vérification: N.A.M. — Approved / Approbation: Chief Engineer

Office of Chief Engineer
Bureau de l'Ingénieur en chef

CN RAIL

Date: 18 FEB. 1971 — Drawing Number / Dessin numéro: TS-501

Tie Manufacture Specification – Cross and Switch

Material and Manufacture

1. Harwood ties shall be made from beech, maple, ash, oak and birch.
2. All ties must have a boxed heart. Ties manufactured by halving or quartering large logs are not acceptable.
3. All ties shall be made from sound, live, straight timber and shall be free from the following:

   - Decay and Rot
   - Large Knots
   - Unsound Knots
   - Splits over 3”
   - Shakes
   - Slanting Grain
   - Large or Numerous Holes

4. All Ties shall have bark completely removed.

Dimensions

1. Track ties shall be eight (8) feet long with the following face dimensions at the narrowest point:

No. 1 Ties	Shall be squared with dimension of seven (7) inches thick with nine (9) inches width of face.
No. 2 Ties	Shall be squared with dimensions of six (6) inches thick with eight (8) inches width of face.

   Variations of one-half (1/2) inch over in thickness will be permitted. Ties may have wane one-half (1/2) inch wide on one or both corners of one side only.

2. Length Tolerance
   a) Cross ties – plus one (1) inch
   b) Switch ties – plus two (2) inches, minus one (1) inch

Machining of Cross Ties

Adzing – Hardwood Ties

1. No adzing required on any tie.

Boring – Harwood Ties

1. No boring is required for any tie.

Creosote Treatment

1. Seven (7) pounds per cubic foot of 50% creosote and 50% petroleum, or;
2. Kopper Creosote Petroleum Solution (Pressure Applications)
3. The ONTC will not be accepting ACZA ties (Crossties / Switch Ties) until we determine if the product is acceptable for our use.

Trimming

1. Trimmed ties shall be cleanly sawed at both ends to the specified length as they pass through the boring and adzing machine.

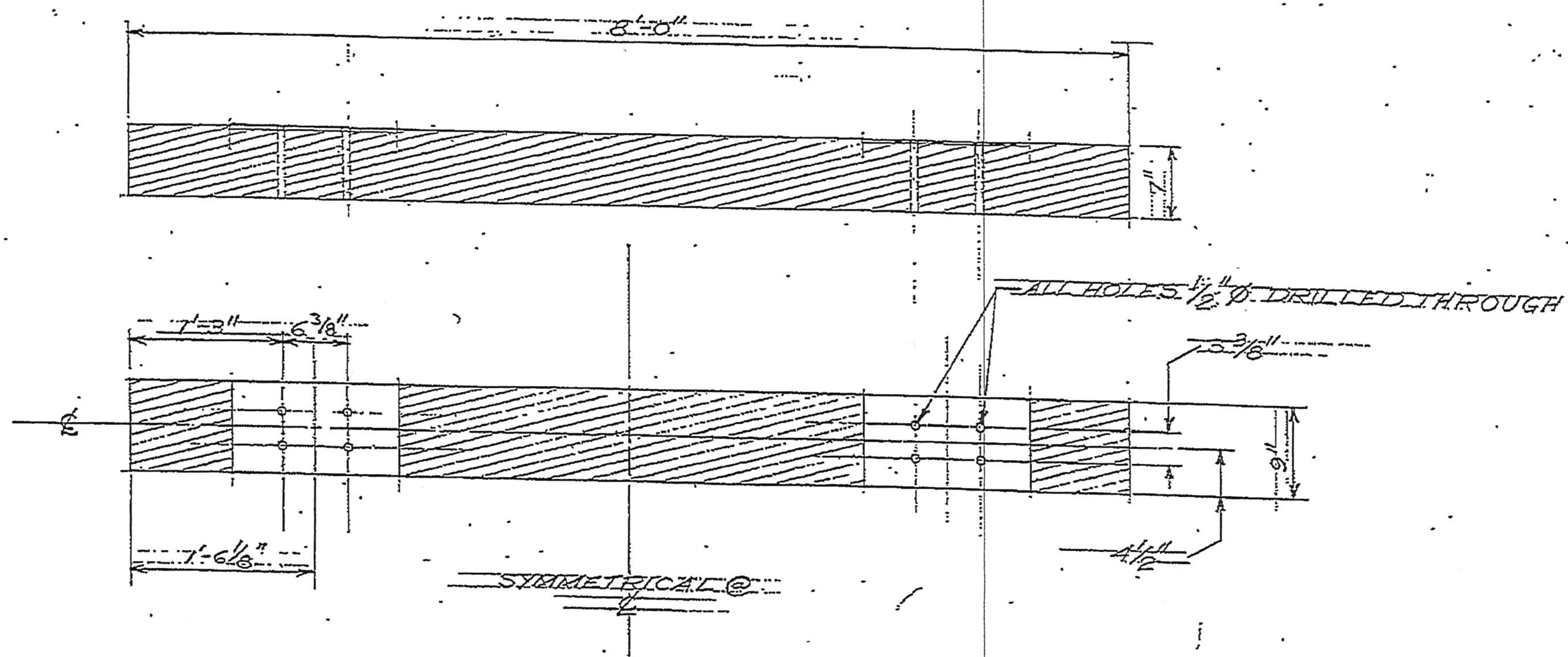
Branding

1. Branding of the ends of ties as the pass through the machine shall be with letters, figures, or symbols to indicate the following:

   Year: 2026
   Railway: O.N.R.

2. Letter height shall be approximately 1 ½ inches. Dies used for branding shall have a cutting edge of 1/8 inches wide shall indent the wood at least ¼ inch deep

Ontario Northland Railway
Office of the Director Rail Infrastructure September 25, 2023



LOCATION

DESCRIPTION 8'-0" No.1 HARDWOOD CROSS TIE BORING TO BE READ IN CONJUNCTION WITH SPECIFICATION

REVISED PAL - 01/2011

DRAWN S

TRACED

CHECKED

ONTARIO NORTHLAND RAILWAY

ENGINEERING DEPARTMENT — NORTH BAY, ONTARIO

CHIEF ENG.

SCALE 1"=1'-0"

DATE JANUARY 1988

NO. A-4585

MANUAL OF TRACK REQUIREMENTS

Revision Date: January 8, 2026

Approved Date: January 12, 2026

Effective Date: February 1, 2026

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 (internal)
09	2025-09	Manual overhaul including, - 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) TB P.Eng (external) *(stamped approval available at Training and Regulatory Affairs)*
10	2026-01	Corrections including, - Removal of outdated references, *Sub-Part C - Figure* numbering, included switch point guard criteria, updated untested rail speed restrictions to be consistent across Manual, road surface criteria updated at grade crossings, Appendix D	PAL (internal) TB P.Eng (external) *(stamped approval available at Training and Regulatory Affairs)*

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)

TABLE OF CONTENTS

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INDEX OF FIGURES

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PART I – GENERAL

1. Scope and Application

1.1. This rulebook contains the minimum requirements for managing track owned and operated by *Ontario Northland*. Conditions on track must equal or exceed the minimum requirements laid out in this document, as well as those laid out in the *Transport Canada* *Rules Respecting Track Safety.* Where conditions on track do not comply with these requirements action must be taken to:

a) Bring the track into compliance,

b) Reduce speed to such that is in compliance,

c) Halt operations over the track or,

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

i. 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.**

1.2. Requirements are standards, practices and procedures which MUST be followed to ensure safety and/or to comply with regulation, or action MUST be taken to protect the condition, as above.

1.3. When any person, including a contractor, performs any function required by these rules, that person is required to perform that function in accordance with these rules.

1.4. This *Manual of Track Requirements* is issued by the Director, Rail Infrastructure and may only be altered on their authority.

1.5. Changes in railway requirements or practices that do not conflict with Transport Canada standards, may be implemented on a phased schedule or program under the direction of the Director, Rail Infrastructure.

1.6. Each employee responsible for the maintenance and/or inspection of track owned and maintained by *Ontario Northland* must be trained and pass a qualifying test in these requirements.

1.7. All personnel responsible for the inspection or maintenance of track must have access to this manual while performing these duties.

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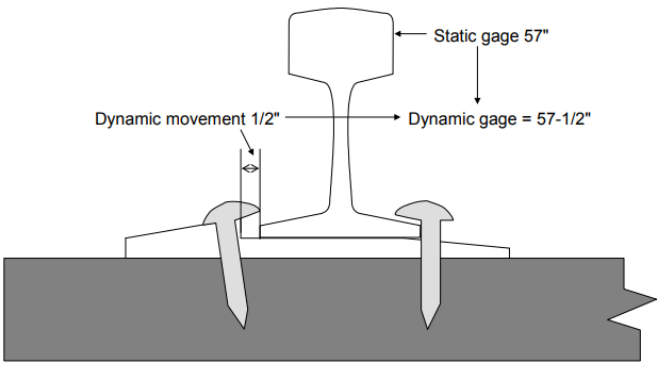
2. Transport Canada Rules Respecting Track Safety

2.1. These mandatory Rules were issued to establish minimum standards which ensure safe operation of trains on standard gauge track operated on or used by Canadian railways and are applicable to all of *Ontario Northland*'s operations.

2.2. Track conditions must equal or exceed these minimum standards.

2.3. When unloaded track is measured to determine compliance with the requirements of these rules, the amount of rail movement which occurs while the track is loaded must be added to the measurements of the unloaded track.

- In addition to the static (unloaded) geometry measurements taken, the amount of visually detectable dynamic (loaded) deflection that occurs under train movement must be considered. This includes the amount of vertical or lateral rail deflection occurring between a rail base and a tie plate or a tie plate and a crosstie; from voids between the crosstie and ballast section resulting from elastic compression; or any combination of the above. Each deflection under the running rails must be measured and properly considered when computing the collective deviations under load. It is very important that consideration be given to both rails when measuring these deflections.



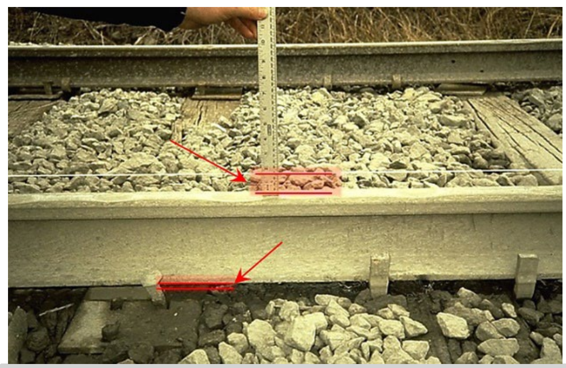


Figure PART I – 1 – Examples of Rail Movement Affecting Gauge (left) and Affecting Surface (right)

2.4. A full copy of the *Rules Respecting Track Safety* are contained at the end of this manual or through corporate SharePoint. These Rules may be cited as the *Track Safety Rules (TSR)*.

2.5. The railway may adopt additional or more stringent requirements than those contained in the *Track Safety Rules.*

2.6. In the event of a discrepancy between the *Manual of Track Requirements* and the *Rules Respecting Track Safety*, the most restrictive standard will apply.

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

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3. Interpretations (Definitions)

3.1. **Adjustment Length** is the amount that rail is to be adjusted based on the length of rail removed.

3.2. **Alignment** is the measurement used to describe the line uniformity (straightness) of the rails in a horizontal plane. The measurement for alignment shall be the maximum mid ordinate, (positive or negative), in inches, of a 62’ *(18,900 mm)* or 31’ *(9,500 mm)* chord measured at the gauge point. On a curved track the high (outside) rail is used as the line rail.

3.3. **Backpack Pump**, for the purposes of fire prevention and suppression and its application under the Industrial Operations Protocol, means a container with a minimum of 18 litres of water which is equipped with a serviceable single action hand pump to disperse the water.

3.4. **Balanced or Equilibrium Speed** is the train speed that results in equal vertical dynamic loadings on the high and low rails of a curve.

3.5. **Ballast Car** is a hopper style rail car (rolling stock) which distributes ballast from the under side of the rail car.

3.6. **Ballasted Track** is a section of track where the tie cribs and shoulders are comprised of consolidated track ballast which provides adequate vertical, lateral, and longitudinal restraint of the rail.

3.7. **Battered Rail End** is a flattening down and widening of the rail head at the end of a rail.

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

3.9. **Bolted Rail** includes welded rail, in lengths up to and including 90’ *(27,432 mm)* which are joined by joint bars.

3.10. **Branch Line** is identified as Agrium and Iroquois Falls Subdivisions for rail classification purposes.

3.11. **Broken Base** is any break in the base of a rail.

3.12. **Bumping Post** is a device at the end of a stub track to prevent rolling stock from going off the ends of the rails.

3.13. **Census Metropolitan Areas (CMAs)** means population centres defined and published by Statistics Canada as core (i.e. at least 50,000 persons) and secondary core (i.e. at least 10,000 persons) of CMAs.

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

3.15. **Compound Fissure** means a progressive fracture originating from a horizontal split head that turns up or down, or in both directions, in the head of the rail. Transverse development normally progresses substantially at a right angle to the length of the rail.

3.16. **Compromise Bars** are rail joint bars connecting rails of different heights and sections.

3.17. **Continuous Welded Rail (CWR)** is rail welded into lengths of 400’ *(121,920 mm)* or more.

3.18. **Corrugation** is a repetitive longitudinal pattern of shallow wavelike depressions along the rail surface.

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

3.20. **Crossing Surface** means the part of a road that lies between the ends of a railway tie and that has the width shown in Figure 5-1 of the Grade Crossings Standards.

3.21. **Crossover** means a track joining adjacent main tracks, or a main track and another track.

3.22. **Crushed Head** is a short length of rail, not at a joint, which has drooped or sagged across the width of the rail head and the sagging or drooping is also visible in the head/web fillet area. Crushed head occurrences have no repetitive regularity and thus do not include corrugations and have no apparent localized cause such as a weld or engine burn.

3.23. **Damaged Rail** is any rail broken or damaged by derailment, defective rolling stock, slipping or similar causes including by track units or off-track equipment.

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

3.25. **Destressing Rail** is the operation of removing rail or adding steel in continuous welded rail, to make the longitudinal thermal stress equal (within specified limits) to what it would be if laid stress-free at the preferred rail laying temperature. A rail's neutral temperature is re-adjusted to the desired value.

3.26. **Detail fracture** means a progressive fracture originating at or near the surface of the rail head. These fractures should not be confused with transverse fissures, compound fissures, or other defects which have internal origins. Detail fractures may arise from shelled spots, head checks, or flaking.

3.27. **Deviation requiring a one-class speed reduction** means any measured deviation that exceeds the limits of the current class of track but does not exceed the limits of the class of track that is one class below the current class of track.

3.28. **Deviation requiring a two-class speed reduction** means any measured deviation that exceeds both the limits of the current class of track and the limits of the class of track that is one class below the current class of track;

3.29. **Diamond (railway crossing)** is an intersection of two tracks at grade with no connecting route between the two tracks.

3.30. **Dynamic Track Stabilizer** is a combination of horizontal vibration and vertical load applied to the track which accelerates the initial track settlement immediately after maintenance work.

3.31. **Engine Burn Fracture** means a progressive fracture originating in spots where driving wheels have slipped on top of the rail head. In developing downward these fractures frequently resemble the compound or even transverse fissures with which they should not be confused or classified.

3.32. **Fire Danger Level in Canada** is the fire danger level shown for the area on the interactive map that, as part of the Canadian Wildland Fire Information System, is published on the Department of Natural Resources website or on any other Government of Canada website. If more than one fire danger level is shown for the area on the interactive map, the fire danger level for the area that is the highest indicated level shall be used.

Note: If provincial fire risk differs from federal, the more restrictive will apply.

3.33. **Fire Equipment Cache**, for the purposes of fire prevention and suppression and its application under the Industrial Operations Protocol, contains at least one pumping unit and three shovels located centrally for worksites within a 10 km radius or less.

3.34. **Fire Hazard** per the Prevention and Control of Fires on Line Works Regulations, means, (a) fuel or combustible material, including vegetation, that is found along a line work and that has a fast-burning rate and could readily ignite; and (b) conditions, including topography, that are present along a line work and that increase the likelihood of a fire igniting on the line work or spreading from the line work into the surrounding environment.

3.35. **Fire Intensity Codes in Ontario**, as part of the Industrial Operations Protocol, indicate a different rate with which a fire would burn and a different left of difficulty in controlling or suppressing a fire (A – Extreme Fire Danger, B – Very High Fire Danger, C – High Fire Danger, D – Moderate Fire Danger and E – Low Fire Danger).

3.36. **Fire Watch** is the person assigned to observe a location during and after work with means of communication. Must be equipped with sufficient firefighting equipment to suppress flare-ups and be stationed in a safe position to fight fires as work is being performed and upon its completion for at least one hour (if required per the Ministry of Natural Resources and Forestry's Industrial Operations Protocol).

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

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

3.39. **Gauge** is the perpendicular measurement between the gauge faces (inner sides) of the two running rails taken at 5/8" *(16 mm)* below the centre of top of rail head. Standard gauge is 56 ½" *(1,435 mm)* on tangents and curves up to 14°.

3.40. **Gauge Face Wear** is loss in rail width measured on the gauge side of the rail 5/8" *(16 mm)* from the top of the worn rail. For rail that is not transposed, the gauge face wear equals the lateral rail wear.

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

3.42. **Guard Rail** is rail installed on bridges, high embankments and other designated locations as a safety appliance. They are intended to contain and guide a derailed truck, keeping the vehicle upright on the track structure. Guard rails are also installed on turnouts to protect the frog.

3.43. **Harmonic (Rock and Roll)** is type of defect created through a series of low staggered joints that causes the motion on rolling stock.

3.44. **Head Wear (Vertical Wear)** is the reduction in the total height of the rail compared to the nominal rail section, measured in the centre of the head of the rail.

3.45. **Head Web Separation** is a progressive fracture longitudinally separating the head and web of the rail at the fillet under the head.

3.46. **Heat of the Day** is the time of day that the rail temperature is expected to be at its highest (e.g., usually between 1100 and 2200 hours).

3.47. **High-Risk Work** means work that involves the use of a rail-grinding train or the controlled burning of brush as defined by the Prevention and Control of Fires on Line Works Regulations. Employees who conduct or supervise contractors 'high-risk work' must be trained on the prevention and control of fires.

3.48. **Higher Risk Key Train** means any Key Train that includes loaded tank cars carrying crude oil or liquefied petroleum gases, as defined in the Transportation of Dangerous Goods Act, 1992, in a continuous block of 20 or more tank cars or 35 or more tank cars dispersed through a train.

3.49. **Horizontal Split Head** is a horizontal progressive defect originating inside of the rail head, usually ¼" or more below the running surface and progressing horizontally in all directions, and generally accompanied by a flat spot on the running surface. The defect appears as a crack lengthwise of the rail when it reaches the side of the rail head.

3.50. **Hot Work** is any activity as defined in the Ministry of Natural Resources and Forestry's Industrial Operations Protocol. May involve cutting, grinding, welding, pin-brazing, or open flames and sparks.

3.51. **Inactive Track** means a track used less than once per month and secured in a manner that will prevent use by train or movements.

3.52. **In-Service Rail Failure** is any type of rail break or rail weld failure in normal service.

3.53. **Industrial Operations Protocol** is the Ontario Ministry of Natural Resources and Forestry's protocol which provides direction on how to prevent industrial caused wildfires and expedite the suppression of any fires occurring on or near industrial worksites in forested areas. The protocol is a supplement to the Industrial Operations portion of Ontario Regulation 207/96 "Outdoor Fires". All matters requiring interpretation, the regulation should be consulted.

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

3.55. **Interlocking** is an arrangement of interconnected signals and signal appliances for which interlocking rules and special instructions are in effect.

3.56. **Joints** are locations where two rail ends meet and are connected with a joint bar, or by other means. Jointed rail shall be laid with staggered joints.

- **Permanent Joints** are fully drilled and bolted. For all joints in CWR, every tie is box anchored for a minimum of 200' *(6,100 mm)* in each direction.

- **Temporary Joints** are joints which are expected to be removed from track or are intended to be welded. In CWR, all holes are drilled except those nearest the rail ends. A joint gap not exceeding 3/8" *(10 mm)* is to be left with four bolts installed in the outer most holes of the joint. Temporary Joints must be welded or made into Permanent Joints within 3 years of being installed.

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

- **Suspended Joints** have the centre of the joint located between ties.

3.57. **Key Route** means any track on which, over a period of one year, is carried 10,000 or more loaded tank cars or loaded intermodal portable tanks containing dangerous goods, as defined in the Transportation of Dangerous Goods Act, 1992 or any combination thereof that includes 10,000 or more loaded tank cars and loaded intermodal portable tanks.

3.58. **Key Train** means an engine with cars that includes one or more loaded tank cars of dangerous goods that are included in Class 2.3, Toxic Gases and of dangerous goods that are toxic by inhalation subject to Special Provision 23 of the Transportation of Dangerous Goods Regulations; or that includes 20 or more loaded tank cars or loaded intermodal portable tanks containing dangerous goods, as defined in the Transportation of Dangerous Goods Act, 1992 or any combination thereof that includes 20 or more loaded tank cars and loaded intermodal portable tanks.

3.59. **Lateral Wear** is the loss in rail head width measured as the difference between a new rail profile and the worn rail profile across the rail head 5/8" *(16 mm)* below the top of the worn rail.

3.60. **Line of Track or Track** means a railway of any length including yard tracks, sidings, spurs, and other tracks auxiliary thereto, and including the right-of-way and the structures supporting or protecting the track or facilitating drainage from the track.

3.61. **Localized Surface Collapse** means a short length of rail, not at a joint, which has flattened out across the width of the rail head. LSCs have no repetitive regularity and thus do not include corrugations and have no apparent localized cause such as a weld or engine burn. Their individual length is relatively short, as compared to a condition such as head flow on the low rail of curves.

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

3.63. **MGT (Million Gross Tons)** means the total weight that travels over a section of track.

3.64. **Movement(s)** the term used in these Rules to indicate that the rule is applicable to trains, equipment, transfers, or engines in yard service.

3.65. **Occupied Passenger Train** means a train consisting of one or more passenger cars that is transporting passenger(s) in revenue service.

3.66. **Ordinary Break** is a partial or complete break in which there is no sign of a fissure, and in which none of the other rail defects are found.

3.67. **No Test Rail** is rail that the rail flaw detector car is unable to test.

3.68. **New Rail** is rail that has never been in service.

3.69. **Partial Worn Rail**, sometimes known as second-hand rail, is rail that has been in service and removed for any cause.

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

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

3.72. **Preferred Rail Laying Temperature (PRLT)** is the designated rail laying temperature established to balance the risk of track buckles at high temperature and pull-aparts at low temperatures. At Ontario Northland, the PRLT is 85°F / *29.4°C*; Effective January 1, 2026, the PRLT is 90°F / *32.2°C*.

3.73. **Preferred Rail Laying Temperature Range (PRLTR)**, up to December 31, 2025, is the PRLT plus 15°F (85°F to 100°F / *29.4°C to 37.8°C*); Effective January 1, 2026, 90°F to 105°F / *32.2°C to 40.6°C*.

3.74. **Pull Apart or Stripped Joint** means a condition when no bolts are mounted through a joint on the rail end, rending the joint bar ineffective due to excessive expansive or contractive forces.

3.75. **Pumping Unit**, for the purposes of fire prevention and suppression and its application under the Industrial Operations Protocol, means a unit consisting of a water pump not affixed to another machine that is capable of maintaining a minimum pressure of 60 pounds per square inch when used with a nozzle with a half inch opening attached directly to the pump, a toolbox containing nozzles with assorted tip sizes, wyes, stranglers, hose wrenches, spark plugs and assorted hand tools such as screw drivers and pliers, a minimum of 20 litres of fuel appropriate to operate the pump, one intake hose that is a minimum of eight feet long with a foot valve, and one and a half inch fire hoses measuring in total a minimum of 2,400 feet in length.

3.76. **Quality Assurance (QA)** means a systemic set of activities carried out by QA personnel to verify that the work is done in accordance with the railway company's standards and procedures, and in compliance with the TSR.

3.77. **Quality Assurance (QA) Personnel** is a track inspector, track supervisor or a professional engineer, who is not directly involved in performing the maintenance and repair work.

3.78. **Rail** is a rolled steel section used as a running surface for equipment and track units.

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

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

3.79. **Rail Anchors** are devices which are attached to the rail and bear against the side of the crosstie to control longitudinal rail movement. Certain types of rail fasteners also act as rail anchors and control longitudinal rail movement by exerting a downward clamping force on the upper surface of the rail base.

3.80. **Rail Laying Temperature (RLT)** is the actual rail temperature at which the CWR is installed.

3.81. **Rail Neutral Temperature (RNT)** is the actual rail temperature at which the rail is neither in tension nor compression.

3.82. **Rail Wear** is the loss in rail head due to abrasive interaction between steel wheels and steel rail over time. Loss in rail head is determined using the combination of vertical and lateral wear measurements.

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

3.84. **Repeat Geometry Defect** means the occurrence of a geometry-related defect, identified by a Heavy Geometry Inspection Vehicle, that is located within 0.01 mile of the same type of geometry-related defect identified during last inspection by a Heavy Geometry Inspection Vehicle. Geometry-related defect means track condition exceeding the thresholds under Part II Subpart C.

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

3.86. **Road Approach** means the part of a road, other than the crossing surface, that lies between the point that marks the start of the stopping sight distance and the point that marks the front of a design vehicle when it is past the clearance point as shown in Figure 10-1 of the Grade Crossings Standards.

3.87. **Running Rail** is rail which carries all vertical loads of railway vehicles and equipment.

3.88. **Runoff** is when surfacing track, or when surfacing to a fixed structure, is the elevation difference in the track structure over a 31’ *(9,500 mm)* section.

3.89. **Safety Critical Maintenance** means track geometry conditions that meet or exceed the URGENT defect thresholds as noted in Sub-Part C, Section 8 URGENT Defects, or rail defects as identified in Sub-Part D, Section 6.5 Rail – Defects and Protection Codes and Sub-Part D, Section 6.9 Rail – Rail Surface Management Plan.

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

3.91. **Siding** means a track adjacent and connected to the main track, which is so designated in the timetable, GBO or operating bulletin.

3.92. **Sightlines**, for the purposes of the Grade Crossing Standards, refers to various distances of unobstructed view(s) based on a number of data points and calculations as found in the Grade Crossing Standards. Calculations may include,

- **Stopping Sight Distance (SSD)** is the stopping sight distance in accordance with calculations found within Article 7.2. of the Grade Crossing Standards.

- **D_{SSD}** is the minimum distance along the line of railway that a crossing user must see approaching railway equipment from the stopping sight distance in accordance with calculations found within Article 7.2. of the Grade Crossing Standards. D_{SSD} is equal to the distance required for the design vehicle at its design speed to go from the stopping sight distance completely past the clearance point on the other side of the grade crossing.

- **$D_{STOPPED}$** is the minimum distance along the line of railway that a crossing user must be able to see approaching railway equipment from the stopped position at a grade crossing in accordance with calculations found within Article 7.2. of the Grade Crossing Standards.. $D_{STOPPED}$ is equal to the greater of the distances that railway equipment at the railway design speed will travel during,

  - the Departure Time (T_P) for the grade crossing design vehicle calculated in accordance with Article 10.3.2 of the Grade Crossing Standards, or

  - the Departure Time (T_P)for pedestrians, cyclists, and persons using assistive devices calculated in accordance with Article 10.3.3. of the Grade Crossing Standards.

- **Clearance Distance (cd)** is the distance between the clearance point in advance of the grade crossing, to the clearance point beyond the farthest rail in accordance with calculations found within Article 7.2. of the Grade Crossing Standards, and as shown in Figure 10-1 of the Grade Crossing Standards.

- **Clearance Point** is the point 2.4 m beyond the outside edge of the farthest rail from the departure point measured perpendicular to the rail.

- **Departure Time (T_P)**, per calculations within 10.3 of the Grade Crossing Standards, is the greater of the time required for the design vehicle to pass completely through the Clearance Distance (cd) from a stopped position (T_D) or the time required for pedestrians, cyclists and persons using assistive devices to pass completely through the Clearance Distance (cd).

- **Gate Arm Clearance Time,** per calculations within 10.3 of the Grade Crossing Standards, is the greater of Gate Arm Clearance Time from SSD position ($T_{G\ SSD}$) or Gate Arm Clearance Time from the stop position ($T_{G\ stop}$) and represents the time, in seconds, it takes the design vehicle to travel from either the Stopping Sight Distance (SSD) position or the Stop position to the point past the gate arm.

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

3.94. **Split Web** is a lengthwise crack along the side of the web and extending into or through it.

3.95. **Spot Tie Replacement** is considered to be,

- At most two adjacent ties are replaced;
- The four ties on each side of the replaced ties are undisturbed and not hanging;
- Anchor pattern is complete, and anchors are in good condition, effective and tight;
- Installation of ties should disturb the track as littles as possible, jacking of track should be to minimum, base of plates on newly installed ties upon completion of install should be even with (0" below or at more 1/4" *(6 mm)* above) base of plate on adjacent undisturbed tie.
- The ambient temperature is less than 80°F *(27°C)* and is expected to stay less than 80°F *(27°C)* for 48 hours.
- Newly installed ties are fully plated, spiked, anchored, and tamped. Cribs are full and shoulders restored.

3.96. **Stoniness**, for the purposes of fire prevention and suppression within the Industrial Operations Protocol, is the measure of a stony surface being equal to or less/greater than 15% of the worksite. Stony surface refers to the worksite being covered by stones or boulders that are 25 cm in diameter or greater at or just below the surface of the soil or contains more than one outcropping of bedrock.

3.97. **Superelevation** is the amount by which the outer rail of a curve is banked above the inner rail.

- **Balanced Elevation** is the curve elevation that for trains traveling at the maximum authorized speed results in equal vertical dynamic loadings on the high and low rail.
- **Underbalanced Elevation** is the elevation of the outer rail relative to the inner rail on a curve that is less than balanced elevation.

3.98. **Surface** is the vertical alignment or the surface uniformity in the vertical plane. The measurement for surface shall be the maximum positive or negative mid-ordinate, in inches of a 62' *(18,900 mm)* chord measured along the top surface of the rail.

3.99. **Surfacing**

- **Spot Surfacing** is,
  - The restoration of the track surface, cross-level and alignment through short stretches of track, not more than 19’ 6” *(5,900 mm)* in length, when a continuous raise is not necessary;
  - The lift is 1” *(25 mm)* or less;
  - The track is not identified as a high-risk track buckle location; and
  - The track is tangent or of curvature less than 1° 30 min. and the ambient temperature is less than 80°F *(27°C)* and is expected to stay less than 80°F *(27°C)* for 48 hours, or if curvature 1° 30 min. or more and the ambient temperature is less than 70°F *(21°C)* and is expected to stay less than 70°F *(21°C)* for 48 hours.
- **Out-of-Face Surfacing** is the continuous raising of track to restore track surface, cross-level, and alignment or of whole curves.

3.100. **Temperature**

- **Ambient Temperature** is the air temperature as measured by a thermometer, not including humidity or wind chill.
- **Rail Temperature** is the temperature of the rail. Rail temperature in cold weather is typically equal to the ambient temperature. As a guideline, in hot weather, the rail temperature is equivalent to the ambient temperature plus 30°F *(16°C)*.

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

- **Temperature Differential** is the difference between the PRLT, and the rail temperature taken at the time of installation.

3.101. **Thermite Weld** is a process of welding the ends of two rails together by pouring molten steel between the rail ends causing fusion.

3.102. **Track Buckle** is a lateral or vertical misalignment of track structure due to excessive compressive forces in the rail.

3.103. **Track Inspector** means a person certified in this capacity in accordance with Part I, Section 4.

3.104. **Track Supervisor** means a person certified in this capacity in accordance with Part I, Section 4.

3.105. **Trained and/or Capable**, for the purposes of fire prevention and suppression and its application under the Industrial Operations Protocol, is having a Fire Prevention and Preparedness Plan, applicable fire suppression equipment on-site and in serviceable condition per the fire risk and type of operations, means of 2-way communication with local fire management headquarters (through RTC) and other workers at the site and at least 25% of the persons at the site having received the SP105/106 forest fire suppression training using the MNRF's materials.

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

3.107. **Turnout** is a track structure by means of which vehicles are diverted from one track to another.

3.108. **Ultrasonic Rail Flaw Testing** is a non-destructive method of testing the internal structure of rail through the use of high-frequency sound waves.

3.109. **Vertical Split Head** is a vertical split, through or near the middle of the head, and extending into or through it. A crack or rust streak may show under the head close to the web or pieces may split off the side of the head.

3.110. **Vertical Wear** is the loss in rail head height measured as the difference between a new rail profile and the worn rail profile at a point on the top of the rail in line with the middle of the web.

3.111. **V_{max}** is the maximum speed permitted based on the degree of curve, superelevation, and imbalance.

3.112. **Water Delivery System**, for the purposes of fire prevention and suppression and its application under the Industrial Operations Protocol, means a system consisting of a water supply, a water pump or equivalent means of pressurizing water and the hoses, attachments and tools necessary for the operation and maintenance of the system that is mounted on a machine that can deliver water to any place on a worksite.

3.113. **Wayside Inspection Systems (WIS)** are devices located along the track, or wayside, that monitor locomotive and railcar mechanical health to proactively detect real-time issues on active trains to enable preventative action and may include,

- **Acoustic Bearing Detectors** assess wheel bearing sound signatures to identify compromised components well in advance of a heat-generating failure. The system is designed to monitor roller bearings and identify those with internal defects in freight and passenger cars as they pass at nominal operating speed. They can help find roller bearing flaws early, before the bearings overheat.

- **Hot Bearing Detectors (HBD)** located on the side of railway tracks monitor the wheel bearing temperature on passing rolling stock. Real-time alarms directly notify the train crew via radio. The train is stopped and bearing inspected. Cars found with hot bearings are set out at the first available opportunity to safely do so. The system uses a pair of upward-facing infrared cameras to measure bearing temperatures relative to ambient (background) temperatures. Overheated bearings occur when inadequate lubrication, component misalignment, or mechanical damage increase bearing friction.

- **Hot Wheel Detectors (HWD)** use an infrared scanner looking for heat in the wheel. Real-time alarms directly notify the train crew via radio, if there is an issue. These are installed in conjunction with Hot Bearing Detectors.

- **Dragging Equipment Detectors (DED)** are used to identify low-hanging hazards on the undercarriage. These detectors can be standalone or added to Hot Bearing Detector sites.

- **Wheel Profile Detectors (WPD)** create an image of the wheel profile to detect abnormalities in the wheel profile.

- **Wheel Impact Load Detection (WILD) System** is a device that measures the force exerted on the rail by each wheel of a train as it passes. Designed to detect irregular forces on the rail to identify flat / broken wheels and shifted loads.

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

3.115. **Yard** means a system of non-main tracks, utilized to switch equipment and for other purposes over which movements may operate subject to prescribed signals, rules and special instructions.

3.116. **Yard Track** means a track unclassified or classified as Category 1,2,3 or 4 for inspection purposes.

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4. Certification of Training

4.1. ONTC shall qualify and certify Track Supervisor (Inspector) to inspect track for defects or supervise restoration or renewal of track under traffic conditions. Each person certified shall have at least:

a) Completed training in a course on track inspection and maintenance, and

b) Demonstrated experience in track inspection and maintenance.

4.2. Demonstrated by passing a qualifying test that they:

a) Know and understand the requirements of the MTR and TSR;

b) Can detect deviations from those requirements; and

c) Can prescribe appropriate remedial action to correct or safely compensate for those deviations.

4.3. ONTC shall maintain a record of all employees who have been certified. Recertification must be completed at intervals not exceeding three (3) years.

4.4. Employees may be required to authorize movements to pass over a broken rail provided that:

a) The employee has demonstrated experience in track maintenance, signal, or train operations.

b) The employee must be trained and qualified to identify rail end mismatch, rail defects, condition of track ties, track surface, gauge, and alignment defects.

c) The employee must pass a written examination. The sole purpose of the examination is to ascertain their ability to effectively apply the requirements of the MTR and TSR.

d) Requalification must be completed at intervals not exceeding three (3) years.

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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

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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.

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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

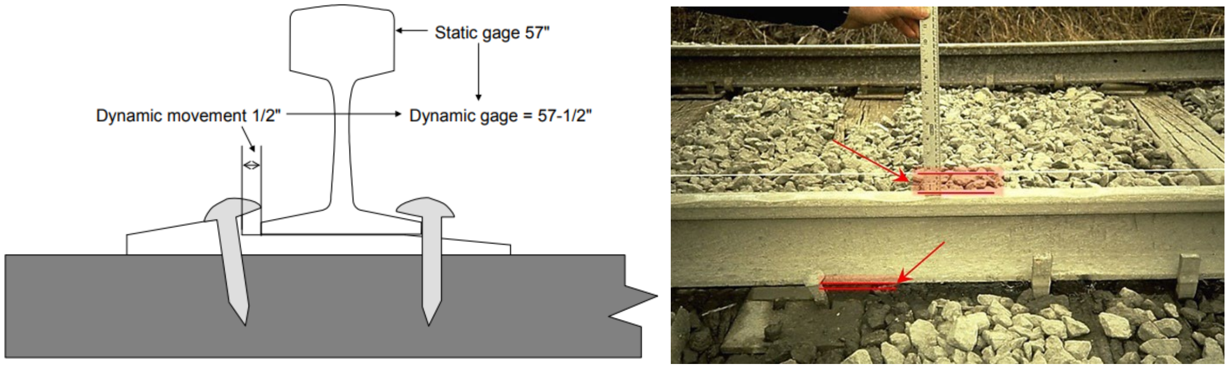

Figure SUB-PART C – 1 – Examples of Rail Movement Affecting Gauge (left) and Affecting Surface (right)

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)*.

5. Portable Track Loading Fixture (PTLF) Guidelines

a) The Portable Track Loading Fixture (PTLF) is an easy-to-use, manually operated track inspection tool designed to test the lateral strength of railroad crossties and fastening systems.

Figure SUB-PART C – 3 – Portable Track Loading Fixture

b) The PTLF applies the 4,000 pounds of lateral force necessary to measure changes in gauge under load.

c) Its insulated design will not shunt track signals.

d) While you may use this tool to aid in track inspections or to test the effectiveness of repairs, it is recommended to be used when any of the following conditions exist:

   i. Within joint areas where there are symptoms (e.g., movement of the plates, gaps at the end of ties, defective ties)

   ii. Where there are 3 or more consecutive defective ties

   iii. Where there are symptoms in any curve

   iv. Where the static measurement (including all rail movement measurements OR the measurement added to simulate rail movement found in our MTR) differs by ¼" *(6 mm)* or more from 56 ½" *(1,435 mm)* and there are symptoms (defective ties, plate cutting, poor surface, etc.)

   v. Where the static measurement (including all rail movement measurements OR the measurement added to simulate rail movement found in our MTR) differs by ½" *(13 mm)* or more from 56 ½" *(1,435 mm)* and there are NO symptoms; meaning all track conditions within 31' of the gauge variance are found to be in good condition (e.g., non-defective ties, good surface and line)

e) Directions for its use is as follows:

   i. Measure and record initial static (unloaded) track gauge using approved measuring device.

   ii. Ensure the PTLF is not damaged and in good working condition. Before applying pressure, ensure that all personnel are advised and are well clear to avoid possible injury from kick-back of rail or tool.

   iii. Place the PTLF over a crosstie, between rails, so that the shoes on each end rest on the rail base. Ensure PTLF ends engage the area of the rail web near the base and the cylinder side head's long side is facing up as shown in Figure SUB-PART C – 3 – Portable Track Loading Fixture

   Note: Placement in track locations other than rail base is unacceptable.

   iv. Apply hydraulic pressure to ram and increase load incrementally to 4,000 psi.

   CAUTION: DO NOT EXCEED 4,000 psi. EXCESSIVE PRESSURE MAY DAMAGE THE PTLF AND CAUSE PERSONAL INJURY.

   v. Observe the movement of the rail, tie plates and fastener components to assess which components contribute to poor track strength or gauge restraint conditions.

   vi. Measure and record PTLF loaded gauge and compare to the limits specified in Sub-Part C – Track Geometry, Section 4 – Gauge.

   vii. Before releasing pressure, ensure that all personnel are advised and are well clear to avoid possible injury from kick-back of rail or tool.

   viii. Release PTLF hydraulic pressure.

   ix. After the load is released, measure the gauge to which the track returns. This gauge, referred to as *exercised gauge*, can be slightly different from the unloaded gauge.

- *Exercised gauge* is useful to assess track strength and its ability to maintain and restore gauge.

Note: The difference between the loaded gauge and *exercised gauge* is the rail displacement.

x. After PTLF release, ensure rail is properly seated in affected tie plates.

6. Variation in Gauge

a) When the gauge is less than 56 inches *(1,422 mm)* and the change in gauge over a distance of 20 feet *(6,096 mm)* or less on either side of the defective location exceeds 1 ½ inches *(38 mm)*, train speed must be reduced according to Class 1 track speed.

7. Gauge Rods

a) Do not use gauge rods as a permanent replacement for ties to correct a gauge problem on main track and main track sidings,

b) Gauge rods are prohibited within a crossing circuit,

c) In yards and spurs, gauge rods may be used to assist in maintaining gauge in areas where additional strength is needed (for example, in yard turnouts and in areas of high curvature or wye tracks) but must not be used in lieu of ties,

d) Gauge rods may be used as a temporary repair on main track and main track sidings when it is impractical to perform a proper repair,

e) Temporary gauge rods are to be removed as quickly as practical and not remain in Main track for more than one year,

f) Gauge rods in main track are to be inspected monthly on foot,

g) 16 inches *(406 mm)* of the gauge rod will be painted in the center of the track and be highly visible,

h) Gauge rods applied on main track are to have their location (additionally, its GPS when possible) and number used, documented in the applicable record, which is to be kept up to date.

i) The date the gauge rods are removed will be documented on the same record.

8. URGENT Defects

a) URGENT defects are considered *Safety Critical Maintenance* requiring repairs and / or speed restrictions placed to protect traffic.

b) Only *Quality Assurance (QA)* personnel, not involved with the repair, are to verify the repairs have been completed to standards.

c) A geometry defect must be treated as an URGENT defect if;

   i. The measurement meets or exceeds the threshold for the class of track as prescribed in Figure SUB-PART C – 4 – URGENT Defects, or

   ii. The defect is reported as URGENT by the Track Evaluation Car (may be identified with a "U" on the report), or

   iii. The following combination track surface defects meeting or exceeding the thresholds as prescribed in Figure SUB-PART C – 4 – URGENT Defects,

      - Alignment and Surface: Alignment as measured from a mid-ordinate of a 31-foot chord when found within 11 ft from uniform profile on either rail that is measured from the mid-ordinate of a 62-foot chord.

      - Alignment and Warp 31: Alignment as measured from a mid-ordinate of a 31-foot chord when found within 11 ft from the difference in cross level between any two points less than 31 ft apart on a spiral.

d) The District Manager, or their designate, must immediately take any action considered necessary to provide full protection for any track condition to be treated as URGENT. Immediate action includes;

   i. Repairs are made bringing the track back into compliance and repairs have been verified by QA personnel with any applicable speed restrictions in place prior to next train,

   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.

URGENT DEFECT THRESHOLDS *(inches and millimeters)*	CLASS 1	CLASS 2	CLASS 3	CLASS 4	CLASS 5
FREIGHT	*10*	*25*	*40*	*60*	*80*
PASSENGER	*15*	*30*	*60*	*80*	*95**
Wide Gauge	1-1/2” *(38 mm)*	1-1/4” *(32 mm)*	1-1/4” *(32 mm)*	1” *(25 mm)*	1” *(25 mm)*
Narrow Gauge	3/4" *(19 mm)*	3/4" *(19 mm)*	1/2" *(13 mm)*	1/2" *(13 mm)*	1/2" *(13 mm)*
Variation in Gauge	1 5/8" *(41 mm)*	1 1/2" *(38 mm)*	1 1/8” *(29 mm)*	7/8” *(22 mm)*	5/8” *(16 mm)*
Surface 62’	3” *(76 mm)*	2-3/4” *(70 mm)*	2-1/4” *(57 mm)*	2” *(51 mm)*	1-1/4” *(32 mm)*
Warp 62’	3” *(76 mm)*	2-1/4” *(57 mm)*	2” *(51 mm)*	1-3/4” *(45 mm)*	1-1/2” *(38 mm)*
Warp 31’	2” *(51 mm)*	1-3/4” *(45 mm)*	1-1/4” *(32 mm)*	1” *(25 mm)*	3/4" *(19 mm)*
Runoff 31’	3-1/2” *(89 mm)*	3” *(76 mm)*	2” *(51 mm)*	1-1/2” *(38 mm)*	1” *(25 mm)*
Alignment 62’ in Curves	5” *(127 mm)*	3” *(76 mm)*	1-3/4” *(45 mm)*	1-1/2” *(38 mm)*	5/8” *(16 mm)*
Alignment 62’ in Tangent	5” *(127 mm)*	3” *(76 mm)*	1-3/4” *(45 mm)*	1-1/2” *(38 mm)*	3/4" *(19 mm)*
Alignment 31’ in Curves	N/A	N/A	1-1/4” *(32 mm)*	1” *(25 mm)*	1/2" *(13 mm)*
XLV from Design Tangent / Curve	3” *(76 mm)*	2” *(51 mm)*	1-3/4” *(45 mm)*	1-1/4” *(32 mm)*	1” *(25 mm)*
XLV from Design Spiral	1-3/4” *(45 mm)*	1-1/2” *(38 mm)*	1-1/4” *(32 mm)*	1” *(25 mm)*	3/4" *(19 mm)*
Reverse Elevation	3” *(76 mm)*	2” *(51 mm)*	1-3/4” *(45 mm)*	1-1/4” *(32 mm)*	1” *(25 mm)*
Design Speed / Vmax	3” *(76 mm)*	3” *(76 mm)*	3” *(76 mm)*	3” *(76 mm)*	3” *(76 mm)*
Rock & Roll Surface	7/8” *(22 mm)*	3/4" *(19 mm)*	3/4" *(19 mm)*	5/8” *(16 mm)*	1/2" *(13 mm)*
Rock & Roll Crosslevel	1-1/4” *(32 mm)*	1” *(25 mm)*	1” *(25 mm)*	7/8” *(22 mm)*	3/4" *(19 mm)*

URGENT - Combination Alignment and Surface Defect Thresholds *(inches and millimeters)*		CLASS 1**	CLASS 2	CLASS 3	CLASS 4	CLASS 5***
	FREIGHT	*10*	*25*	*40*	*60*	*80*
	PASSENGER	*15*	*30*	*60*	*80*	*95**
Alignment and Surface Combination *Any part of one defect must be within 11’ of the other defect to be considered a combination defect.*	**Alignment 31’**	N/A	1” *(25 mm)*	7/8” *(22 mm)*	7/8” *(22 mm)*	N/A
	Surface 62’	N/A	1-1/2” *(38 mm)*	1-1/4” *(32 mm)*	1-1/4” *(32 mm)*	N/A
Alignment and Warp 31’ Combination *Any part of one defect must be within 11’ of the other defect to be considered a combination defect.*	**Alignment 31’**	2” *(51 mm)*	1-1/4” *(32 mm)*	1” *(25 mm)*	3/4" *(19 mm)*	N/A
	Warp 31’	1-3/4” *(45 mm)*	1-1/4” *(32 mm)*	1” *(25 mm)*	3/4" *(19 mm)*	N/A

*100 mph for LRC Trains

**Individual Class 1 track surface thresholds provide a sufficient level of safety for the combination of alignment and uniform profile therefore specific combination defect thresholds are not required.

***Individual Class 5 track surface thresholds as defined provide a sufficient level of safety therefore specific combination defect thresholds in class 5 track are not required.

Figure SUB-PART C – 4 – URGENT Defects (inches and millimeters)

9. NEAR URGENT Defects

a) Geometry defects that are within 1/8” *(3 mm)* of the Urgent threshold are classed as NEAR URGENT defects.

b) NEAR URGENT defects are to be inspected and remedial action taken within 30 days. If the defect is not corrected within 30 days, a speed restriction will be applied reducing it to the next lower class of track.

c) NEAR URGENT defects may be identified by an “N”.

NEAR URGENT DEFECT THRESHOLDS *(inches and millimeters)*					
	CLASS 1	**CLASS 2**	**CLASS 3**	**CLASS 4**	**CLASS 5**
FREIGHT	*10*	*25*	*40*	*60*	*80*
PASSENGER	*15*	*30*	*60*	*80*	*95**
Wide Gauge	1-3/8” *(35 mm)*	1-1/8” *(29 mm)*	1-1/8” *(29 mm)*	7/8” *(22 mm)*	7/8” *(22 mm)*
Narrow Gauge	N/A	N/A	N/A	N/A	N/A
Variation in Gauge	N/A	N/A	N/A	N/A	N/A
Surface 62’	2-7/8” *(73 mm)*	2-5/8” *(67 mm)*	2-1/8” *(54 mm)*	1-7/8” *(48 mm)*	1-1/8” *(29 mm)*
Warp 62’	2-7/8” *(73 mm)*	2 1/8” *(54 mm)*	1 7/8” *(48 mm)*	1 5/8” *(41 mm)*	1 3/8” *(35 mm)*
Warp 31’	1-7/8” *(48 mm)*	1-5/8” *(41 mm)*	1-1/8” *(29 mm)*	7/8” *(22 mm)*	5/8” *(16 mm)*
Runoff 31’	3-3/8” *(86 mm)*	2-7/8” *(73 mm)*	1-7/8” *(48 mm)*	1-3/8” *(35 mm)*	7/8” *(22 mm)*
Alignment 62’ in Curves	4-7/8” *(124 mm)*	2-7/8” *(73 mm)*	1-5/8” *(41 mm)*	1-3/8” *(35 mm)*	1/2" *(13 mm)*
Alignment 62’ in Tangent	4-7/8” *(124 mm)*	2-7/8” *(73 mm)*	1-5/8” *(41 mm)*	1-3/8” *(35 mm)*	5/8” *(16 mm)*
Alignment 31’ in Curves	N/A	N/A	1-1/8” *(29 mm)*	7/8” *(22 mm)*	3/8” *(10 mm)*
XLV from Design Tangent / Curve	2-7/8” *(73 mm)*	1-7/8” *(48 mm)*	1-5/8” *(41 mm)*	1-1/8” *(29 mm)*	7/8” *(22 mm)*
XLV from Design Elev Spiral	1-5/8” *(41 mm)*	1-3/8” *(35 mm)*	1-1/8” *(29 mm)*	7/8” *(22 mm)*	5/8” *(16 mm)*
Reverse Elevation	2-7/8” *(73 mm)*	1-7/8” *(48 mm)*	1-5/8” *(41 mm)*	1-1/8” *(29 mm)*	7/8” *(22 mm)*
Design Speed / Vmax	N/A	N/A	N/A	N/A	N/A
Rock & Roll Surface	N/A	N/A	N/A	N/A	N/A
Rock & Roll Crosslevel	N/A	N/A	N/A	N/A	N/A

Figure SUB-PART C – 5 – NEAR URGENT Defects (inches and millimeters)

*100 mph for LRC Trains

10. Interpolation of Speeds Between Track Classes

a) When a defect is detected during a track geometry car inspection, for a period of 72 hours after the inspection, linear interpolation to determine the speed of the temporary slow order may be used to protect the defect.

b) Records of slow orders or reason for not imposing one must be maintained.

c) When the 72 hours expires and the track defect has not been repaired, the slow order must be revised to those of the acceptable track Class.

d) Figures SUB-PART C – 6 and C – 7 may be used to determine the maximum temporary speed restriction to be applied, for a one class speed reduction only, for a period of 72 hours.

FREIGHT SPEED MPH	WIDE GAUGE *(inches)*	ALIGNMENT *(inches)*			SURFACE *(inches)*	WARP *(inches)*		CROSSLEVEL *(inches)*		RUNOFF *(inches)*
		Tangent 62'	Curve 62'	Curve 31'		31' Spiral	62' Tangents Curves & Spirals	Tangent & Curves	Spiral	
10	58	5	5	N/A	3	2	3	3	1-3/4	3-1/2
15	57-7/8	4-1/4	4-1/4	N/A	2-7/8	1-7/8	2 -5/8	2-5/8	1-5/8	3-5/16
20	57-13/16	3-5/8	3-5/8	N/A	2-13/16	1-13/16	2-5/16	2-5/16	1-9/16	3-1/8
25	57-3/4	3	3	N/A	2-3/4	1-3/4	2	2	1-1/2	3
30	57-3/4	2-1/2	2-1/2	1-1/4	2-9/16	1-9/16	1-7/8	1-7/8	1-3/8	2-5/8
35	57-3/4	2-1/8	2-1/8	1-1/4	2-3/8	1-3/8	1-13/16	1-13/16	1-5/16	2-5/16
40	57-3/4	1-3/4	1-3/4	1-1/4	2-1/4	1-1/4	1-3/4	1-3/4	1-1/4	2
45	57-11/16	1-11/16	1-11/16	1-3/16	2-3/16	1-3/16	1-5/8	1-5/8	1-3/16	1-7/8
50	57-5/8	1-5/8	1-5/8	1-1/8	2-1/8	1-1/8	1-1/2	1-1/2	1-1/8	1-3/4
55	57-9/16	1-9/16	1-9/16	1-1/16	2-1/16	1-1/16	1-3/8	1-3/8	1-1/16	1-5/8
60	57-1/2	1-1/2	1-1/2	1	2	1	1-1/4	1-1/4	1	1-1/2

Figure SUB-PART C – 6 – Freight Speed – Allowable Temporary Speed Restrictions for Test Car Defects

PSSGR. SPEED MPH	WIDE GAUGE *(inches)*	ALIGNMENT *(inches)*			SURFACE *(inches)*	WARP *(inches)*		CROSSLEVEL *(inches)*		RUNOFF *(inches)*
		Tangent 62'	Curve 62'	Curve 31'		31' Spiral	62' Tangents Curves & Spirals	Tangent & Curves	Spiral	
15	58	5	5	N/A	3	2	3	3	1-3/4	3-1/2
20	57-7/8	4-1/4	4-1/4	N/A	2-7/8	1-7/8	2-5/8	2-5/8	1-5/8	3-5/16
25	57-13/16	3-5/8	3-5/8	N/A	2-13/16	1-13/16	2-5/16	2-5/16	1-9/16	3-1/8
30	57-3/4	3	3	N/A	2-3/4	1-3/4	2	2	1-1/2	3
45	57-3/4	2-3/8	2-3/8	1-1/4	2-1/2	1-1/2	1-7/8	1-7/8	1-3/8	2-1/2
50	57-3/4	2-1/8	2-1/8	1-1/4	2-3/8	1-3/8	1-13/16	1-13/16	1-5/16	2-5/16
55	57-3/4	1-15/16	1-15/16	1-1/4	2-5/16	1-5/16	1-3/4	1-3/4	1-1/4	2-1/8
60	57-3/4	1-3/4	1-3/4	1-1/4	2-1/4	1-1/4	1-3/4	2	1-1/4	2
65	57-11/16	1-11/16	1-11/16	1-3/16	2-3/16	1-3/16	1-5/8	1-5/8	1-3/8	1-7/8
70	57-5/8	1-5/8	1-5/8	1-1/8	2-1/8	1-1/8	1-1/2	1-1/2	1-1/8	1-3/4
75	57-9/16	1-9/16	1-9/16	1-1/16	2-1/16	1-1/16	1-3/8	1-3/8	1-1/16	1-5/8

Figure SUB-PART C – 7 – Passenger Speed – Allowable Temporary Speed Restrictions for Test Car Defects

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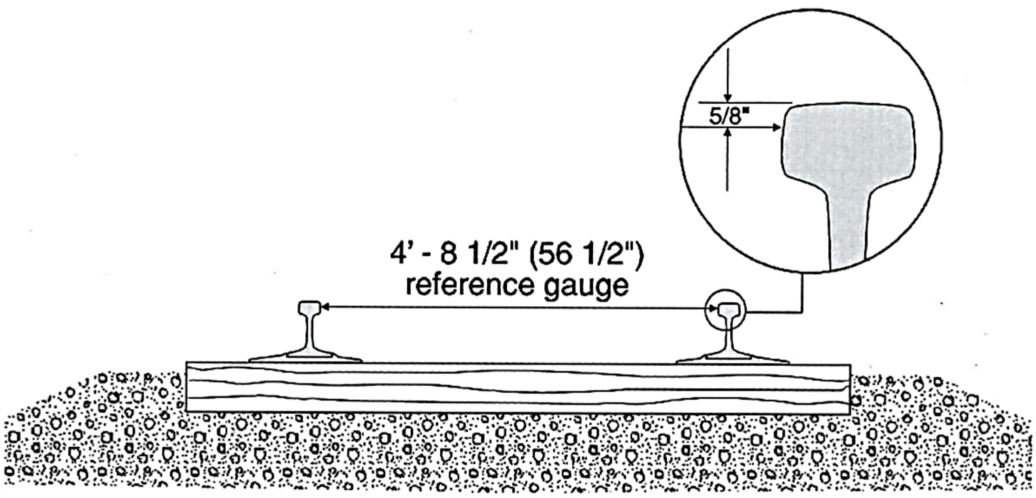
11. Track Defects

11.1 Track Defects – Gauge

Following are 3 gauge defects for track;

- Wide Gauge
- Narrow Gauge
- Variation in Gauge

Gauge is measured at 5/8" *(16 mm)* below the rail head as shown in the following Figure



Track Gauge

Figure SUB-PART C – 8 – Gauge Measurement Visual

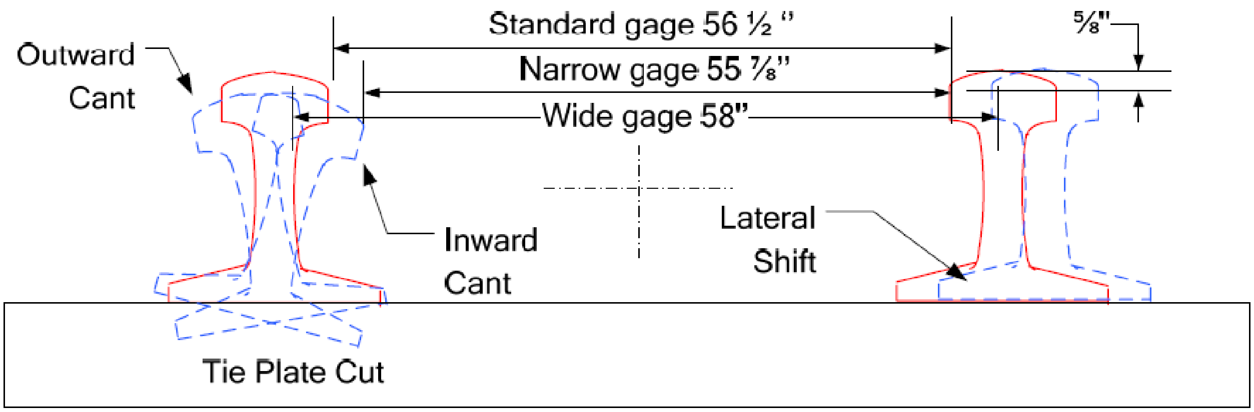


Figure SUB-PART C – 9 – Effects of Plate Cutting and Lateral Shift on Gauge

a) Wide Gauge Defects

i. When the gauge of track is greater than the normal designed standard as a result of poor installation or due to wear and deterioration of part(s) of the track structure, wide gauge can and will occur.

WIDE GAUGE *Freight Speed MPH* *Passenger Speed MPH*	Class 1 *10* *15*	Class 2 *25* *30*	Class 3 *40* *60*	Class 4 *60* *80*	Class 5 *80* *95*
URGENT	1-1/2" *(38 mm)*	1-1/4" *(32 mm)*	1-1/4" *(32 mm)*	1" *(25 mm)*	1" *(25 mm)*
NEAR URGENT	1-3/8" *(35 mm)*	1-1/8" *(29 mm)*	1-1/8" *(29 mm)*	7/8" *(22 mm)*	7/8" *(22 mm)*

Figure SUB-PART C – 10 – Wide Gauge Defects (inches and millimeters)

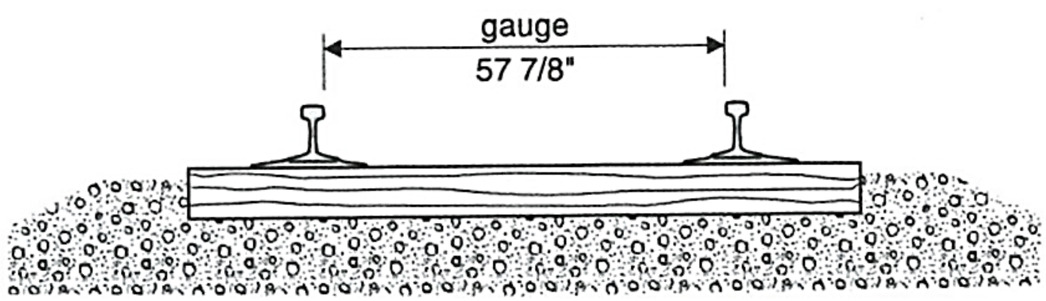


Figure SUB-PART C – 11 – Wide Gauge Example

ii. Gauge that is wide by 1/2" *(13 mm)* or greater results in increased rail surface damage. Any Urgent defect must either be corrected or protected and then corrected. Wide gauge can become serious once it reaches the Urgent threshold. The track can spread, the rail can roll over and the wheels drop between the rails, resulting in derailment.

iii. Identifying Wide Gauge in track

- A standard track gauge is required to check for wide gauge conditions keeping in mind the measurements taken are considering static (not under load). Look for,
  - Poor tie condition or cluster of bad ties
  - Centre bound track and / or hanging ties
  - Nose diving tie plates
  - Worn tie plate shoulders and spike holes
  - Ice build-up on tie plates
  - Canting rail
  - Loose or missing bolts
  - Battered joints

- In addition to the previous, check the following;
    - Step on the tie ends on the low side of the curve. If you hear the plates clank on the high side, the track is centre bound.
    - Place a lining bar on the inside base of the rail, near the track gauge. Push on the bar and watch for movement at the rail's base. This will occur due to poor ties and / or worn plate shoulders, worn spike holes and / or neck worn spikes.

b) Narrow Gauge Defects

i. When the gauge of track is less than the designed standard, the gauge is considered narrow or tight. It is important that correct gauge be maintained in the frog and switch area. On tangent track, narrow or tight gauge contributes to unstable ride, truck hunting, wheel, and rail wear.

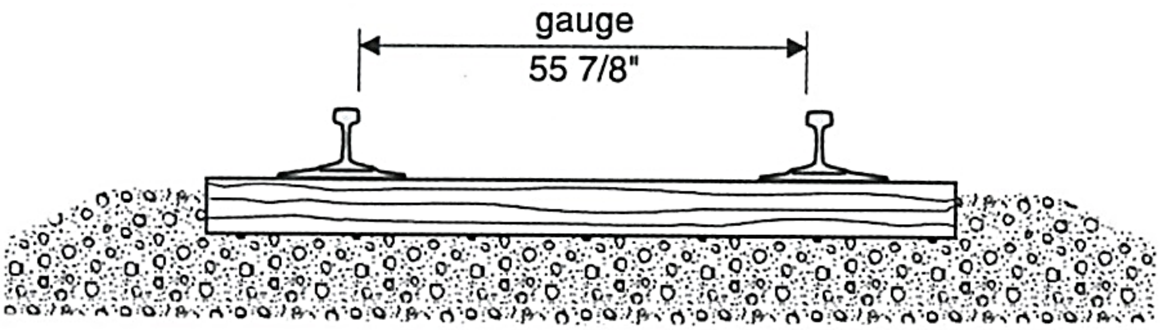


Figure SUB-PART C – 12 – Narrow Gauge Example

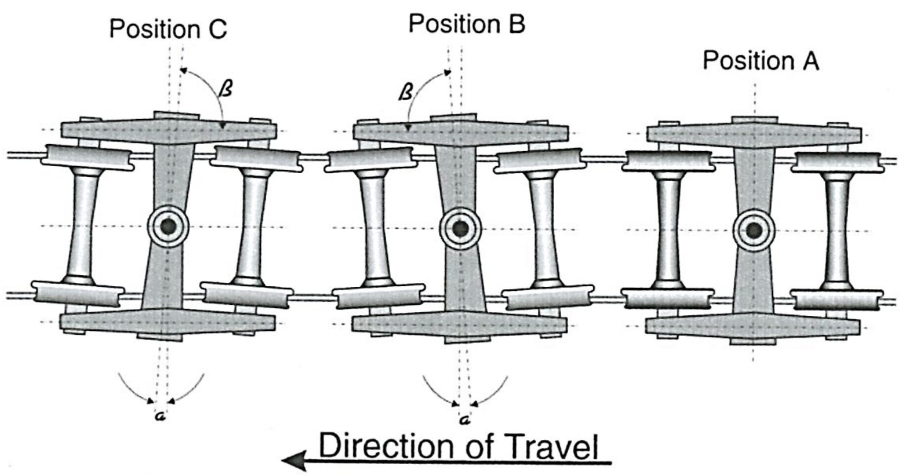


Figure SUB-PART C – 13 – Truck and Wheelset Movement

NARROW GAUGE	Class 1	Class 2	Class 3	Class 4	Class 5
Freight Speed MPH	*10*	*25*	*40*	*60*	*80*
Passenger Speed MPH	*15*	*30*	*60*	*80*	*95*
URGENT	3/4" *(19 mm)*	3/4" *(19 mm)*	1/2" *(13 mm)*	1/2" *(13 mm)*	1/2" *(13 mm)*

***Figure SUB-PART C – 14 – Narrow Gauge Defects** (inches and millimeters)*

ii. Identifying Narrow Gauge in track

- If the track gauge does not fit the track, the gauge of the track is narrow or tight. A tape measure may be required to identify the defect value.
- In addition to the above, check the following;
  - Skewed ties
  - Canting of rail inwards

- Rail was laid too tight
- Excessive adzing
- Cluster of bad ties
- Broken tie plates

c) Variation in Gauge Defects

i. Variation in Gauge is when the gauge is less than 56” *(1,422 mm)* and the change in gauge over a distance of 20’ *(6,096 mm)* or less on either side of the defective location exceeds 1 1/2" *(38 mm)*, train speed must be reduced according to Class 1 track speed.

VARIATION IN GAUGE	Class 1	Class 2	Class 3	Class 4	Class 5
Freight Speed MPH	*10*	*25*	*40*	*60*	*80*
Passenger Speed MPH	*15*	*30*	*60*	*80*	*95*
Variation in Gauge	1 5/8" *(41 mm)*	1 1/2" *(38 mm)*	1 1/8” *(29 mm)*	7/8” *(22 mm)*	5/8” *(16 mm)*

Figure SUB-PART C – 15 – Variation in Gauge Defects (inches and millimeters)

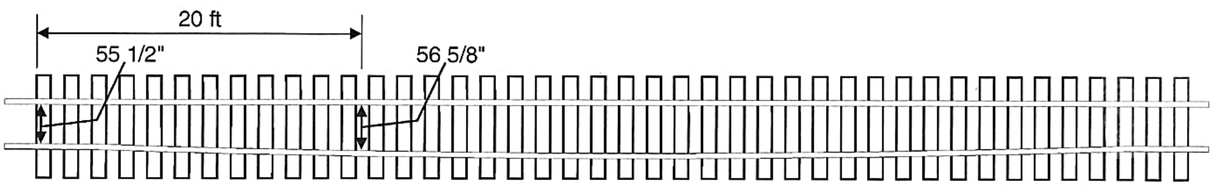


Figure SUB-PART C – 16 – Variation in Gauge Class 3 Example

ii. Identifying Variation in Gauge in track

- Sighting along the gauge side of the affected rail and using a tape measure to measure gauge

iii. Understanding the Effects of Variation of Gauge

- Where there is a variation of gauge over a distance of 20 feet *(6,096 mm)* or less, the angle between the wheel flange and the gauge corner of the rail will increase
- As one rail move inward, it forces the axle over towards the opposite rail, and where tight (narrow) gauge occurs, it may mean that rail is already in contact with the throat of the wheel.

11.2 Track Defects – Alignment

Following are 3 alignment defects for track;

- Alignment 62’ in Tangent
- Alignment 62’ in Curve
- Alignment 31’ in Curve

Alignment is measured over a 31’ or 62’ foot base line along the left and / or the right rail. Defects are taken at the mid-chord ordinate (MCO).

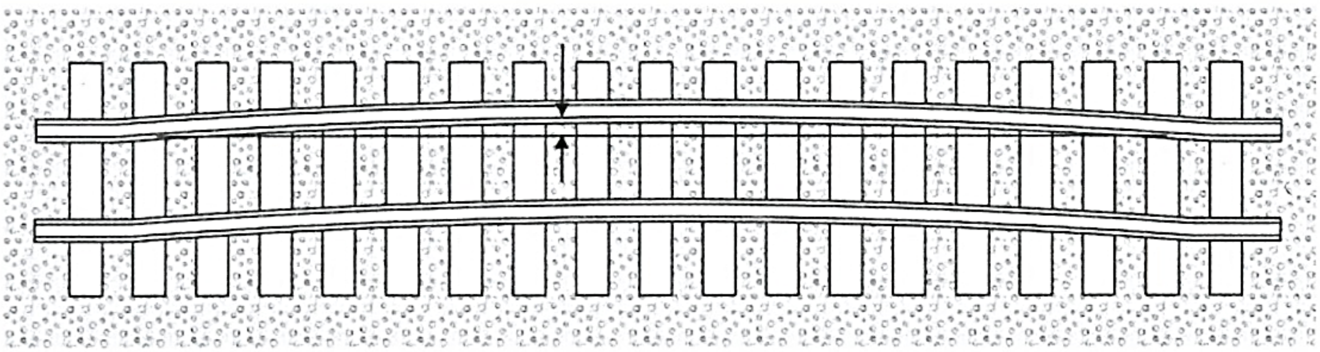


Figure SUB-PART C – 17 – Alignment Defect Example

a) Alignment 62' in Tangent Defects

i. If the alignment on tangent track, measured at the midpoint of a 62' chord, with the ends placed 5/8" *(16 mm)* below the top of the rail, deviates from tangent more than the value in the following table, it will be reported as a defect.

   - The end of the line must be points on the gauge side of the line rail, 5/8" *(16 mm)* below the top of the railhead. Either rail may be used as the line rail; however, the same rail must be used for the full length of that tangential segment of track

ii. This defect causes the wheels to kick outwards, placing additional stress on the rail and ties and if severe, may cause the wheel to climb the rail.

ALIGNMENT 62' in TANGENT	Class 1	Class 2	Class 3	Class 4	Class 5
Freight Speed MPH	*10*	*25*	*40*	*60*	*80*
Passenger Speed MPH	*15*	*30*	*60*	*80*	*95*
URGENT	5" *(127 mm)*	3" *(76 mm)*	1-3/4" *(45 mm)*	1-1/2" *(38 mm)*	3/4" *(19 mm)*
NEAR URGENT	4-7/8" *(124 mm)*	2-7/8" *(73 mm)*	1-5/8" *(41 mm)*	1-3/8" *(35 mm)*	5/8" *(16 mm)*

***Figure SUB-PART C – 18 – Alignment 62' in Tangent Defects** (inches and millimeters)*

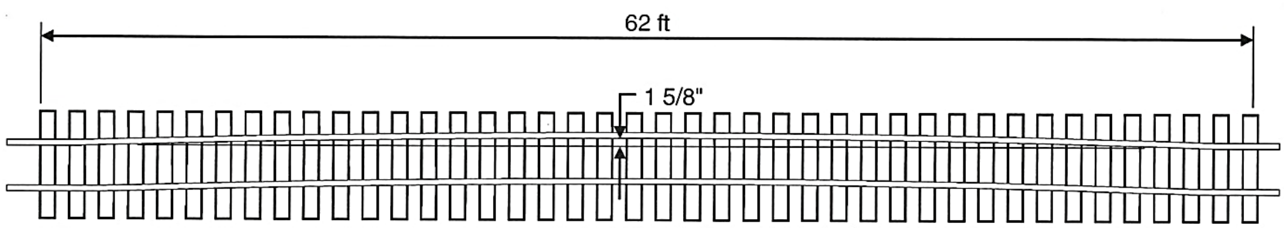


Figure SUB-PART C – 19 – Alignment in Tangent Track Example

iii. Identifying an Alignment Defect in Tangent Track

   - Most cases you can see this defect by sighting along the gauge side of the rail then measured with a stringline.
   - In addition, look for the following;
     - Hanging ties
     - Tie plates nose diving
     - Loose or missing bolts
     - High, missing, bent or throat cut spikes
     - Batter or bent rail ends
     - Worn or broken plates, ice build-up in plates
     - High water
     - Cluster(s) of bad ties

iv. Correcting Alignment 62’ in Tangent

- If defect is in a switch area,
    - Rail braces may require correction
- If defect is on a bridge,
    - The track may have to be spike lined
- Defects occurring in hot weather may require rail to be cut out
- Defect could be at a bad joint showing a slight swing
- If the defect is long, it may require correcting by lining the track with equipment

b) Alignment 62’ in Curve Defects

i. If the alignment on either or both rails in a curve or spiral, measured at the midpoint of a 62’ chord, with the ends placed 5/8” *(16 mm)* below the top of the rail, deviates from more than the value in the following table from the design alignment for the specific curve or spiral, it will be reported as a defect.

- The ends of the chord must be points on the gauge side of the outer rail, 5/8” *(16 mm)* below the top of the railhead

ii. This defect causes the wheels to kick outwards, placing additional stress on the rail and ties and if severe, may cause the wheel to climb the rail.

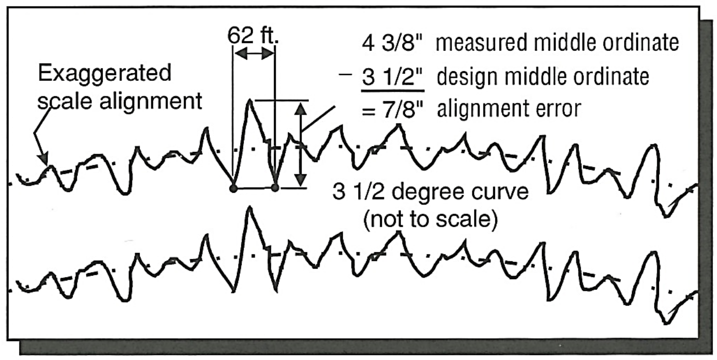


Figure SUB-PART C – 20 – Alignment 62' in Curve Defect Example

ALIGNMENT 62’ in a CURVE	Class 1	Class 2	Class 3	Class 4	Class 5
Freight Speed MPH	*10*	*25*	*40*	*60*	*80*
Passenger Speed MPH	*15*	*30*	*60*	*80*	*95*
URGENT	5” *(127 mm)*	3” *(76 mm)*	1-3/4” *(45 mm)*	1-1/2” *(38 mm)*	5/8” *(16 mm)*
NEAR URGENT	4-7/8” *(124 mm)*	2-7/8” *(73 mm)*	1-5/8” *(41 mm)*	1-3/8” *(35 mm)*	1/2" *(13 mm)*

Figure SUB-PART C – 21 – Alignment 62' in Curve Defects (inches and millimeters)

iii. Identifying an Alignment Defect in Curve

- If short (a few feet long), it may be located at a joint or where there may be a slight swing in the track within the curve and using the stringline method.
- In addition, look for the following;
  - Hanging ties
  - Excessive adzing
  - Tie plates are nose diving
  - Loose or missing bolts
  - High, missing, bent or throat cut spikes
  - Battered of bent rail ends

- Worn or broken plates, ice build-up on plates
- High water
- Cluster(s) of bad ties

iv. Correcting Alignment 62’ in Curve

- Curve lining, spike lining or gauging may be some of the methods required to correct the defect; lining equipment may be required, and rail may need to be cut out.

c) Alignment 31’ in Curve Defects

i. A 31’ chord is particularly necessary for determining short alignment deviations. A 62’ chord may be “blind” to short alignment conditions, where a 31’ chord can detect those defects.

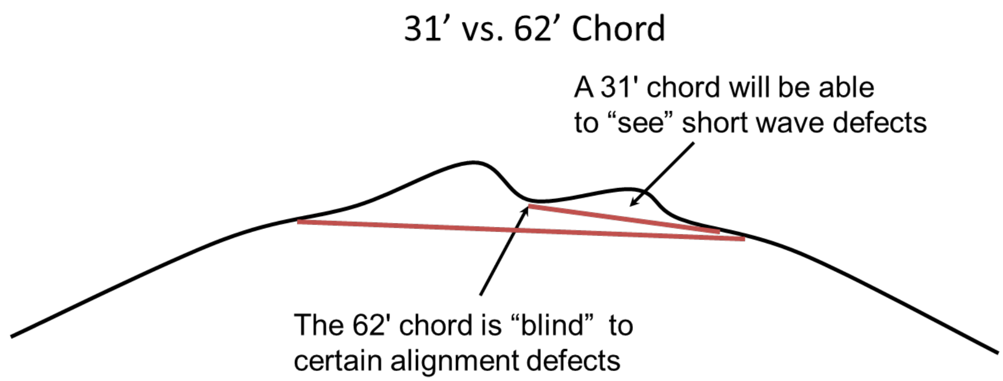


Figure SUB-PART C – 22 – Alignment 31' vs Alignment 62’ Curve Defects

ii. If the alignment on either or both rails in a curve or spiral, measured at the midpoint of a 31’ chord, with the ends placed 5/8” *(16 mm)* below the top of the rail, deviates from more than the value in the following table from the design alignment for the specific curve or spiral, it will be reported as a defect.

- The ends of the chord must be points on the gauge side of the outer rail, 5/8” *(16 mm)* below the top of the railhead

iii. This defect causes the wheels to kick outwards, placing additional stress on the rail and ties and if severe, may cause the wheel to climb the rail.

ALIGNMENT 31’ in a CURVE	Class 1	Class 2	Class 3	Class 4	Class 5
Freight Speed MPH	*10*	*25*	*40*	*60*	*80*
Passenger Speed MPH	*15*	*30*	*60*	*80*	*95*
URGENT	N/A	N/A	1-1/4” *(32 mm)*	1” *(25 mm)*	1/2" *(13 mm)*
NEAR URGENT	N/A	N/A	1-1/8” *(29 mm)*	7/8” *(22 mm)*	3/8” *(10 mm)*

***Figure SUB-PART C – 23 – Alignment 31' in Curve Defects** (inches and millimeters)*

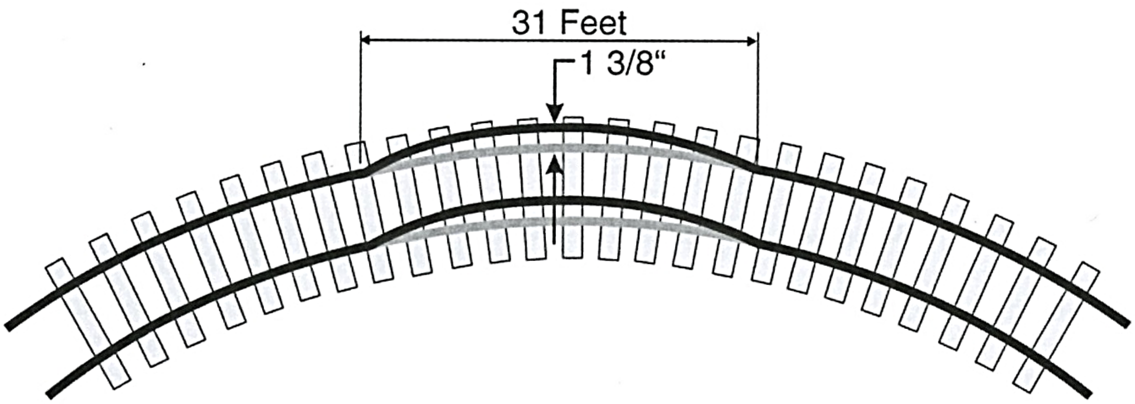


Figure SUB-PART C – 24 – Alignment 31' in a Curve Example

iv. Identifying an Alignment Defect in Curve(s)

- If short (a few feet long), it may be located at a joint or where there may be a slight swing in the track within the curve and using the stringline method.
- In addition, look for the following;
  - Hanging ties
  - Excessive adzing
  - Tie plates are nose diving
  - Loose or missing bolts
  - High, missing, bent or throat cut spikes
  - Battered of bent rail ends
  - Worn or broken plates, ice build-up on plates
  - High water
  - Cluster(s) of bad ties

v. Correcting Alignment 31’ in Curve(s)

- Curve lining, spike lining or gauging be some of the methods required to correct the defect; lining equipment may be required, and rail may need to be cut out.

11.3 Track Defects – Surface

Following are 3 surface defects for track;

- Surface 62’
- Runoff 31’
- Rock and Roll Surface (RR/Surface)

Surface is measured over a 31’ or 62’ foot base line along the top of left and / or the right rail. Defects are taken at the mid-chord ordinate (MCO). In this case there may not be excessive cross level because both rails are going down a uniform amount.

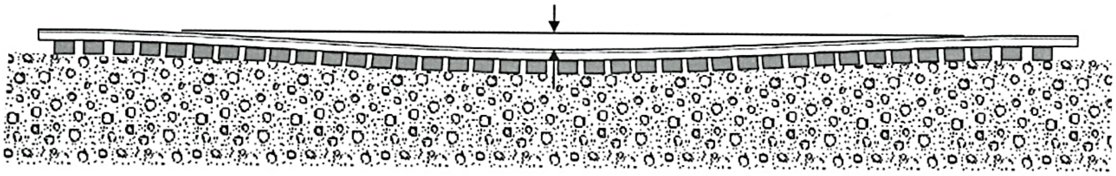


Figure SUB-PART C – 25 – Surface Defect Example

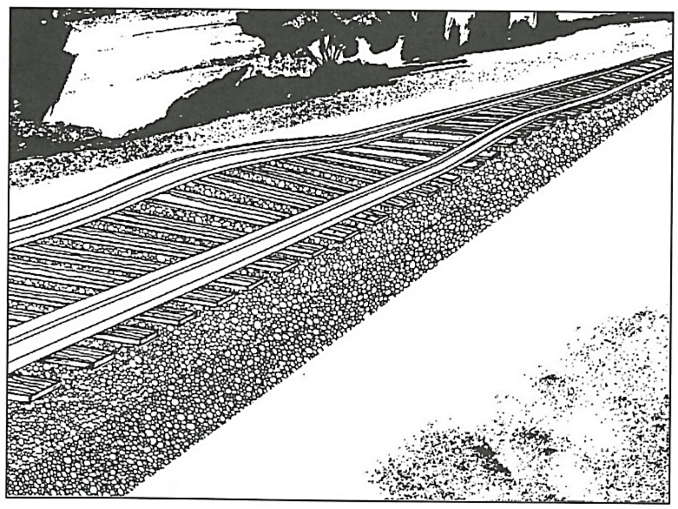


Figure SUB-PART C – 26 – Surface Defect Example

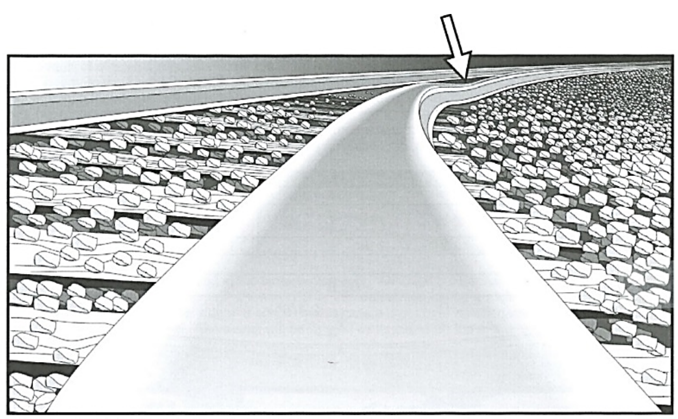


Figure SUB-PART C – 27 – Low Spot Visible - Low Side of Curve Example

a) Surface 62’ Defects

i. If the surface, measured at the midpoint of a 62’ chord strung along the top of the rail exceeds the value shown in the following table, it will be reported as a defect

ii. This defect may cause cars to bounce on their springs causing wheel unloading; if the defect is severe, uncoupling may occur.

SURFACE 62’ MCO *Freight Speed MPH* *Passenger Speed MPH*	Class 1 *10* *15*	Class 2 *25* *30*	Class 3 *40* *60*	Class 4 *60* *80*	Class 5 *80* *95*
URGENT	3” *(76 mm)*	2-3/4” *(70 mm)*	2-1/4” *(57 mm)*	2” *(51 mm)*	1-1/4” *(32 mm)*
NEAR URGENT	2-7/8” *(73 mm)*	2-5/8” *(67 mm)*	2-1/8” *(54 mm)*	1-7/8” *(48 mm)*	1-1/8” *(29 mm)*

Figure SUB-PART C – 28 – Surface 62' Defects (inches and millimeters)

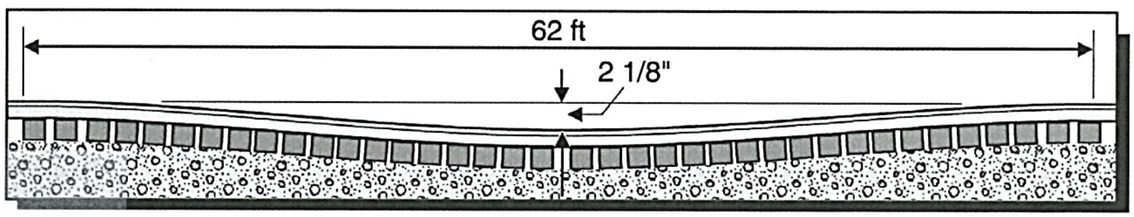


Figure SUB-PART C – 29 – Surface 62' Example

iii. Identifying a Surface 62’ defect;

- Check both rails for a vertical drop (sag) or raise (peak)
- May appear as a shallow spot or hump in the track
- In addition, look for the following;
  - Hanging ties
  - High, missing, bent or throat cut spikes
  - Battered of bent rail ends
  - Engine burns
  - Corrugated rail
  - High water, clogged ditches
  - Cluster(s) of bad ties
  - Failed culvert

iv. Correcting Surface 62' MCO Defects

- Will require surfacing or shimming depending on the season; tamping rock or ballast under the track to remove the surface problem. If more than an isolated spot or two, surfacing the entire track may be necessary with equipment.

b) Runoff 31’ Defects

i. If the runoff in the track surface measured over 31’ exceeds the value shown in the following table, a defect will be reported

ii. Can occur in both rails or will occur in one rail

iii. This defect can cause suspension springs to unload rapidly, causing wheel unloading, and perhaps derailment

iv. May be found off a road crossing or at the end of a surfacing lift or bridges

v. Conditions created by track degradation (e.g., settlement or frost heaves) are to be addressed using the uniform profile parameter

RUNOFF 31’ *Freight Speed MPH* *Passenger Speed MPH*	Class 1 *10* *15*	Class 2 *25* *30*	Class 3 *40* *60*	Class 4 *60* *80*	Class 5 *80* *95*
URGENT	3-1/2” *(89 mm)*	3” *(76 mm)*	2” *(51 mm)*	1-1/2” *(38 mm)*	1” *(25 mm)*
NEAR URGENT	3-3/8” *(86 mm)*	2-7/8” *(73 mm)*	1-7/8” *(48 mm)*	1-3/8” *(35 mm)*	7/8” *(22 mm)*

Figure SUB-PART C – 30 – Runoff 31' Defects (inches and millimeters)

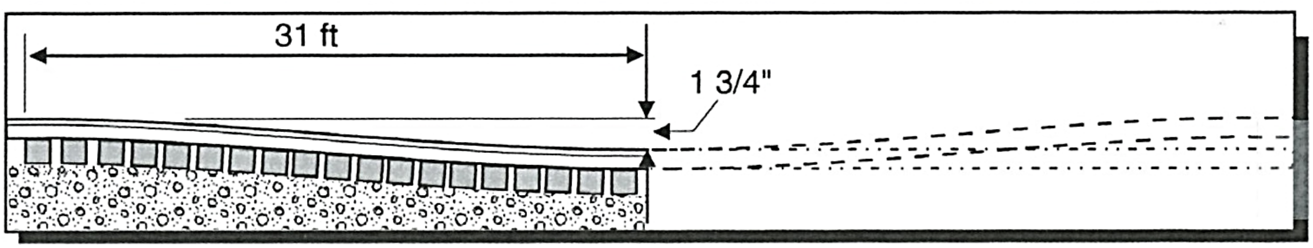


Figure SUB-PART C – 31 – Surface Runoff 31' Defect Example

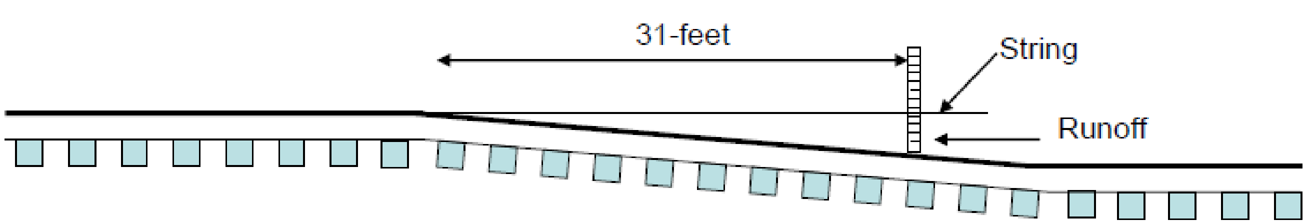


Figure SUB-PART C – 32 – Surface Runoff 31'

vi. Identifying a Runoff 31’ defect;

- Sighting each individual rail, the defect will appear as a drop or raise in the track surface

vii. Correcting Runoff 31’ Defects

- Will require surfacing or shimming depending on the season; tamping rock or ballast under the track to remove the surface problem. If more than an isolated spot or two, surfacing the entire track may be necessary with equipment.

c) Rock and Roll Surface (RR/Surface) Defects

i. If five or more consecutive alternating changes in surface measurement exceeds the value listed in the table for that class of track, it will report as an URGENT defect

ii. There is no direct relation between defect size and track speed

iii. Dynamic loading will increase with speed

iv. This defect causes rolling stock, usually empty cars, to rock and is more typical at speeds of 13 to 21 mph

v. A pattern of low joints (or over-peaked joints) can cause cars to roll, bounce and rock so that the wheels could lift from the rail and derail

ROCK AND ROLL SURFACE	Class 1	Class 2	Class 3	Class 4	Class 5
Freight Speed MPH	*10*	*25*	*40*	*60*	*80*
Passenger Speed MPH	*15*	*30*	*60*	*80*	*95*
URGENT	7/8” *(22 mm)*	3/4" *(19 mm)*	3/4" *(19 mm)*	5/8” *(16 mm)*	1/2" *(13 mm)*
NEAR URGENT	N/A	N/A	N/A	N/A	N/A

Figure SUB-PART C – 33 – Rock and Roll Surface Defects (inches and millimeters)

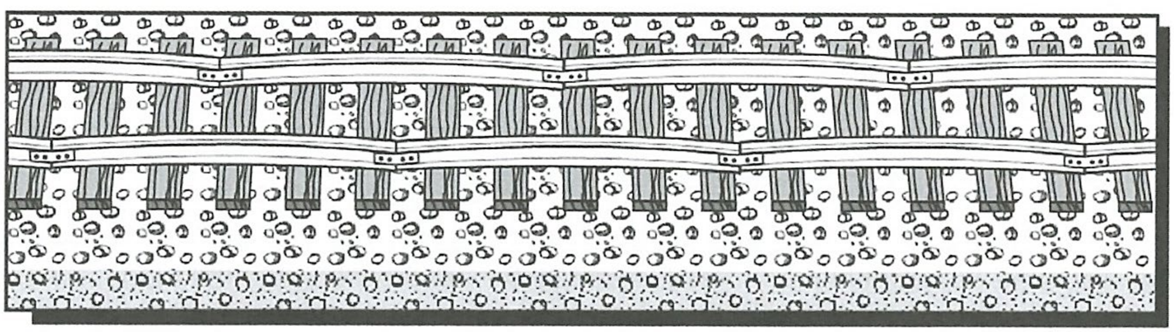


Figure SUB-PART C – 34 – Rock and Roll Surface Defect Example

vi. Identifying a Rock and Roll defect;

- Look for a series of low joints; three or more on one rail plus three or more on the opposite rail
- In addition, look for the following;
  - Hanging ties
  - Pumping ballast
  - Mud on side of rails in joint areas
  - Water near the track

vii. Correcting Rock and Roll Defects

- Will require surfacing correction of each rail depending on the season; tamping rock or ballast under the track to remove the surface problem. If more than an isolated spot or two, surfacing the entire track may be necessary with equipment.

11.4 Track Defects – Crosslevel

Following are 3 crosslevel defects for track;

- WARP 62'
- WARP 31'
- Rock and Roll Crosslevel (RR/XLV)

Crosslevel is a comparison of the tops of parallel rails. A low spot, on one rail in tangent track, causes variation between the two rails and has to be brought back to zero. Curve elevation is a form of crosslevel variation required to counteract centrifugal force when a train passes through a curve. Track twist is the transition from tangent to curved track designed into a curve's spiral or easement to accommodate the change from zero elevation on tangent track to the superelevation of the curve. See "**Curve Easement, Elevation and Speed Limitations**".

a) WARP 62'

i. If the difference in crosslevel between any two points less than 62' apart on tangents, spirals or in curves exceeds the value in the following table for that class of track, a defect will be reported.

- Subtract largest and smallest same rail measurements within 62'
- Add opposite rail measurements within 62'

ii. A rail car will tend to lean over as it rides over the low spot (on one side) unloading the wheel on the opposite side, or the diagonally opposite wheel. Where one end of the car is going down in a low spot on one side and the other end of the car is going down on the opposite side.

iii. If the maximum change in crosslevel between two points within specific distances along the track

WARP 62'	Class 1	Class 2	Class 3	Class 4	Class 5
Freight Speed MPH	*10*	*25*	*40*	*60*	*80*
Passenger Speed MPH	*15*	*30*	*60*	*80*	*95*
URGENT	3" *(76 mm)*	2-1/4" *(57 mm)*	2" *(51 mm)*	1-3/4" *(45 mm)*	1-1/2" *(38 mm)*
NEAR URGENT	2-7/8" *(73 mm)*	2 1/8" *(54 mm)*	1 7/8" *(48 mm)*	1 5/8" *(41 mm)*	1 3/8" *(35 mm)*

Figure SUB-PART C – 35 – WARP 62' Defects (inches and millimeters)

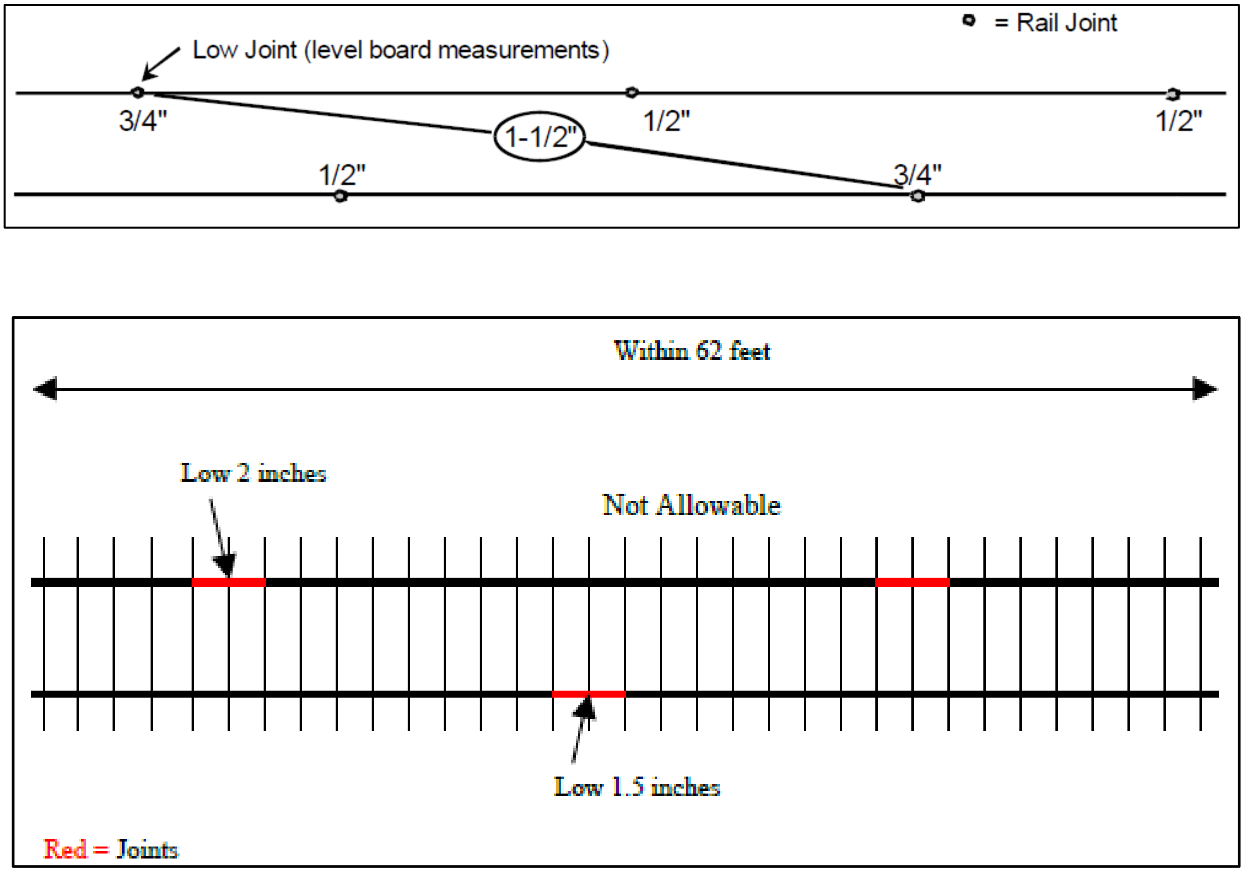


Figure SUB-PART C – 36 – Warp 62' Examples (tangent)

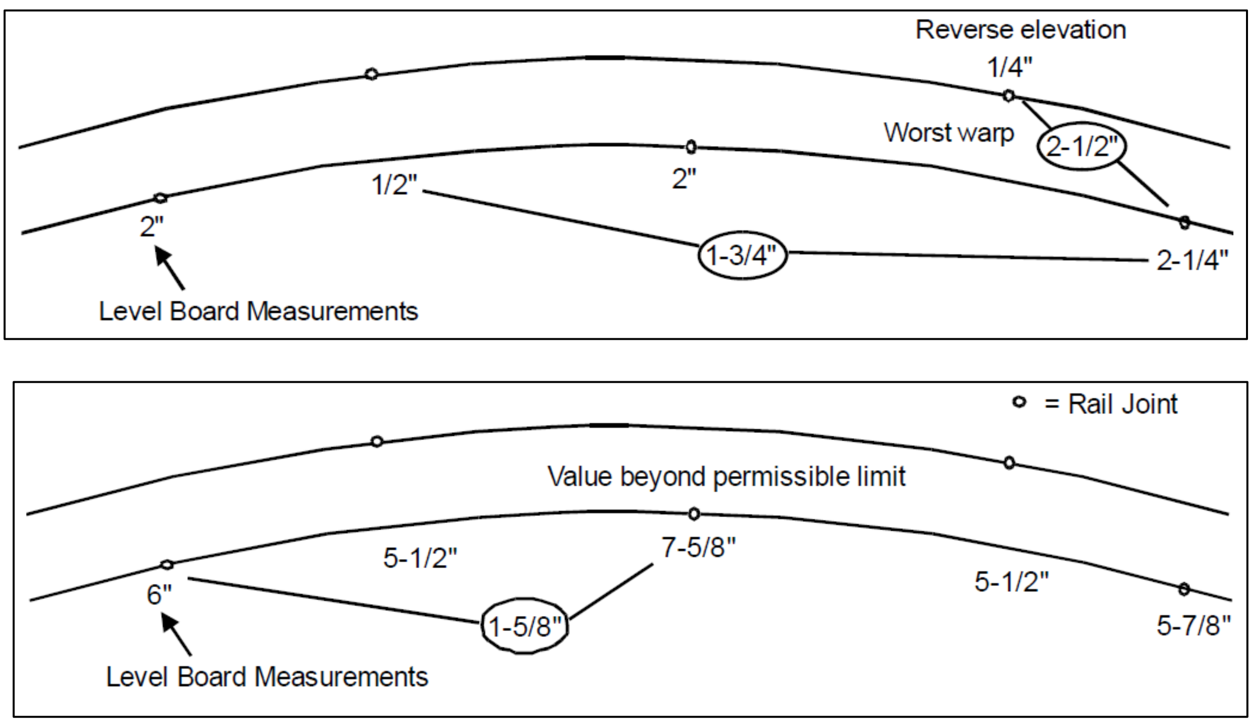


Figure SUB-PART C – 37 – Warp 62' Examples (curves)

iv. Identifying a WARP 62’ defect;

- Measure for warp by checking the cross level on one side and adding that measurement to where it is low on the other side within 62’ of each other
  - In tangent, either rail can be the grade (reference) rail, however the same rail must be used throughout
  - In curves and spirals, the low rail is used as the grade (reference) rail
- Take note of the unloaded measurements seen in the field
- Can occur as a low spot on one side of the track with another defect accompanying it.
- Can occur by two joints within 62’ of each other but on opposite rails; the combination of their values (one high and one low) will affect the crosslevel variation.

v. Correcting WARP 62’ Defects

- Surfacing once the variation has been found

b) WARP 31'

i. If the difference in crosslevel between any two points less than 31' apart in spirals exceeds the value as shown in the following table, a defect will be reported.

ii. As you approach the full body in a curve, the spiral's superelevation increases

iii. Occurs in spirals only

iv. A low spot in a spiral can unload a wheel which is simultaneously in heavy flanging while the truck is turning in the spiral

WARP 31' *Freight Speed MPH* *Passenger Speed MPH*	Class 1 *10* *15*	Class 2 *25* *30*	Class 3 *40* *60*	Class 4 *60* *80*	Class 5 *80* *95*
URGENT	2" *(51 mm)*	1-3/4" *(45 mm)*	1-1/4" *(32 mm)*	1" *(25 mm)*	3/4" *(19 mm)*
NEAR URGENT	1-7/8" *(48 mm)*	1-5/8" *(41 mm)*	1-1/8" *(29 mm)*	7/8" *(22 mm)*	5/8" *(16 mm)*

Figure SUB-PART C – 38 – WARP 31' Defects (inches and millimeters)

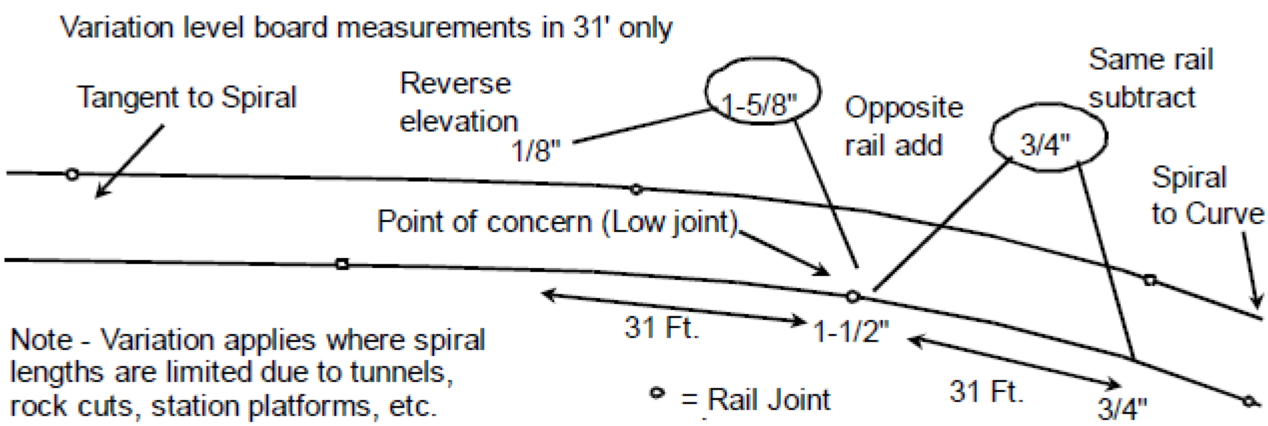


Figure SUB-PART C – 39 – WARP 31' Example

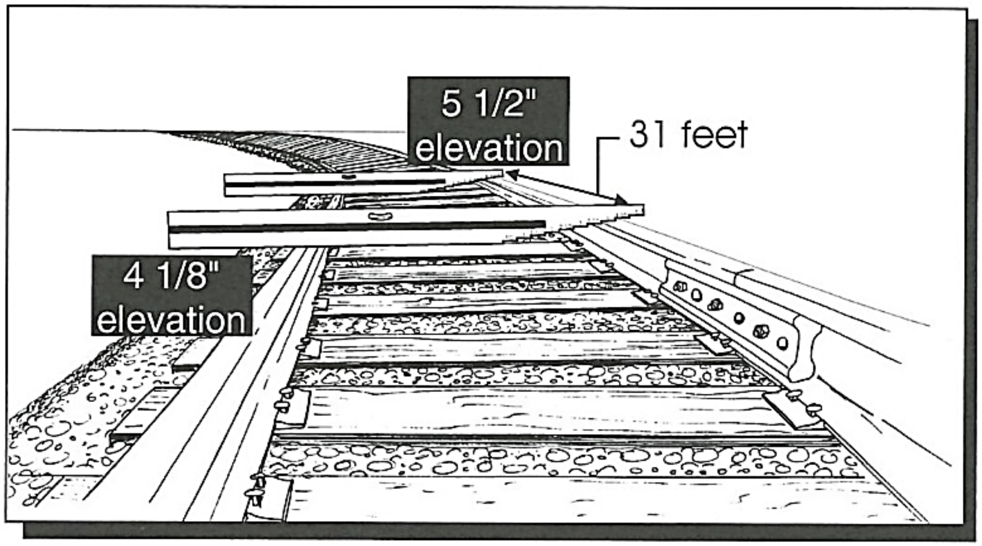


Figure SUB-PART C – 40 – WARP 31' Example

v. Identifying a WARP 31’ defect;

- A low joint or something similar may have caused this defect
- Can be difficult to spot by eye
- In spirals, the low rail is used as the grade (reference) rail
- Take note of the unloaded measurements seen in the field

vi. Correcting WARP 31’ Defects

- Care must be taken when correcting this defect to ensure another crosslevel defect is created

c) Rock and Roll Crosslevel (RR/XLV)

i. Not to be confused with Rock and Roll Surface defect which involves 6 or more consecutive alternating changes in surface measurements.

ii. If three consecutive alternating changes in crosslevel measurements exceed the values as shown in the following table for that class of track, it is an URGENT defect.

iii. A pattern of crosslevel defects over a distance of 45’ to 65’ coinciding with the length of the car’s truck centre spacing may cause a car to rock excessively on its springs, causing the wheels to lift from the rail.

iv. No direct relation between size of defect and track speed class.

v. Dynamic loadings will increase with speed.

vi. May cause a rocking condition in some types of rolling stock, usually an empty car and is more typical at speeds between 15 to 25 mph.

ROCK AND ROLL CROSSLEVEL	Class 1	Class 2	Class 3	Class 4	Class 5
Freight Speed MPH	*10*	*25*	*40*	*60*	*80*
Passenger Speed MPH	*15*	*30*	*60*	*80*	*95*
URGENT	1-1/4” *(32 mm)*	1” *(25 mm)*	1” *(25 mm)*	7/8” *(22 mm)*	3/4" *(19 mm)*
NEAR URGENT	N/A	N/A	N/A	N/A	N/A

***Figure SUB-PART C – 41 – Rock and Roll Crosslevel Defects** (inches and millimeters)*

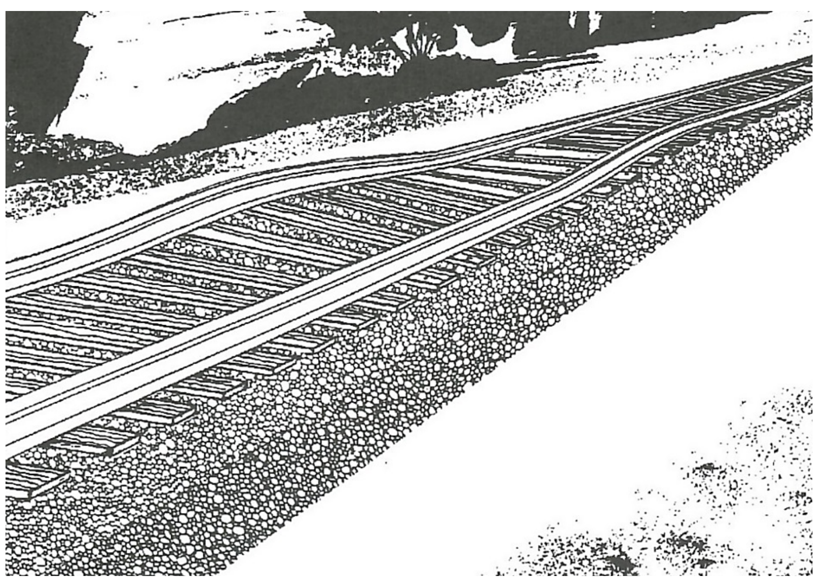


Figure SUB-PART C – 42 – Rock and Roll Crosslevel Defect Example

vii. Identifying a Rock and Roll Crosslevel defect;

- A series of ups and downs which are opposite to the other rail over a short distance
- In addition to the above, look for the following;

- Poor subgrade conditions
- Poor ballast and pumping ballast
- Hanging ties
- Water near the track
- Heavy frost heaves in cold weather

viii. Correcting Rock and Roll Crosslevel Defects

- Correct the surface of each rail.

11.5 Track Defects – Design

Following are 5 design defects for track;

- V_{MAX} Defect (Design Speed)
- XLV from Design Tangent Defect
- XLV from Design Curve Defect
- XLV from Design Spiral Defect
- Reverse Elevation

Over many years, the reliance was placed on tampers to smooth the tracks, they also may have deviated from its original design that would be seen by the experienced Foreman who would eye longer than 62'. As a general rule, when curves are tamped and lined, the operator should try to take the curve back to the curvature and elevation specified on the curve list.

a) V_{MAX} Defect

i. If the posted speed exceeds the calculated design speed because the curvature is too sharp and / or the superelevation is not enough for the authorized speed, it will report an URGENT defect

ii. If inadequate superelevation, a passing train could cause the high rail to be pushed outwards resulting in wide gauge or even rail rollover

iii. The maximum allowable speed is calculated using the average curvature through the body of the curve (excluding the spiral) and the average elevation, allowing 3" unbalanced elevation through the body of the curve

iv. One cause of inadequate curve elevation is when the ends of curves are run-off

v. If run-off occurs in a curve, use the actual minimum elevation when computing the maximum allowable operating speed for that curve

- Speed restrictions posted by the geometry test car are not the speed for the class of track but is the exact speed the curve is designed for; therefore, round this speed off to the next lower number in multiples of 0 and 5 (e.g., 37 to 35, 33 to 30 and 30 to 30); never increase the speed until the defect is corrected

DESIGN SPEED	Class 1	Class 2	Class 3	Class 4	Class 5
Freight Speed MPH	*10*	*25*	*40*	*60*	*80*
Passenger Speed MPH	*15*	*30*	*60*	*80*	*95*
URGENT	3" *(76 mm)*	3" *(76 mm)*	3" *(76 mm)*	3" *(76 mm)*	3" *(76 mm)*
NEAR URGENT	N/A	N/A	N/A	N/A	N/A

Figure SUB-PART C – 43 – Design Speed (VMAX) Defects (inches and millimeters)

vi. Identifying a V_{MAX} defect;

- Check the rails, ties and fastening for early signs of possible rail rollover
- Rail is both heavily curve worn and poorly lubricated
- Use a track level to confirm incorrect superelevation

vii. Correcting V_{MAX} Defects

- Will most likely need to be corrected using tamping / lining equipment account longer sections of the curve geometry require remedial action
- At times, a small spot may be causing the defect (e.g., low joint) and can be corrected with track maintenance
- May also be caused by excessive curvature caused by bunching up steel at the spiral to curve location

b) XLV from Design Tangent Defect

i. If the elevation in tangent deviates from zero elevation by more than the value shown in the following table, a defect will be reported.

XLV FROM DESIGN TANGENT	Class 1	Class 2	Class 3	Class 4	Class 5
Freight Speed MPH	*10*	*25*	*40*	*60*	*80*
Passenger Speed MPH	*15*	*30*	*60*	*80*	*95*
URGENT	3” *(76 mm)*	2” *(51 mm)*	1-3/4” *(45 mm)*	1-1/4” *(32 mm)*	1” *(25 mm)*
NEAR URGENT	2-7/8” *(73 mm)*	1-7/8” *(48 mm)*	1-5/8” *(41 mm)*	1-1/8” *(29 mm)*	7/8” *(22 mm)*

***Figure SUB-PART C – 44 – XLV from Design Tangent Defects** (inches and millimeters)*

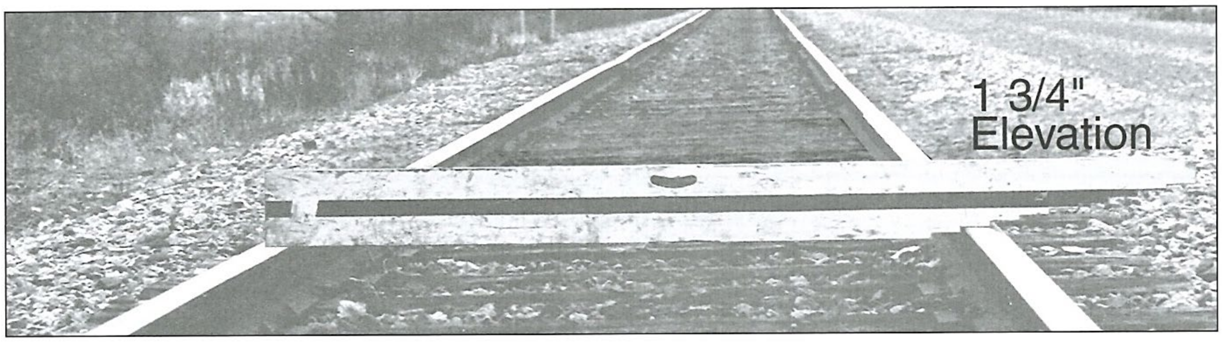


Figure SUB-PART C – 45 – XLV from Design Tangent Defect Example

ii. Identifying a XLV from Design Tangent defect;

- Using a track level, to identify the difference in elevation between the grade rail and the opposite rail, measured at right angles
  - Either rail can be the grade (reference) rail in tangent track however, the same rail must be used throughout

iii. Correcting XLV from Design Tangent Defects

- Use a tamper to lift and tamp the rail that has lost elevation

c) XLV from Design Curve Defect

i. If the elevation in a curve deviates from designated elevation on curves between spirals by more than the value shown in the following table, a defect will be reported.

XLV FROM DESIGN CURVE *Freight Speed MPH* *Passenger Speed MPH*	Class 1 *10* *15*	Class 2 *25* *30*	Class 3 *40* *60*	Class 4 *60* *80*	Class 5 *80* *95*
URGENT	3" *(76 mm)*	2" *(51 mm)*	1-3/4" *(45 mm)*	1-1/4" *(32 mm)*	1" *(25 mm)*
NEAR URGENT	2-7/8" *(73 mm)*	1-7/8" *(48 mm)*	1-5/8" *(41 mm)*	1-1/8" *(29 mm)*	7/8" *(22 mm)*

***Figure SUB-PART C – 46 – XLV from Design Curve Defects** (inches and millimeters)*

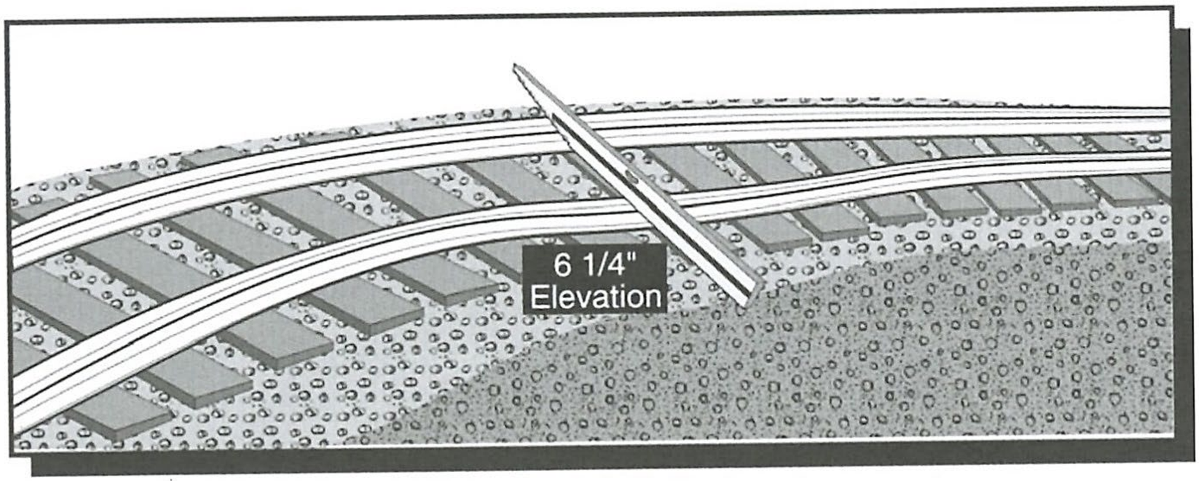


Figure SUB-PART C – 47 – XLV from Design Elevation Curve Defect Example

ii. Identifying a XLV from Design Curve defect;

- Place track level at the low point using the low rail as the grade (reference) rail to identify the difference between the 2 rails and design, taking note of the unloaded measurements seen in the field.

iii. Correcting XLV from Design Curve Defects

- Ideally, use a tamper to lift and tamp the rail that has lost elevation

d) XLV from Design Spiral Defect

i. If the elevation in a spiral deviates from designated elevation through the spiral(s) by more than the value shown in the following table, a defect will be reported.

XLV FROM DESIGN SPIRAL	Class 1	Class 2	Class 3	Class 4	Class 5
Freight Speed MPH	*10*	*25*	*40*	*60*	*80*
Passenger Speed MPH	*15*	*30*	*60*	*80*	*95*
URGENT	1-3/4" *(45 mm)*	1-1/2" *(38 mm)*	1-1/4" *(32 mm)*	1" *(25 mm)*	3/4" *(19 mm)*
NEAR URGENT	1-5/8" *(41 mm)*	1-3/8" *(35 mm)*	1-1/8" *(29 mm)*	7/8" *(22 mm)*	5/8" *(16 mm)*

Figure SUB-PART C – 48 – XLV from Design Spiral Defect (inches and millimeters)

ii. Identifying a XLV from Design Spiral defect;

- Place track level at the low point using the low rail as the grade (reference) rail to identify the difference between the 2 rails and design, taking note of the unloaded measurements seen in the field.

iii. Correcting XLV from Design Spiral Defects

- Ideally, use a tamper to lift and tamp the rail that has lost elevation

e) Reverse Elevation Defect

i. If the elevation in a curve is reversed from the curvature direction by more than the values shown in the following table, a defect will be reported. This defect is to identify locations in a curve where the high rail sagged and has less elevation than the low rail. This type of defect can occur in areas of shallow curvature or in turnouts as a result of poor ballast / sub-grade. Other design defects are generally within this curve. This defect may cause the cars to lean over.

REVERSE ELEVATION *Freight Speed MPH* *Passenger Speed MPH*	Class 1 *10* *15*	Class 2 *25* *30*	Class 3 *40* *60*	Class 4 *60* *80*	Class 5 *80* *95*
URGENT	3” *(76 mm)*	2” *(51 mm)*	1-3/4” *(45 mm)*	1-1/4” *(32 mm)*	1” *(25 mm)*
NEAR URGENT	2-7/8” *(73 mm)*	1-7/8” *(48 mm)*	1-5/8” *(41 mm)*	1-1/8” *(29 mm)*	7/8” *(22 mm)*

Figure SUB-PART C – 49 – Reverse Elevation Defect (inches and millimeters)

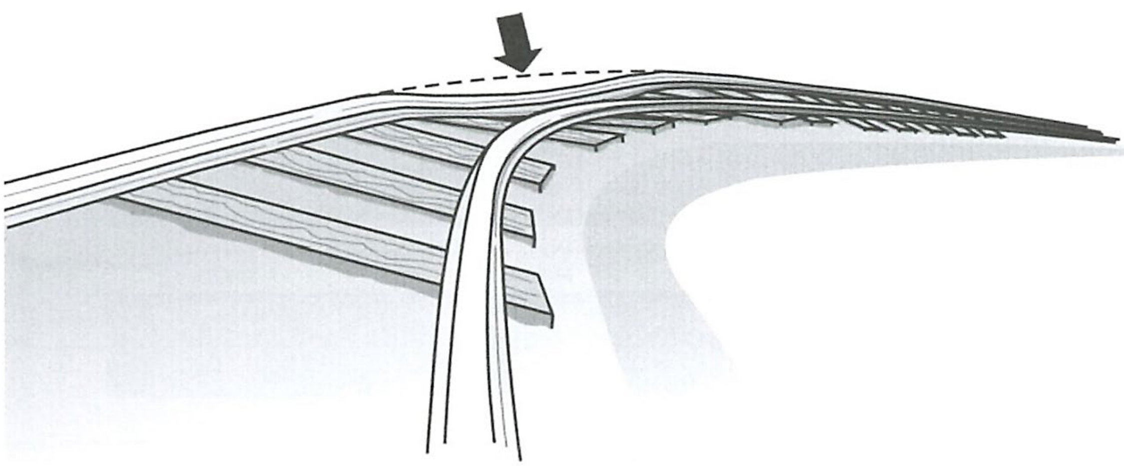


Figure SUB-PART C – 50 – Reverse Elevation Defect Example

ii. Identifying a Reverse Elevation defect;

- This defect can appear as a low spot on the high rail or a high spot on the low rail. In some areas (shallow curves or throughout most of the curve), you may not see it by eye. The use of a track level is required taking note of the unloaded measurements seen in the field.

iii. Correcting Reverse Elevation Defects

- Ideally, use a tamper to lift and tamp the rail that has lost elevation

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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.

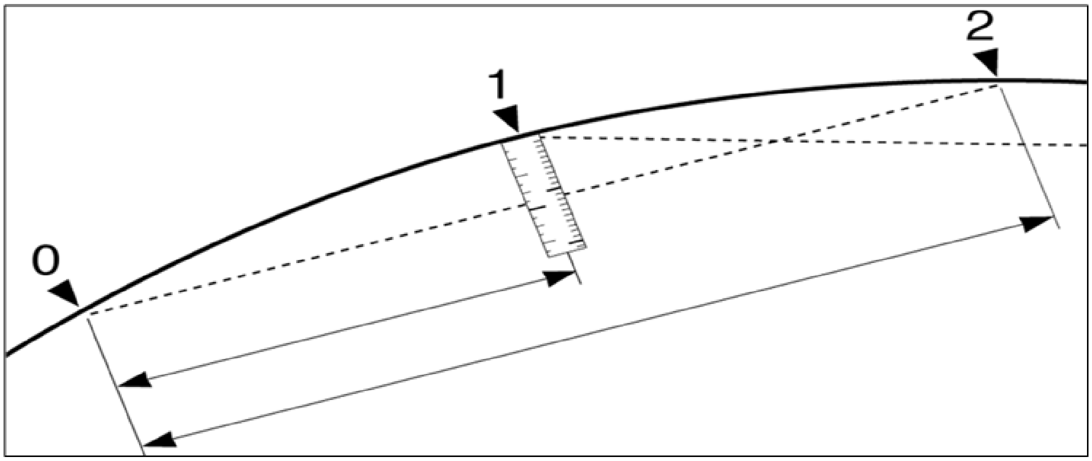


Figure SUB-PART C – 51 – Degree of Curve Measurement

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 – 60 – 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:

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

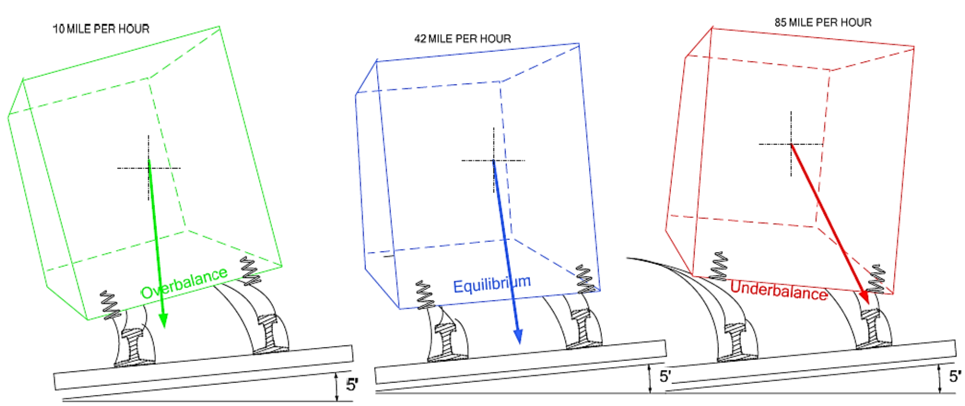
Where:

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 12.12 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 – 60 – 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.

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13. Surfacing and Lining

13.1 Surfacing and Lining – General

a) Except in cases of emergencies and precautions are taken, no out-of-face surfacing and lining will be performed if the rail temperature is above the PRLTR.

b) Do not raise track more than necessary to maintain good surface. Individual lifts should not exceed 3” and overall raises exceeding 6” are to be avoided unless authorized by the Director, Rail Infrastructure.

c) When the track is raised during surfacing operations, do not allow the rate of change in surface, e.g., the rate of run-out, to be more than the rate shown in Figure Sub-Part D – 3 – Run-Out Gradient.

d) Special attention is to be given to the surface and line of track at the approaches to bridges, culverts, switches, diamonds, road crossings and tunnels.

e) Signals must be notified when surfacing around insulated joints, switch machines, crossing protection equipment or other signal devices, care must be taken to prevent damage to bond wires, conduits, or other signal connections to the track. Particular attention is to be given to Wayside Inspection Systems (WIS).

f) Ensure brooming and regulating operations do not damage adjacent property especially at highway underpasses and pedestrian walkways.

g) To prevent centre bound track, avoid tamping tie centres.

h) Whenever it is necessary to disturb the ballast to permit surfacing and lining, whether it is manual or mechanical, restore the ballast shoulder and fill the ballast cribs before returning the track back to train service.

i) To control harmonics on Class 2 through 5 jointed tracks with staggered joints, the cross-level differences shall not exceed 1 ¼ inches *(32 mm)* in all of six consecutive pairs of joints, as created by 7 low joints. Track with joints staggered less than 10 feet shall not be considered as having staggered joints. Joints within the 7 low joints outside of the regular joint spacing shall not be considered as joints for purposes of this section. For 79 ft or 80 ft rails, this subsection is not applicable.

j) The rules specify the 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 rules may require remedial action to provide for safe operation over the track.

13.2 Surfacing and Lining – Clearances

a) When surfacing or lining track where overhead or lateral clearances are involved (e.g., 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 its distance from adjacent tracks must not be changed without the authority of the Director, Rail Infrastructure.

b) Where permanent reference points are situated to indicate the location and elevation of the track, they must be adhered to.

13.3 Surfacing and Lining – CWR Territory

a) Work requirements and speed restriction requirements associated with surfacing and lining in CWR territory are given in Sub-Part D – Section 7.8 – CWR – Buckled Track.

b) The work requirements and speed restrictions for Surfacing and Lining in CWR territory also apply in jointed territory.

13.4 Surfacing and Lining – Concrete Tie Track

a) Prior to surfacing or mechanized tie replacement on a main track CWR curve which is more than 3°, the curve must be staked per Sub-Part D – Section 7.7.1. – Surfacing and Lining in CWR Territory.

b) When surfacing is performed in concrete tie track:

- Adjust tamper head limit switches to ensure the correct penetration of the tamping tools below the tie.
- Ballast regulator plow blades must be adjusted to ensure no impact of the fasteners.
- Upon completion of ballast regulating, inspect the fastening system and replace the missing or damaged fasteners.

c) The work requirements and speed restrictions for Surfacing and Lining in CWR territory also apply in jointed territory.

d) Concrete ties should be inspected for signs of center bound condition.

- This condition is represented by transverse cracks visible in the middle third of the tie.

13.5 Surfacing and Lining – Ballast Stabilization

Ballast stabilizing machines have a relatively large mass (approx. 60 tonnes). This enables it to transmit the large vertical forces required into the track structure concurrently with horizontal oscillations of the track to produce a controlled settlement of the ballast.

The frequency of oscillation, vertical loading and machine work speed are variables which have an effect on the degree of stabilisation obtained. All three factors can be varied and monitored as required.

The operation should be done taking into consideration the operating techniques and instructions issued by the manufacturer.

The objective of ballast stabilization is to accelerate the compaction of newly tamped ballast, a process which occurs naturally under traffic. Stabilization improves track lateral stability, and reduces the need for speed restrictions. Stabilization can be achieved in one of two ways:

a) With a ballast compactor, which uses vibrating plates to apply pressure directly onto the ballast surface; or

b) With a Dynamic Track Stabilizer (DTS), which imparts a horizontal vibration (normally at about 35 cycles per second) and a static vertical load onto the rails.

- Produces a homogenous compaction of the entire ballast bed which ensures that any cavities underneath the ties are reduced, and
- A re-arrangement and consolidation of the ballast bed may be achieved.

13.5.1 General Guidelines

a) Dynamic Track Stabilization (DTS) is typically equivalent to about 100,000 gross tonnes of rail traffic.

b) Only stabilize track which has been recently tamped, and which has good quality ballast.

NOTE: Stabilization has no beneficial effect elsewhere.

c) With dynamic track stabilization, ties and fastenings must be in good condition, to satisfactorily resist the loadings applied to them.

d) Bring a dynamic track stabilizer to its operating frequency as quickly as possible and while the machine is moving – avoid low frequency vibrations.

e) Use of dynamic track stabilization on or within 10 m of bridges, spans, concrete structures, or buildings is restricted unless authorized by the Director, Rail Infrastructure. These authorizations are to be reviewed in conjunction with the asset condition assessment reports.

f) Do not stabilize over or near structures, weak formation, or other areas which may not adequately withstand vibration.

g) Use of stabilizers in tunnels is prohibited.

h) When track is being tamped with multiple lifts, stabilize the ballast after each lift.

13.5.2 Operating Restrictions

Vibrating forces generated by the machine can be quite powerful and under certain conditions may excite critical vibration frequencies in nearby structures, although most structures have critical frequencies in the low portion of the stabilizer's vibration range.

When starting the vibration units,

a) The units should be engaged onto the rails and

b) Brought up to the required vibrating frequency as quickly as possible.

Conversely, when stopping the vibration units,

a) They should be stopped as rapidly as possible.

This will prevent any possible critical vibration frequency ranges from being prolonged.

Starting and stopping the vibration units should occur only when the machine is moving.

In order to avoid possible damage to structures or the machine itself, the stabilizer should not be used:

a) On any track with heavily fouled or cemented ballast;

b) On open top bridges;

c) On ballast top timber bridges and steel trough bridges;

d) In tunnels;

e) On track within 5m of multi-storey buildings;

f) On concrete slab track and over pits;

g) Over any level crossing that has not been recently tamped;

h) At locations near old or fragile signalling equipment as specified by Signals and Communications;

i) Through turnouts, crossovers and diamonds and similar locations where the track has not been recently tamped and then only with care and with the roll clamps open;

j) Through platforms where the ballast between tie ends and the platform wall is heavily fouled.

13.5.3 Conditions Required for Effective Stabilizing of Track

Under the following conditions, a DTS may be used provided the following conditions are met,

a) Requirements of Sub-Part D – Section 7 – Continuous Welded Rail (CWR) are adhered to.

b) Applicable temporary speed restrictions per Sub-Part D – Section 7.9 – CWR Temporary Speed Restrictions Account Track Work are applied.

c) Area DTS is performed is in CWR territory with 115 lbs rail or greater.

d) Ballast should be relatively clean and free flowing. The machine should not be used on heavily fouled or cemented ballasted track.

e) DTS is performed following tamping, and travels over the track at a continuous speed no more than 2 mph. It should also work far enough behind preceding machines so that its operation is not hampered by slower production machines or by any problems with the machines ahead.

  - Ballast must be disturbed prior to using the stabiliser so that it can flow under the actions of the machine. For best results the track should be ballast cleaned and/or tamped prior to stabilising.

  - The track must be regulated to fill cribs and form shoulders so that there is sufficient ballast to allow for ballast loss due to settlement of the ballast during the stabilising process.

f) Rail to tie fastenings must be sound so that the horizontal oscillation generated by the machine can be transmitted through the rails and sleepers into the ballast.

g) The track must be in the required position and to desired standard prior to stabilizing. The machine can correct some minor faults in top and superelevation but is not designed to correct major faults in track geometry or poor quality after tamping.

h) If the total raise will be more than 4", perform the raise in at least 2 lifts with the DTS being utilized in between lifts.

i) DTS puts the track panel and ballast into a targeted horizontal vibration, while applying a static vertical load.

j) Shoulders and cribs restored to ensure optimal frictional resistance to dynamic loading.

k) Sufficient rail anchors and fasteners are applied to resist longitudinal forces.

l) Surface, line and gauge restored.

m) Except in cases of emergencies, no out-of-face surfacing and lining, rail replacement or tie renewal will be performed if the rail temperature is above the PRLTR.

13.5.4 Use of Ballast Stabilizing Machines

The ballast stabilizing machine should finish its run-out ramp. For example, at zero pressure and vibrators turned off whilst moving, no closer than 10 metres from the nearest extremity of a bridge abutment or return wingwall. The reverse is to apply at the start of the operation. For example, when moving away from the structure.

The machine may travel over:

a) Brick or masonry under-bridge spans over 5 metres long where the parapets directly contain the ballast;

- Concrete bridges are acceptable

b) Structurally sound masonry or other types of culverts less than 5 metres span but only if the culvert has a minimum of 1 metre cover between the top of the culvert and the underside of the ballast bed;

c) Modern pre-stressed concrete reinforced concrete or steel under-bridge, only with concrete piers and abutments and only where these substructure elements have been constructed/renewed at the time of the deck construction.

d) Also refer to Section 13.5.1 e)

This specification assumes bridge components are free of structural defects.

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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.

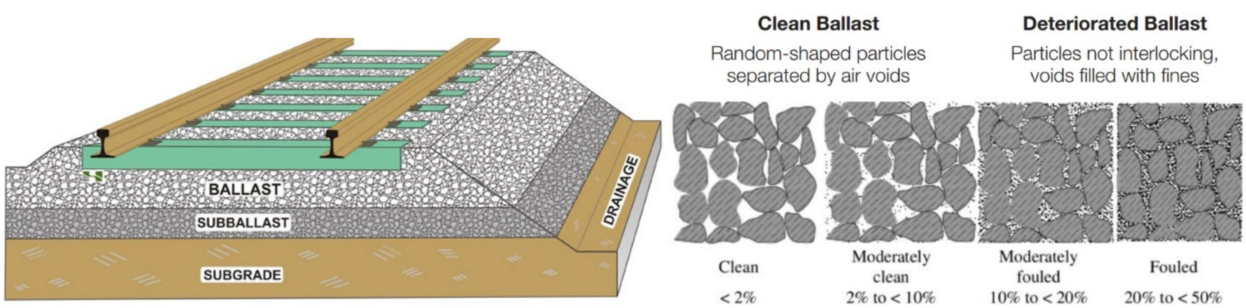

Figure SUB-PART D – 1 – Sub-Grade, Sub-Ballast, Ballast, Drainage and Clean vs. Deteriorated Ballast

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.

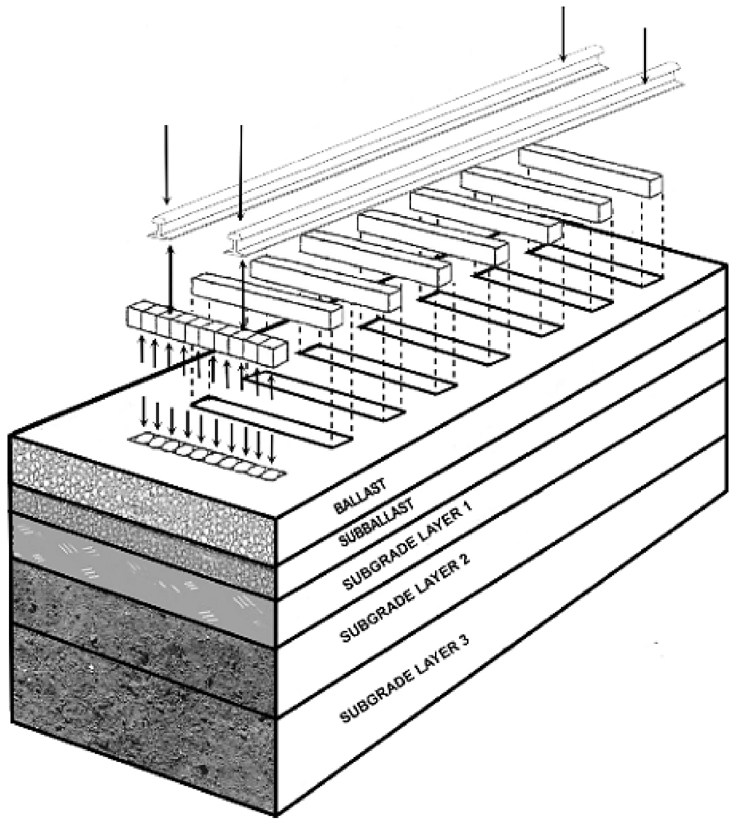

Figure SUB-PART D – 2 – Materials of Sub-Grade, Sub-Ballast, and Ballast Layers

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 – CWR – Buckled Track.

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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 13 – 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)*,

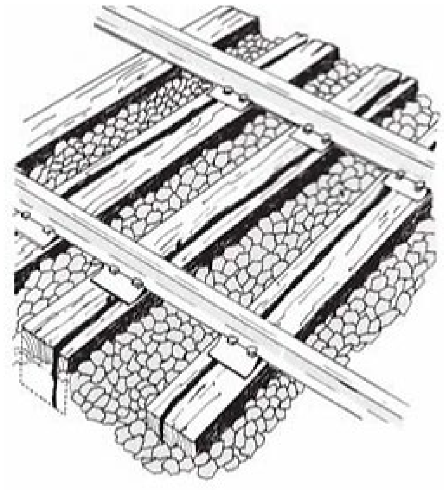
iv. Tie cut more than 40% of tie thickness, or

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

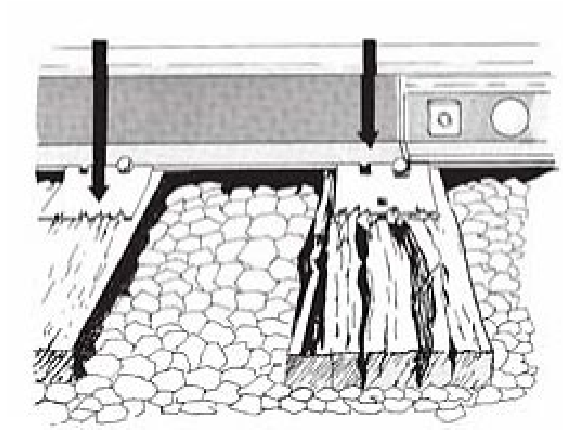
vi. Not holding surface, line, or gauge.

Figure SUB-PART D – 4 – Examples of Tie Damage / Defects (other than concrete)

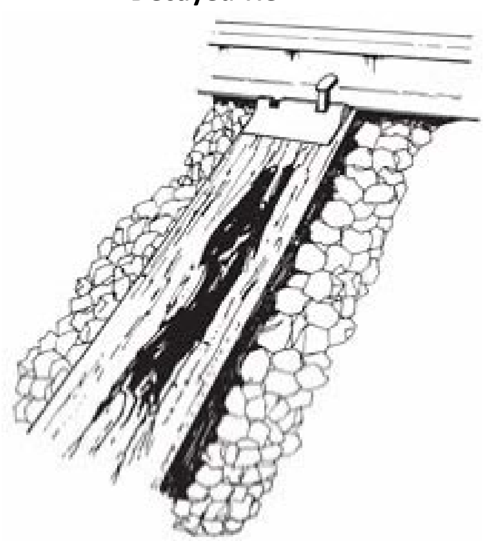
Tie Split End to End
- tie will not hold spikes or rail



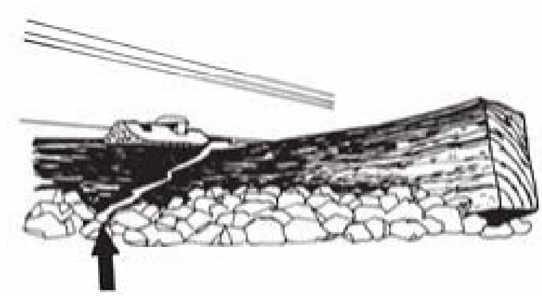
Spike Killed or Crushed
- sign of spreading track



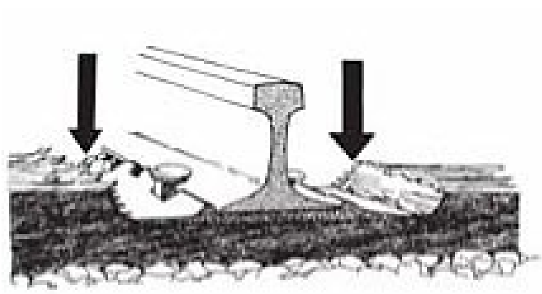
Decayed Tie



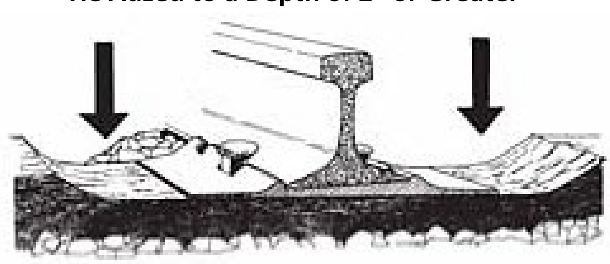
Broken Tie Under Rail Base



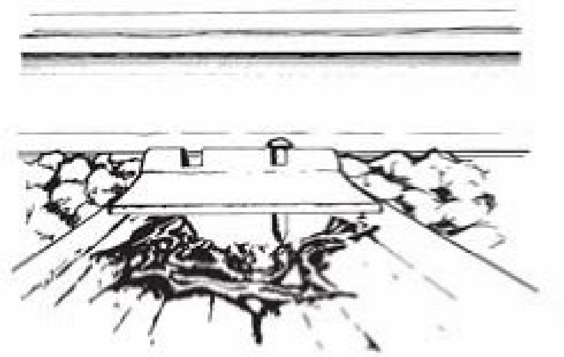
Tie Cut More Than 40% of Thickness



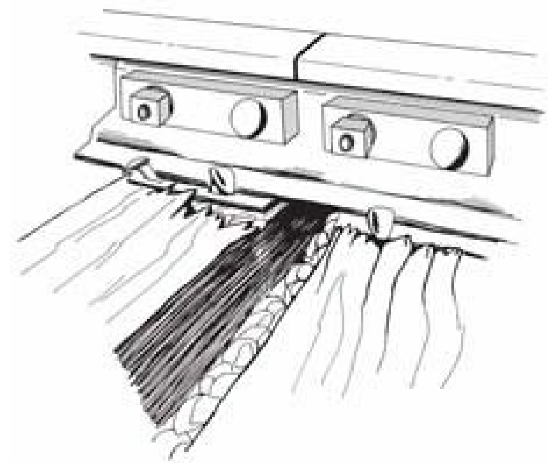
Tie Adzed to a Depth of 2” or Greater



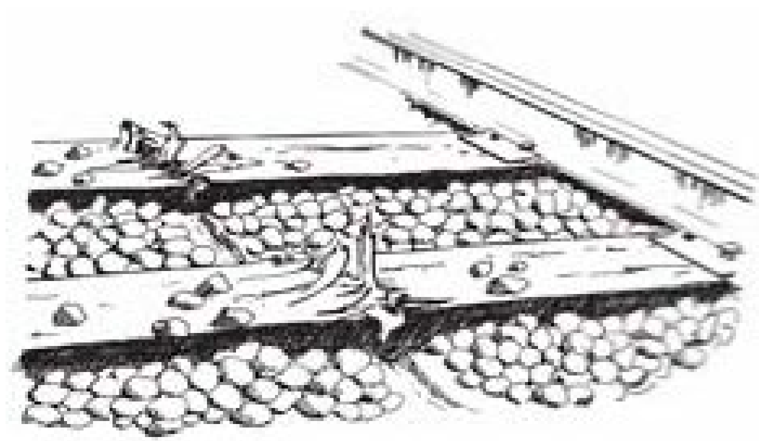
Burnt Tie



Spike Killed, Crushed of Decayed



Damaged Tie
- Depth of 2” or more due to derailments, dragging equipment or fire



2.4 Ties – Concrete Ties – General

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

b) Surfacing on concrete tie track must be in accordance with [Sub-Part C – Section 13 – Surfacing and Lining].

c) Concrete tie performance is reduced where there is inadequate support:

   i. The track holds water or is muddy.

   ii. Drainage of water and replacement of fouled ballast should extend approximately 12” below the bottom of tie.

   iii. There are impacts from rail conditions.

      - Joints should be welded as soon as possible.
      - Surface irregularities such as corrugated rail, crushed heads, wheel burns, etc. should be removed as soon as possible.

2.5 Ties – Concrete Tie Installation

a) Concrete ties shall be installed:

   i. With tie centers at maximum 24”.

   ii. With a minimum 12” of clean, well draining ballast under the bottom of the tie.

   iii. With 12” of shoulder ballast.

   iv. Not installed within 20’ of an open deck bridge which is more than 50’ long.

      - At the direction of the Director, Rail Infrastructure, twelve 11’ hardwood ties will be installed as transition ties off the bridge backwall.

b) Transition ties,

   i. At the transition from wood ties to concrete ties, at the direction of the Director, Rail Infrastructure, install a transition tie set consisting of four each 9’ *(2,800 mm)*, 10’ *(3,100 mm)* and 11’ *(3,400 mm)* hardwood ties spaced 20” *(508 mm)* with the 11’ ties adjacent to the concrete ties.

      - While the transition tie set is preferred, twelve 10’ timber transition ties spaced 20” *(508 mm)* apart are acceptable in lieu of the timber transition tie set.

   ii. Permanent transition tie sets shall not be placed within horizontal curves nor within spirals. The distance between transition tie sets and spirals (TS and ST geometry points) and simple curves (BC and EC) shall be the greater of:

      - Preferred minimum: 200’ *(61,000 mm)*
      - Absolute minimum: 40’ *(12,200 mm)*

   iii. Any values lower than 200’ *(61,000 mm)* must be reviewed and approved by the Director, Rail Infrastructure.

   iv. Installation of permanent transition tie sets within 40’ *(12,200 mm)* of spirals or in full body of curves must be reviewed and approved in writing.

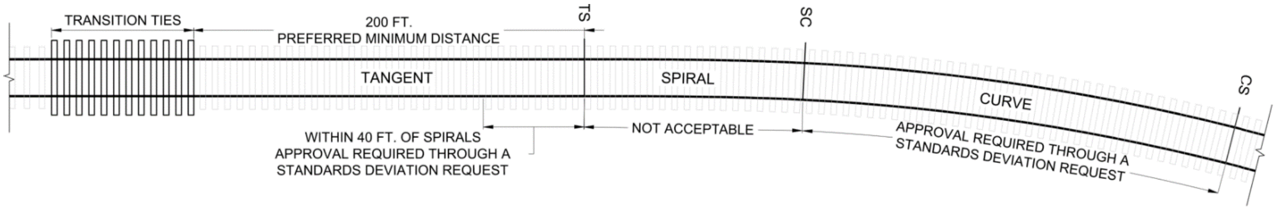


Figure SUB-PART D – 5 – Location of Permanent Transition Tie Sets

c) Concrete ties shall have the correct clips, pads and insulators applied at the time of installation.

d) No ties shall be installed when the rail temperature is above the PRLTR unless directive by the Director, Rail Infrastructure who must specify all necessary precautions to be taken such as mandating the use of a stabilizer, increased inspections, more restrictive speed restrictions or limiting work to emergency applications.

2.6 Ties – Concrete Tie Defects

a) Defective concrete ties are defined as those that are:

i. Broken through or deteriorated to the extent that the stressing tendon material is visible, or shows signs such as loss of tension in pre-stressing wires or crumbling concrete;

ii. So deteriorated or broken off in the vicinity of the shoulder or insert so that the fastener assembly can either pull out or move laterally more than 3/8” relative to the crosstie;

iii. So deteriorated that the base of either rail can move laterally more than:

- 1/2” relative to the crosstie on tangent track or curves of less than 2°;
- 3/8” relative to the crosstie on curves of 2° or greater

iv. Bottom of the tie is worn to the extent that pre-stressing wires are exposed.

v. So deteriorated or abraded at any point under the rail seat to a depth of 1/2” or more. An abraded tie is no longer defective if repairs to the tie have been performed;

vi. So deteriorated such that the crosstie's fastening or anchoring system, including rail anchors, is unable to maintain longitudinal rail restraint, or maintain rail hold down, or maintain gauge due to insufficient fastener toe load; or

vii. Less than two fasteners are present on the same rail. Except where fastener placement impedes insulated joints from performing as intended, the fastener may be modified or removed, provided the crosstie supports the rail.

b) A cracked tie should not be confused for a defective tie. A concrete tie is not considered defective until the crack extends through the entire tie or runs through the shoulder. Tie end damage caused by handling, ballast regulators or impacts does not make the tie defective.

Figure SUB-PART D – 6 – Broken Through Concrete Tie (left) **and Transversely Broken Concrete Tie Between Rails** (right)

2.7 Ties – Joint Tie Requirements (Timber and Concrete)

a) Note that each 39-foot segment has approximately 22 ties.

b) Ensure that at least the number of non-defective ties shown in the following table:

MINIMUM NON-DEFECTIVE TIES PER 39 FT		
CLASS OF TRACK	**Tangent and Curves No Greater Than 2°**	**Turnouts and Curves Greater Than 2°**
Class 1	5	6
Class 2	8	9
Class 3	8	10
Class 4, 5	12	14

Figure SUB-PART D – 7 – Minimum Non-Defective Ties per 39'

c) For Class 1 or Class 2 lines,

i. Ensure that each rail joint is supported by at least one non-defective tie, with a tie plate, whose centerline is within 24 inches *(610 mm)* either side of the rail joint location.

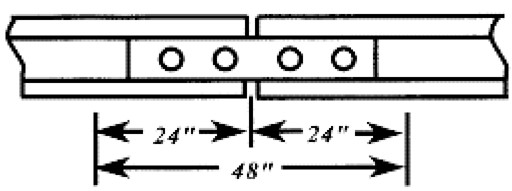


Figure SUB-PART D – 8 – Class 1 and Class 2 - Non-Defective Tie Spacing in a Joint - Within 24"

d) For Class 3 through Class 5 track,

i. Ensure that each rail joint is supported by at least one non-defective tie, with a tie plate, whose centerline is within 18 inches *(457 mm)* either side of the rail joint location.

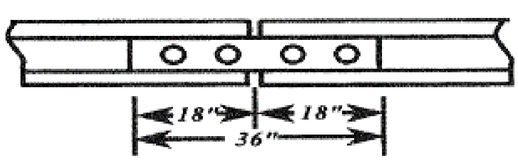


Figure SUB-PART D – 9 – Class 3 through Class 5 - Non-Defective Tie Spacing in a Joint – Within 18"

e) For Class 2 through Class 5 track,

    i. Ensure that there are not more than 2 defective ties in adjacent positions in the joint area.

f) Where the above tie conditions are not met, local forces must spot in ties or train speeds must be restricted to bring the track into compliance.

2.8 Ties – Maintenance (Timber and Concrete)

a) When renewing ties, maintain the surface, line, and gauge of the track.

b) Immediately tamp the new tie so as to make its bearing surface match that of the adjacent ties.

c) Do not insert tie plates, pads, etc. after the tie has been tamped.

d) For timber ties, when a spike is pulled, plug the spike hole in the tie with a wooden tie plug or approved chemical tie compound. When re-spiking, drive the spike into the plug (if possible).

e) A spot program should be undertaken when there is a high frequency of;

    i. Four or more consecutive defective ties,

    ii. Three or more consecutive defective ties in a curve greater than 2°; or

f) Defective ties in the joint area.

g) When renewing ties, regardless of method of installation;

    i. Coordinate work with Signals if at insulated joints, within the limits of signalized crossings or signals and communications equipment (e.g., wayside detectors),

    ii. Correct gauge where required,

    iii. Where required, no more ballast than is absolutely necessary should be removed from the crib or shoulder,

    iv. All ties installed must be spiked and anchored, the ballast shoulders restored, and the ties properly tamped before the close of each day. Any adjacent ties that may be left hanging should also be tamped; and

    v. When necessary to allow trains to operate through tie gang renewal areas during working hours,

        - Not more than three consecutive ties on tangent track or two consecutive ties on curved track can be left unspiked,
        - Ties on either side of all joints must be spiked, and
        - Speed must be limited to a maximum of 10 mph.

    vi. In preparation for the following day tie installation the spiking pattern may be reduced to a minimum of 2 rail holding spikes (one gauge and one field) per plate on each tie to be removed,

    vii. Hard and softwood ties should not be mixed on the main track except when changing from one category to another (e.g., curve to tangent).

h) When piling ties for pick-up or disposal, place them:

i. At a safe distance from the track, clear of the wing of ballast regulators.

ii. On the opposite side of the track from any wire line (if possible).

iii. Every effort should be made to ensure they will not activate an automatic warning system when picking up or disposing them.

iv. Where they will not block key sight lines.

v. Where they will not present a hazard to employees.

vi. Away from streams, rivers, environmentally sensitive or drainage systems.

2.9 Ties – Inspection – General

a) Examine ties in track as early as possible each year to determine their condition. Identify and include on a tie count list any ties that are candidates for renewal based on current condition. Include ties that are defective as in Sub-Part D – Section 2.3 – Timber Tie Defects, Sub-Part D – Section 2.6 – Concrete Tie Defects, and Sub-Part D – Section 2.10 – Concrete Tie Inspection and Maintenance.

b) Include timber ties that exhibit the following conditions:

i. Split end-to-end,

ii. Adzed or plate cut more than 2 inches,

iii. Severely crushed,

iv. Spike killed, or

v. Severely decayed.

c) Do not use a pick or other sharp instrument on the top of the timber tie when testing ties.

d) The Track Supervisor (Inspector) may prepare a mile-by-mile list showing the number of ties that are defective on main tracks, 1/5 of the track miles each year to complete all main tracks every 5 years,

e) Renewal ties should be marked and recorded for which programmed tie renewal is planned for the following year.

2.10 Ties – Concrete Tie Inspection and Maintenance Considerations

a) For concrete ties, the following conditions must be reported to the Supervisor, immediately:

i. Any derailment of equipment on concrete ties, whether damage is noticeable or not.

ii. Any significant abrasion or wearing away of the tie in the rail seat area.

iii. Any loose shoulders.

iv. Any cracking of the tie if it shows signs of continuing deterioration, or if the cracking could affect the ability of the tie to hold the cast shoulder in place.

v. Any significant rate of failure of rail clips that cannot be explained by damage from an outside source (e.g., dragging of equipment, a ballast regulator, etc.).

b) Special attention must be paid to the condition of concrete ties in areas of derailment damage. Note the presence and growth of surface cracks or progressive deterioration of the tie.

c) Rail Seat Abrasion

i. Rail seat abrasion occurs when the concrete in the rail seat area is abraded away by the introduction of moisture. The abrasion erodes the surface of the tie under the rail resulting in loss of restraint by the clip, rail cant and gauge widening.

ii. Inspection for signs of rail seat abrasion on concrete ties is critical. Indications of rail seat abrasion are:

- Tie pads curling, squeezing out, or bleeding at the sides or ends of the rail seat.
- Tie pads worn through or indenting into the surface of the rail seat.
- Excessive rail cant.
  - Each degree of cant is equal to 1/8” *(3 mm)* of gauge widening.
- Signs of rail running through the clips or missing clips.
- Displaced or missing insulators.
- Concrete dust or slurry adjacent to the tie pad.

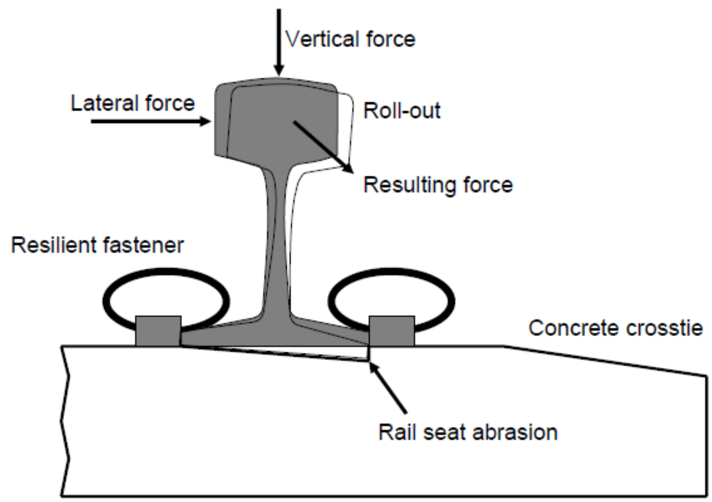


Figure SUB-PART D – 10 – Concrete Tie Rail Seat Abrasion

iii. When signs of significant rail seat abrasion appear, inspect the rail seat by unclipping the rail, jacking the rail up, removing the insulators and pads and examining the rail seat.

d) During rail replacement, tie pads must be removed, and the rail seat examined for abrasion.

e) Inspect the fastening system of concrete ties:

i. Replace sprung or damaged clips.

ii. Shoulder insulators should be firmly seated with the post between the cast shoulder and the base of the rail.

- Insulators that are twisted or cracked should be replaced.
- Shoulder insulators that have a post which is excessively thinned will cause wide gauge and need to be replaced.

f) Tie pads should be inspected for signs of tearing, thinning or wear. Correct pad thickness helps maintain required clip loading. Replace worn or defective pads.

g) Shoulder insulators must not be forced or driven in place. Use a rail positioner to provide the suitable gap for installation.

h) Wide post insulators can be installed on the field side shoulder to correct gauge widening.

i) Use care when applying heat to the rail during relays or adjusting a pull apart. Remove the insulator if necessary and reapply after heating. Always inspect both the insulator and pad after heat has been applied to the rail.

2.11 Ties – Installing Track and Switch Ties in CWR Territory

a) Tie Replacement in CWR Territory

i. No ties will be installed when the rail temperature is above the PRLTR unless directed by the Director, Rail Infrastructure. The Director, Rail Infrastructure must specify all necessary precautions to be taken,

ii. In CWR territory the maximum number of consecutive track ties that can be renewed in a single pass shall be:

NUMBER OF CONSECUTIVE TIES (in CWR)		
	Tangent and Curves No Greater Than2°	Curves Equal or Greater Than 2°
With a Junior or Production Tamper	5	4
With Hand Tamping or Hydraulic Tools	3	2

Figure SUB-PART D – 11 – CWR Territory - Maximum # of Ties Renewed in a Single Pass

iii. Switch ties in CWR territory may be replaced in a single pass provided the appropriate speed restriction is applied.

iv. Crossing ties in CWR territory replaced as part of crossing rehabilitation may all be changed in a single pass provided;

- Crossing surface is replaced immediately following tie renewal,
- Crossing approaches are restored and are of sound condition; and
- The appropriate speed restriction is applied.

v. Hard and softwood ties should not be mixed on the main track except when changing from one category to another (e.g., curve to tangent).

b) Speed Restriction Requirements in CWR Territory

i. Speed restriction requirements associated with installing track and switch ties in CWR territory are given in Sub-Part D – Section 7.8 – CWR – Buckled Track.

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.

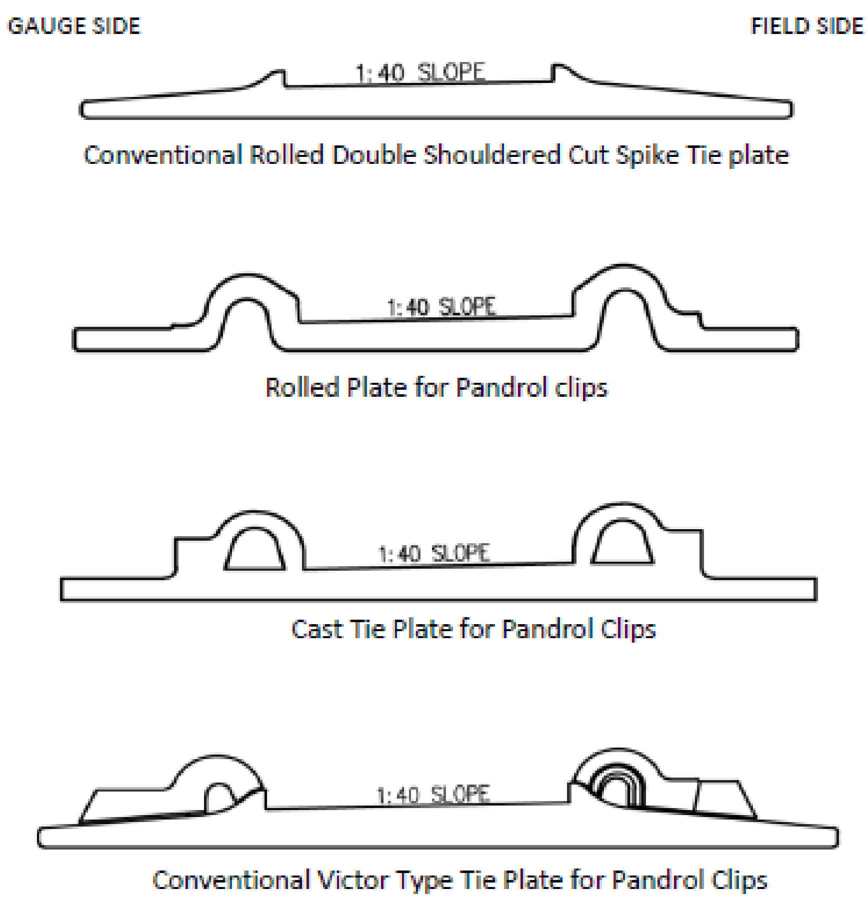


Figure SUB-PART D – 12 – Various Tie Plates and Cant

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,

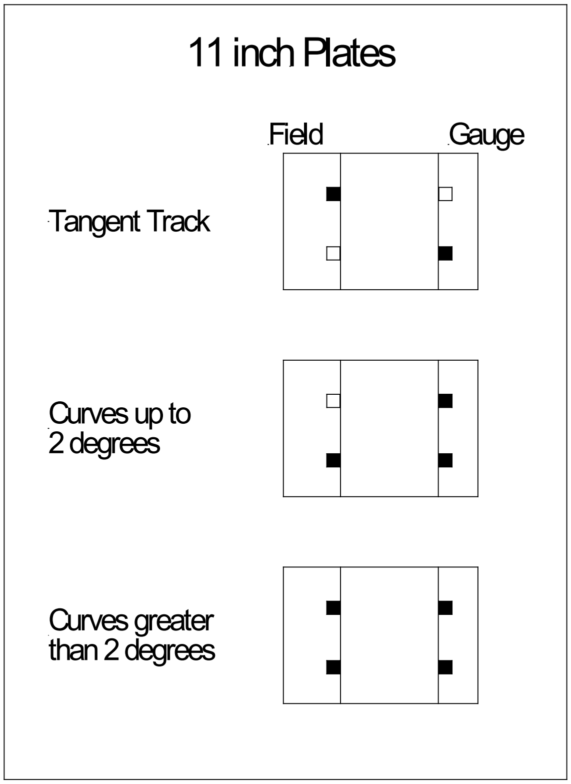


Figure SUB-PART D – 13 – Spiking Patterns – 11" Plates

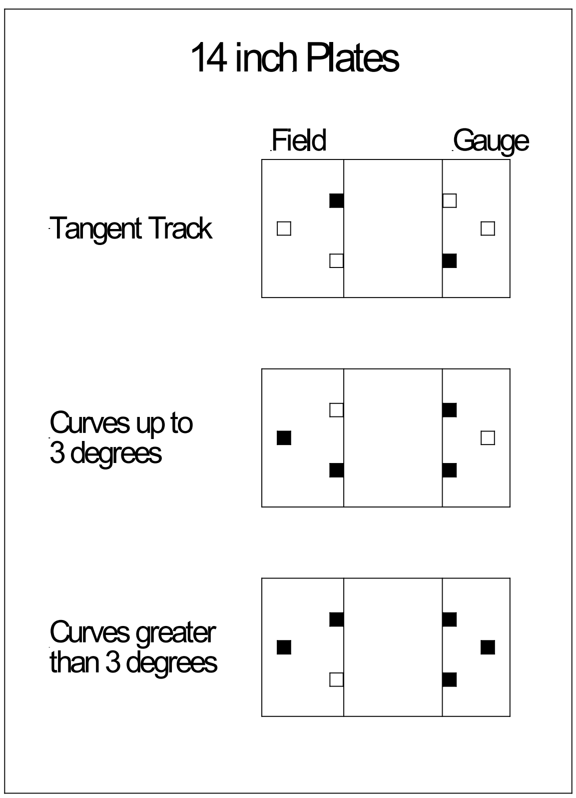


Figure SUB-PART D – 14 – Spiking Patterns - 14" Plates

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

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.

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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 4 – 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.

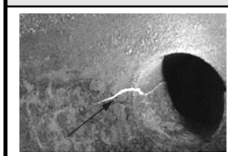
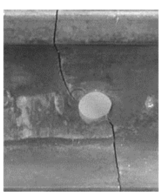
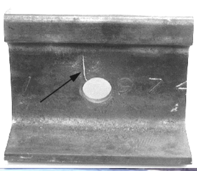
6.5 Rail – Defects and Protection Codes

6.5.1 Bolt Hole Crack – BHO / BHJ

Bolt Hole Crack – BHO or BHJ

Contractor's Designation	**Defect Size*** (inches and millimeters)	**Protection Code per Section 6.6**	**Ways to Reduce Frequency of Defect Occurring**
BHO / BHJ (outside of joint or in joint area)	Cracked Out	1	Joint elimination Keep bolts tightened. Tamp up joints. Build up rail ends by welding. Use proper drilling fixture. Regularly change drill bits.
	More than 1/2" but not Cracked Out *(More than 13 mm but not Cracked Out)*	4	
	1/2" or less *(13 mm or less)*	8	

<u>All noted rail defects</u> detected visually or by using rail flaw detector cars, including defects temporarily repaired by the application of joint bars, <u>must be monitored within 30 calendar days of their detection and at least monthly thereafter,</u> until change out of defective rail.

Appearance in Track		**Defect Cause**
     	Bolt hole cracks originate at a bolt hole in a joint or at a former joint location (e.g. thermite weld) or any holes drilled in rail for any purpose. These cracks can radiate outwards at an angle towards both head and base. In the past bolt hole cracks have progressed from the first bolt hole from the end of the end of the rail at an angle approximately the 45-degree maximum shear plane. In harder premium rails, bolt hole cracks are not regularly seen growing at a large range of angles, some close to vertical, and to emanate from the 2nd or 3rd drilling.	Loose joint bars, battered rail ends, and bad ties in the joint area. Another key initiator is a nick or burr introduced in the drilling of bolt hole by a dull drill bit or an off-center drilling.

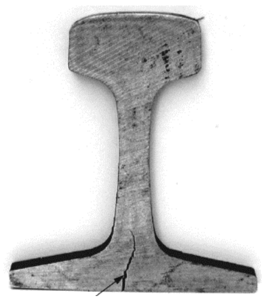
* % of head covered by defect or crack length in inches.

Figure SUB-PART D – 16 – Bolt Hole Crack

6.5.2 Broken Base – BBO / BBJ

Broken Base – BBO or BBJ			
Contractor's Designation	**Defect Size***	**[Protection Code per Section 6.6]**	**Ways to Reduce Frequency of Defect Occurring**
BBO / BBJ (outside of joint or in a joint)	N/A	9	Avoid mishandling rail, striking rail with sharp tools.

<u>All noted rail defects</u> detected visually or by using rail flaw detector cars, including defects temporarily repaired by the application of joint bars, <u>must be monitored within 30 calendar days of their detection and at least monthly thereafter,</u> until change out of defective rail.

<table>
<tr><th colspan="2">Appearance in Track</th><th>Defect Cause</th></tr>
<tr><td>



</td><td>Base breaks are also called broken bases or base fractures. Base breaks are rarely found by rail flaw detector cars unless they have progressed under the rail web, as the ultrasonic signal is only transmitted through the rail web. Base breaks can be recognized as a crack starting near the junction between the base and the web, and extending either along the axis parallel to the rail, curving outwards to the base, or as a half-moon shape of break</td><td>Base breaks develop outwards under the flexural action of the rail from a seam, segregation, or inclusion near the base/web fillet, or inwards from a nick on the edge of the rail. Base breaks also result from derailments or from damaged wheels that have run along the base of the rail, contacting rail anchors.</td></tr>
</table>

* % of head covered by defect or crack length in inches.

Figure SUB-PART D – 17 – Broken Base

6.5.3 Broken Rail or Ordinary Break – BR

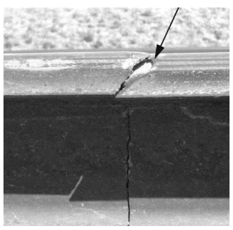
Broken Rail or Ordinary Break – BR			
Contractor's Designation	**Defect Size***	**Protection Code per Section 6.6**	**Ways to Reduce Frequency of Defect Occurring**
BR	N/A	1	Destress Surfacing
All noted rail defects detected visually or by using rail flaw detector cars, including defects temporarily 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.			

Appearance in Track		**Defect Cause**
  Ordinary Break No Visible Defect	Partially or completely broken through, without evidence of a fissure or other type of rail defect that may have caused the break.	High tension in rail, skid flats, out of round wheels, shelled wheel treads.

* % of head covered by defect or crack length in inches.

Figure SUB-PART D – 18 – Broken Rail or Ordinary Break

6.5.4 Damaged Rail

<table>
<tr><th colspan="4">Damaged Rail</th></tr>
<tr><th>Contractor's Designation</th><th>Defect Size*</th><th>Protection Code per Section 6.6</th><th>Ways to Reduce Frequency of Defect Occurring</th></tr>
<tr><td>N/A</td><td>N/A</td><td>7</td><td></td></tr>
<tr><td colspan="4"><u>All noted rail defects</u> detected visually or by using rail flaw detector cars, including defects temporarily repaired by the application of joint bars, <u>must be monitored within 30 calendar days of their detection and at least monthly thereafter,</u> until change out of defective rail.</td></tr>
<tr><th colspan="2">Appearance in Track</th><th colspan="2">Defect Cause</th></tr>
<tr><td>
Damage from wheel slipping

Impact Damage from Broken Wheel</td><td>Any rail broken or injured by wrecks, broken, flat, or unbalanced wheels, slipping, or similar causes.</td><td colspan="2"></td></tr>
</table>

* % of head covered by defect or crack length in inches.

Figure SUB-PART D – 19 – Damaged Rail

6.5.5 Defective Field Weld or Defective Plant Weld – DWF or DWP

<table>
<tr><th colspan="4">Defective Field Weld or Defective Plant Weld – DWF or DWP</th></tr>
<tr><th>Contractor's Designation</th><th>Defect Size*</th><th>Protection Code per Section 6.6</th><th>Ways to Reduce Frequency of Defect Occurring</th></tr>
<tr><td>DWF (CO)
DWP (CO)</td><td>Cracked Out, or
81 – 100%</td><td>1 or 10</td><td rowspan="4">Destressing.

Proper shearing, grinding and handling.

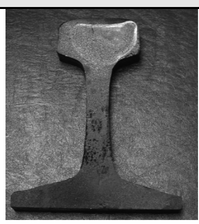
Prevent gouges in finish grinding.

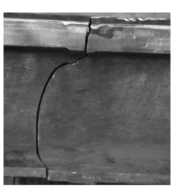
Thermite welding crucible must be dry.

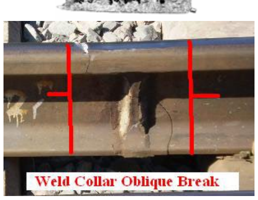
Use of proper welding kit for metallurgy.

Sufficient preheat and cooling time when welding.

Avoid use of damaged tools.</td></tr>
<tr><td>DWF (L)
DWP (L)</td><td>41 – 80%</td><td>4 or 7</td></tr>
<tr><td>DWF (M)
DWP (M)</td><td>21 – 40 %</td><td>4 or 7</td></tr>
<tr><td>DWF (S)
DWP (S)</td><td>0 – 20%</td><td>4 or 7</td></tr>
<tr><td colspan="4"><u>All noted rail defects</u> detected visually or by using rail flaw detector cars, including defects temporarily repaired by the application of joint bars, <u>must be monitored within 30 calendar days of their detection and at least monthly thereafter,</u> until change out of defective rail.</td></tr>
</table>

<table>
<tr><th colspan="2">Appearance in Track</th><th>Defect Cause</th></tr>
<tr><td>

Grinder Gouge

Flash Butt Weld – Shear Drag


</td><td>Weld defects in the rail head are difficult to detect but can be found by rail flaw detector cars. They cannot be inspected visually until the transverse defect has cracked out to show a vertical crack on the side of the rail head.

Web fractures may have one of several characteristic shapes, variously referred to as "flat cracks", "horseshoe breaks", "S" breaks, "H" breaks, or "big dipper failures."</td><td>In the head of the rail, the origin may be a slag inclusion or oxide entrapment.

In the web, fracture may be the result of gouges left from poor finish grinding or from residual stresses in the rail, as in the case of a split web.

In many cases, the cause may be poor fusion due to improper preheat or excessively rapid cooling.</td></tr>
</table>

* % of head covered by defect or crack length in inches.

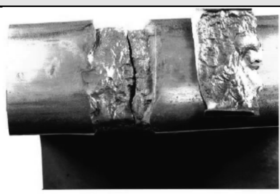
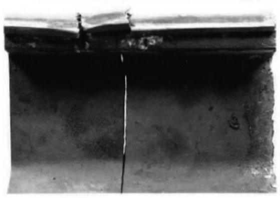
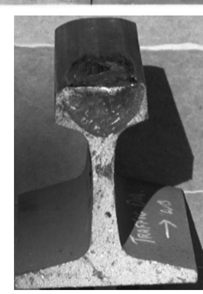
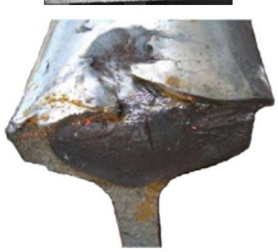
Figure SUB-PART D – 20 – Defective Field Weld or Defective Plant Weld

6.5.6 Engine Burn – EBF

Engine Burn Fracture - EBF			
Contractor's Designation	**Defect Size***	**[Protection Code per Section 6.6]**	**Ways to Reduce Frequency of Defect Occurring**
EBF	100 % (Cracked Out)	1	Prevent wheel slippage. Proper engineer training, Proper traction levels on grades and the use of sanding when wheel slippage.
	81 – 99%	2	
	21 – 80 %	5	
	0 – 20%	7	

*See *Repair Note 3 per Section 6.6* in addition to the above Protection Codes

<u>All noted rail defects</u> detected visually or by using rail flaw detector cars, including defects temporarily repaired by the application of joint bars, <u>must be monitored within 30 calendar days of their detection and at least monthly thereafter,</u> until change out of defective rail.

Appearance in Track		Defect Cause
   	Flat spot on the rail, hairline cracks may be visible on the side of the head, beneath the engine burn area, in the vicinity of an engine burn on the surface, and at right angles to the running surface. Cracks can be visible on either side of the head (field, gage) or in the fillet. Broken pieces will show the burn surface with transverse separation and will have no nucleus. Defects may exist at one, two, or three planes anywhere along the burn area. A horizontal separation will generally start at running surface slanting downward.	Engine burn fractures are caused by repeated wheel impacts at the site of an engine burn due to excessive wheel slip. Rail metal under an engine burn is usually thermally damaged and susceptible to fatigue. The underlying defect associated with the engine burn can be difficult to detect because the rail head surface conditions can prevent detection before failure. Conventional ultrasonic sound detection can be blocked by the rail surface conditions. Growth may be normal or rapid before sudden failure of the rail section through the head, and into the web and base. Complete fracture normally results in a transverse break. Identification of internal rail flaw is not visible until it reaches surface (Cracks Out).

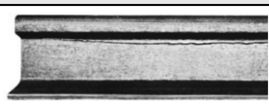
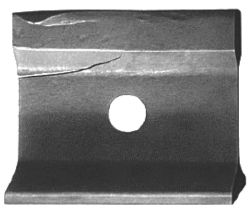
* % of head covered by defect or crack length in inches.

Figure SUB-PART D – 21 – Engine Burn Fracture

6.5.7 Head and Web Separation – HWO / HWJ

Head and Web Separation – HWO or HWJ			
Contractor's Designation	**Defect Size*** (inches and millimeters)	**[Protection Code per Section 6.6](#)**	**Ways to Reduce Frequency of Defect Occurring**
HWO / HWJ (outside of joint or in joint area)	Cracked Out	1	Keep bolts tightened. Build up battered rail ends. Inspect rail when replacing crossing. Maintain good joint support.
	More than 3" *(More than 76 mm)*	6	
	1/2" to 3" *(13 mm to 76 mm)*	4	
	Less than 1/2" *(Less than 13 mm)*	8	

All noted rail defects 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.

Appearance in Track		**Defect Cause**
  	Separation of the head and web of the rail through the fillet area under the head is termed a "Head and Web Separation". Head and web separations may also occur at highway crossings. They are recognized by irregular lines running longitudinally along the fillet or parallel to the head / web fillet. They can also be recognized by a dead sound when tapped with a hammer. In the joint area the crack may be obscured by angle bars.	Head and web separations may occur due to eccentric loading of the rail head, the action of the joint bar in poor rail joints or because of corrosion fatigue where the rail head joins the web.

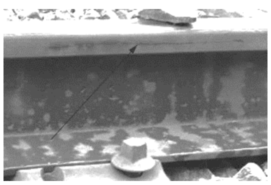
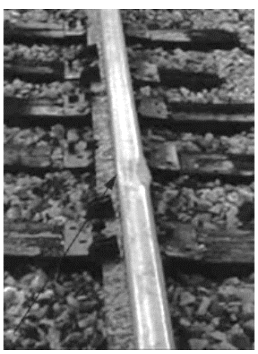
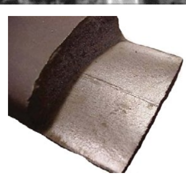
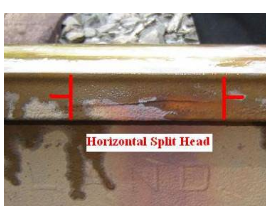
* % of head covered by defect or crack length in inches.

Figure SUB-PART D – 22 – Head and Web Separation

6.5.8 Horizontal Split Head – HSH / HSJ

<table>
<tr><th colspan="4">Horizontal Split Head – HSH or HSJ</th></tr>
<tr><th>Contractor’s Designation</th><th>Defect Size* (inches and millimeters)</th><th>Protection Code per Section 6.6</th><th>Ways to Reduce Frequency of Defect Occurring</th></tr>
<tr><td rowspan="4">HSH / HSJ
(outside of joint or in joint area)</td><td>Cracked Out</td><td>1</td><td rowspan="4">Remove rails with same heat number if defects persist.

Slot rail ends.</td></tr>
<tr><td>More than 12”
(More than 305 mm)</td><td>3</td></tr>
<tr><td>2” to 12”
(51 mm to 305 mm)</td><td>4</td></tr>
<tr><td>Less than 2”
(Less than 51 mm)</td><td>Monitor within 30 days and monthly thereafter until repaired / replaced per Section 6.3 a</td></tr>
<tr><td colspan="4">*All noted rail defects 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.*</td></tr>
</table>

<table>
<tr><th colspan="2">Appearance in Track</th><th>Defect Cause</th></tr>
<tr><td>



</td><td>Horizontal split heads can sometimes be detected visually as they can cause a local flattening of the rail head which would cause a dark spot in contrast to the adjacent shiny running band. When it cracks out, it can be seen as a hairline horizontal crack on the way down from the top of the rail.</td><td>A horizontal split head is a progressive longitudinal fracture along a plan parallel to the rail surface. The origin is at an internal seam, segregation or inclusion introduced in the steel making. It usually grows rapidly but may stop at the end of the seam or at a weld.</td></tr>
</table>

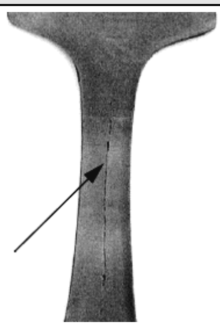
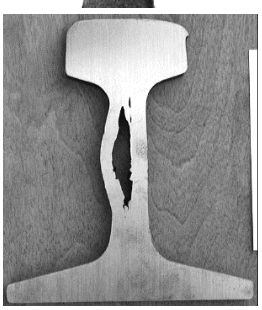
* % of head covered by defect or crack length in inches.

Figure SUB-PART D – 23 – Horizontal Split Head

6.5.9 Piped Rail – PRO / PRJ

Piped Rail – PRO or PRJ			
Contractor's Designation	**Defect Size*** (inches and millimeters)	**Protection Code per Section 6.6**	**Ways to Reduce Frequency of Defect Occurring**
PRO / PRJ (outside of joint or in joint area)	Cracked Out	1	Remove rails with same heat number if defects.
	More than 3" *(More than 76 mm)*	6	
	1/2" to 3" *(13 mm to 76 mm)*	4	
	Less than 1/2" *(Less than 13 mm)*	8	

All noted rail defects 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.

Appearance in Track		Defect Cause
  	Piped rails are seen in older steels. When fully progressed, they can be seen as a bulging of the web on either side or both sides, possibly with shallow cracks on the bulging surface. A slight sinking of the rail head may also be seen.	Piped rails are the result of a longitudinal seam or cavity in the web of the rail, typically found in older rails. Piped rails are generally not a serious defect unless the web has bulged or where the pipe has progressed into a weld.

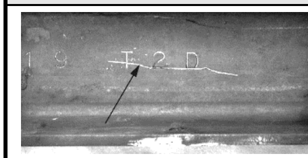
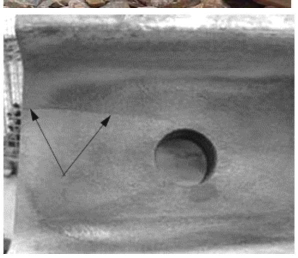
* % of head covered by defect or crack length in inches.

Figure SUB-PART D – 24 – Piped Rail

6.5.10 Split Web – SWO / SWJ

Split Web – SWO or SWJ			
Contractor's Designation	**Defect Size*** (inches and millimeters)	**Protection Code per Section 6.6**	**Ways to Reduce Frequency of Defect Occurring**
SWO / SWJ (outside of joint in joint area)	Cracked Out	1	Avoid mishandling rail, striking with sharp tools.
	More than 3" *(More than 76 mm)*	6	
	1/2" to 3" *(13 mm to 76 mm)*	4	
	Less than 1/2" *(Less than 13 mm)*	8	

All noted rail defects 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.

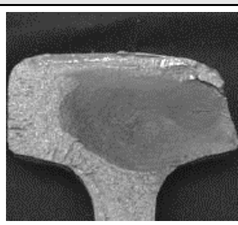
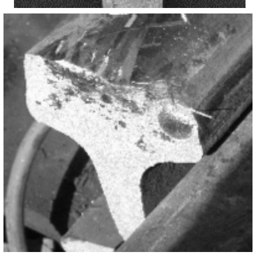
Appearance in Track		Defect Cause
    	Split webs are longitudinal or occasionally transverse cracks along the side of the web and extending into or through it. Often, they can be recognized as a "bleeding" crack in the web.	Split webs will occur because of a bad stamping of the rail identification numbers or due to a nick or a gouge in the rail. Split webs usually grow rapidly in the joint area.

* % of head covered by defect or crack length in inches.

Figure SUB-PART D – 25 – Split Web

6.5.11 Transverse Defect or Detailed Fracture – TDD

Transverse Defect or Detailed Fracture - TDD			
Contractor's Designation	**Defect Size***	**Protection Code per Section 6.6**	**Ways to Reduce Frequency of Defect Occurring**
TDD (CO)	100 % (Cracked Out)	1	Grind gauge corner with production rail grinder to provide relief. Run for a period with lubricators. Destress. Improve tie condition.
TDD (L)	41 – 99%	2 or 9	
TDD (M)	21 – 40%	3 or 9	
TDD (S)	0 – 20%	9	
*See *Repair Note 1 per Section 6.6* in addition to the above Protection Codes			
All noted rail defects 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.			

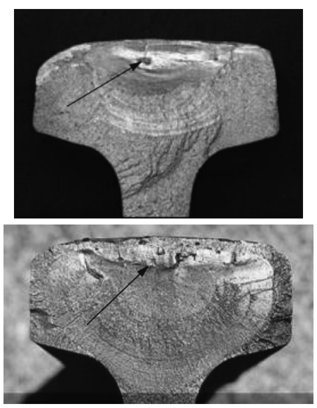
Appearance in Track		**Defect Cause**
  Detail Fracture from Shelling   Detail Fracture from Head Check	The distinguishing features of a transverse defect are the crystalline center or nucleus and the nearly smooth surface of the development which surrounds it. Transverse defects (TD's) are usually found by ultrasonic or induction testing cars but will occasionally reach the surface where they can be identified by cracks on the side or corners of the rail head.	Overloading of gauge corner due to loss of rail, cant, insufficient relief of gauge corner location interfering with throat of wheel. Detail fracture means a progressive fracture originating at or near the surface of the rail head. These fractures should not be confused with transverse fissures, compound fissures, or other defects which have internal origins. Detail fractures may arise from shelly spots, head checks, or flaking. Detail fractures are more common in dirty rail steels and in areas where the rail is in tension. Starts from rail surface cracking and grows inwards.

* % of head covered by defect or crack length in inches.

Figure SUB-PART D – 26 – Transverse Defect or Detailed Fracture

6.5.12 Transverse Defect Under a Weld Repair – DFW / TDW

<table>
<tr><th colspan="4">Transverse Defect Under a Weld Repair – DFW or TDW</th></tr>
<tr><th>Contractor's Designation</th><th>Defect Size*</th><th>Protection Code per Section 6.6</th><th>Ways to Reduce Frequency of Defect Occurring</th></tr>
<tr><td>DFW or TDW (CO)</td><td>100 %
(Cracked Out)</td><td>1</td><td rowspan="5">Complete removal of rail surface defect, cleaning of slag between weld passes, maintaining interpass temperatures and accurate pre and post heating of the rail.</td></tr>
<tr><td>DFW or TDW (L)</td><td>41 – 99%</td><td>2 or 9</td></tr>
<tr><td>DFW or TDW (M)</td><td>21 – 40%</td><td>3 or 9</td></tr>
<tr><td>DFW or TDW (S)</td><td>0 – 20%</td><td>9</td></tr>
<tr><td colspan="3">*See Repair Note 1 per Section 6.6 in addition to the above Protection Codes</td></tr>
<tr><td colspan="4"><u>All noted rail defects</u> detected visually or by using rail flaw detector cars, including defects temporarily repaired by the application of joint bars, <u>must be monitored within 30 calendar days of their detection and at least monthly thereafter,</u> until change out of defective rail.</td></tr>
</table>

<table>
<tr><th colspan="2">Appearance in Track</th><th>Defect Cause</th></tr>
<tr><td>
Detail Fracture under Weld</td><td>A transverse separation associated with a weld repair is a progressive fracture in the head of the rail that initiates from an inclusion or stress crack resulting from a weld repair rail re-surfacing. The defect will typically initiate at the interface between the weld filler metal and parent metal of the rail section. It then progresses transversely into the rail head. Develops substantially at right angles to the running surface at engine burn or electrode burn that have been resurfaced by welding. No evidence of a transverse defect is visible until the defect reaches the rail surface.</td><td>The defect is a result of improper welding techniques, usually during the cleaning phase, associated with the repair of engine burn or electrode burns. It can also be a result of improper cooling which may create martensite and thermal cracks. Transverse separation will initiate from inclusions or heat affected zone (under-bead cracking) of the weld.</td></tr>
</table>

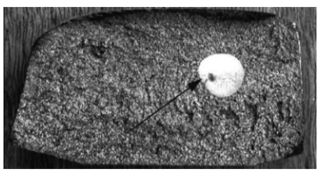
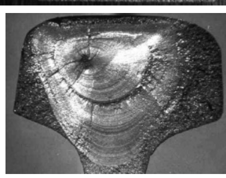
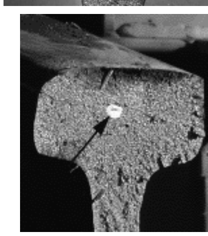
* % of head covered by defect or crack length in inches.

Figure SUB-PART D – 27 – Transverse Defect Under a Weld Repair

6.5.13 Transverse Fissure or Compound Fissure – TDT

Transverse** Fissure or Compound Fissure - TDT			
Contractor's Designation	**Defect Size***	**Protection Code per Section 6.6**	**Ways to Reduce Frequency of Defect Occurring**
TDT (CO)	100 % (Cracked Out)	1	Change out non-Mackie or non-control cooled rail.
TDT (L)	41 – 99%	2	
TDT (M)	21 – 40%	7	
TDT (S)	0 – 20%	7	
*See *Repair Note 1 per Section 6.6* in addition to the above Protection Codes			

<u>All noted rail defects</u> detected visually or by using rail flaw detector cars, including defects temporarily repaired by the application of joint bars, <u>must be monitored within 30 calendar days of their detection and at least monthly thereafter,</u> until change out of defective rail.

Appearance in Track		**Defect Cause**
   Transverse Fissure   Compound Fissure	The term "transverse fissure" describes a transverse defect that has nucleated from a more central location in the railhead. The distinguishing features of a transverse defect are the crystalline center or nucleus and the nearly smooth surface of the development which surrounds it. Transverse defects (TD's) are usually found by ultrasonic or induction testing cars but will occasionally reach the surface where they can be identified by cracks on the side or corners of the rail head.	Transverse fissures are usually the result of trapped hydrogen or other imperfections in rail steel and usually not found in modern rails. Multiple transverse fissures often occur in the same rail. Compound Fissures could start from the rail surface or internally and has multiple angles or fracture faces.

* % of head covered by defect or crack length in inches.

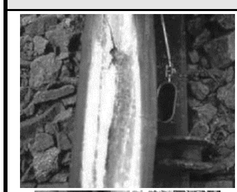
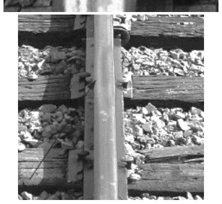
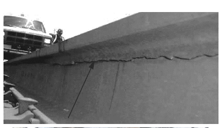
** Transverse defects occurring in non-Mackie and non-control cooled rails are subject to the same rules applying to transverse fissures, except that the entire length of rail must be changed out in all cases.

Figure SUB-PART D – 28 – Transverse Fissure or Compound Fissure

6.5.14 Vertical Split Head – VSH / VSJ

<table>
<tr><th colspan="4">Vertical Split Head – VSH or VSJ</th></tr>
<tr><th>Contractor's Designation</th><th>Defect Size* (inches and millimeters)</th><th>Protection Code per Section 6.6</th><th>Ways to Reduce Frequency of Defect Occurring</th></tr>
<tr><td rowspan="4">VSH / VSJ
(outside of joint or in joint area)</td><td>Cracked Out</td><td>1</td><td rowspan="5">Grind rail to center wheel contact band over rail web.

Remove rails with same heat number if defects persist.</td></tr>
<tr><td>More than 12"
(More than 305 mm)</td><td>3</td></tr>
<tr><td>2" to 12"
(51 mm to 305 mm)</td><td>4</td></tr>
<tr><td>Less than 2"
(Less than 51 mm)</td><td>Monitor within 30 days and monthly thereafter until repaired / replaced per Section 6.3 a</td></tr>
<tr><td colspan="3">*See Repair Note 2 per Section 6.6 in addition to the above Protection Codes</td></tr>
<tr><td colspan="4"><u>All noted rail defects</u> detected visually or by using rail flaw detector cars, including defects temporarily repaired by the application of joint bars, <u>must be monitored within 30 calendar days of their detection and at least monthly thereafter,</u> until change out of defective rail.</td></tr>
</table>

<table>
<tr><th colspan="2">Appearance in Track</th><th>Defect Cause</th></tr>
<tr><td></td><td>Top of rail view may show a dark streak on the running surface. Widening of the head for the length of the split. The side of the head to which the split is offset may show signs of sagging or drooping.
Rust streak on the fillet under the head.
Separation progresses longitudinally and vertically (parallel to side of head) for some distance, then gradually turns outward to head, gage or field side.
In advanced stages, a bleeding crack will be apparent at the head fillet. Eventually, one or both ends of the vertical split head will turn to the gage or field side with rust and/or cracks.
Growth is usually rapid, once the seam or separation has opened anywhere along its length. It continues rapidly until the split begins to turn outward.</td><td>Vertical split heads are progressive longitudinal fractures where the head of the rail separates vertically along a seam, segregation, or inclusion in the rail, usually near the middle of the head. The separation may progress rapidly up to the full length of the rail before gradually turning out to field or gauge. Occasionally a vertical split head may also pass through a weld to find the same seam that was rolled into an adjacent rail.

Vertical split heads grow because of the shearing action of wheels riding to field or to gauge. Residual tensile stresses may also play a role. Vertical split heads occurring in rails with moderate wear are primarily the result of poor steelmaking.

While vertical split heads are usually associated with dirty steel, they will progress faster in heavily worn rails that have flattened in service.</td></tr>
</table>

* % of head covered by defect or crack length in inches.

Figure SUB-PART D – 29 – Vertical Split Head

6.6 Rail – Protection Code Description and Repair Notes

a) All noted rail defects, including those 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) The following lists the specific protection codes used in the column four of the table of Rail Defects and Protection Codes with a description of the protection associated with each code.

PROTECTION CODE DESCRIPTION	
Code	**Explanation of Protection Codes**
1	Assign an employee qualified in Movement Over a Rail Break to visually supervise each operation over defective rail. Apply Movement Over Broken Rails policy per Sub-Part D, Section 6.7 Rail – Authorizing Movement over Rail Breaks
2	Assign a qualified Track Supervisor (Inspector) to visually inspect. Once inspected that person may authorize operation to continue without continuous visual supervision at a maximum of 10 mph for up to 24 hours prior to another such visual inspection or replacement or repair of the rail. After joint bars have been applied, allow trains to operate over this defect at 30 mph.
3	Assign a qualified Track Supervisor (Inspector) to visually inspect. Restrict the operation of trains to not more than 10 mph. Defective rails must be replaced as soon as possible.
4	Limit operating speed over defective rail to that as authorized by a qualified Track Supervisor (Inspector). The operation of trains must be restricted to not more than 30 mph or maximum allowable speed under the class of track, whichever is lower.
5*	Assign a qualified Track Supervisor (Inspector) to visually inspect. Restrict the operation of trains to not more than 10 mph until weld repair bars applied. Then, limit the operating speed to not more than 40 mph or maximum allowable speed under the class of track, whichever is lower, and if rails are not replaced within 3 days, lower the operating speed to 10 mph.
6	Restrict operation of trains to not more than 30 mph as designated by a qualified Track Supervisor (Inspector) or maximum allowable speed under the class of track, whichever is lower, and visually inspect by a qualified Track Supervisor (Inspector) in not more than 10 days.
7	Restrict the operation of trains to not more than 30 mph apply joint bars within 10 days. Then, limit the operating speed to not more than 40 mph or maximum allowable speed under the class of track, whichever is lower.
8	Restrict operation of trains to not more than 50 mph or maximum allowable speed under the class of track, whichever is lower, and if rails are not replaced within 72 hours, lower the operating speed to 35 mph or maximum allowable speed under the class of track, whichever is lower.
9	Apply joint bars and restrict operation of trains to not more than 30 mph or a maximum allowable speed under the class of track, whichever is lower. As a general note, in applying joint bars, 2 bolts per rail end are to be used in the outer most holes.
***10**	Assign a qualified Track Supervisor (Inspector) to visually inspect. Apply joint repair bars and restrict operation of trains to no more than 30 mph or maximum allowable speed under the class of track, whichever is lower, and if rails are not replaced within 24 hours, lower the operating speed to 10 mph.

Figure SUB-PART D – 30 – Description of Protection Codes

*When the rail defect extends through a weld, a section of rail must be cut out when making either emergency or permanent repairs. Note, these repairs must be made in accordance with ONTC Standards.

Code	Repair Note Actions
1	When changing out the defective rail, remove from the track all rail showing gross distortion of the rail section (for example, heavy flow) plus all rail with evidence of rail shelling, occurring in the same rail. Ensure to cut at least 6” away from any weld.
2	When changing out the defect, replace the entire rail and inspect to ensure that the defect has not traveled through the weld into an adjacent rail.
3	Engine burns should be repaired by replacing minimum 12’ of rail in CWR or by replacing the rail in jointed track.

Figure SUB-PART D – 31 – Repair Notes

6.7 Rail – Authorizing Movement over Rail Breaks

a) This requirement expands upon practices outlined in Sub-Part D, Section 6.6. – Rail – Protection Code Description and Repair Notes and has been developed to provide specific criteria for a qualified employee to authorize a train or engine to proceed safely over rail breaks,

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

b) A train or engine must not be permitted to operate over a rail break when any of the following conditions exists:

- The rail break is in a tunnel or on a bridge,
- For supervised moves, the rail break is within 500 feet *(152,400 mm)* of a bridge or tunnel,
- For unsupervised moves, the rail break is within 500 feet *(152,400 mm)* of a bridge or tunnel,
- The ties on either side of the break are defective, crushed, or split in the tie plate area,
- Cracks are observed radiating from the broken rail ends,
- The rail break occurs in an area of unstable grade,
- The offset (overhang) is greater than 2 inches *(51 mm)*,
- The gap is greater than 3 1/2 inches *(89 mm)*,

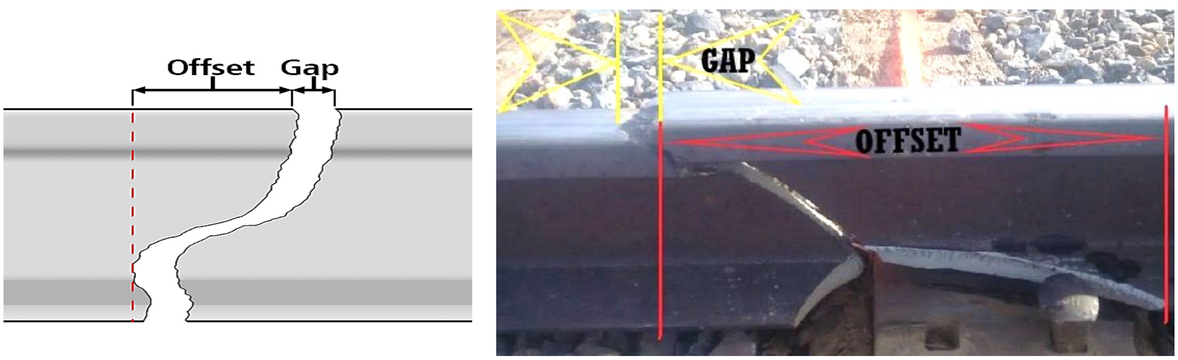


Figure SUB-PART D – 32 – Movement Over a Rail Break - Offset and Gap Measurement Visuals

- In the case of a joint area, the break extends beyond the limits of the joint bar, or
- The break occurs in an area in which the Superintendent, Maintenance of Way has specified that movements over rail breaks are not permitted.

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

d) When none of the conditions outlined in item (b) exist and the gap size is too small to allow for the installation of joint bars with one bolt through the center of the break (less 1 1/8" *(29 mm)*) trains may be permitted to operate over the broken rail at a speed not exceeding 5 miles per hour, under a supervised movement,

e) If the break is at a weld location and bolt holes exist, splice bars, or temporary weld bars must be installed with at least one bolt in each rail end,

f) The condition of the rail break, splice bars, and supporting ties, must be visually observed as the train or engine operates over the break,

g) The requirement for supervision of the train movement over the rail break may be waived if the rail break is a significant distance from a location where the employees' vehicle can be cleared, for example, where there is no other track, grade crossing or road nearby, or where access by foot is impeded by adverse weather conditions provided the following regulatory requirements are met:

- The rail break is either,
  - An ordinary break,
  - A complete break where there is a sign of a transverse fissure or compound fissure, or
  - A complete break at a defective weld,
- Splice bars must be installed,
- The condition of the rail break, splice bars and supporting ties must be inspected prior to each movement over the break,
- Not more than 24 hours has elapsed since the initial inspection of the defect (defects must be repaired within 24 hours of detection), and

h) A 5-mph speed restriction must be applied in accordance with the applicable operating rules:

i) The Rail Traffic Controller (RTC) must be notified, in a clear manner, as to how the restriction is to be applied. One of the following methods must be used;

- Flags placed in accordance with CROR Rule 843/43,
- By the use of an approved rail break sign, or
- When flags or an approved rail break sign are not available, restrictions must be applied between two identifiable locations.

j) Records of these rail breaks must be kept for a period of at least 1 year and include the following information:

- The mileage and subdivision where each rail break occurred,
- The measured gap and offset at the rail break, and
- The type of rail defect.

k) Repairs must be completed within 24 hours from the time the defect is first inspected.

l) Temporary Gap Rail Inserts are allowed if the following conditions are met;

Figure SUB-PART D – 33 – Temporary Gap Rail Insert

- Used only if there are no evident signs of a longitudinal defect such as a vertical split head, horizontal split head, split web or a head web separation,
- Insert rail is of the same weight with head and flange wear difference no more than 1/8” *(3 mm)*,
- Insert rail is free from defects and has been UTT tested,
- Hole is drilled in the middle of the insert prior to cutting to ensure insert will be centered in the gap,
- Within the Maximum Gap range as shown below. The offset of a broken rail can be trimmed to allow for installation of an insert and bolt,
- Sum of the gaps between the parent rail and the insert ends does not exceed ¾” *(19 mm)*,
  - Installed so that it is approximately centered within, and secured with joint bars, or a bolt may be installed through the joint bar and between the rail end and the insert rail with a maximum gap of ¾” *(19 mm)* between the opposite end of the insert rail and the other rail end.
- Constantly monitored during all moments over the location by a qualified employee who has established communication with the train,
- Protected by the speed restrictions as shown in the below table,
- Inspected and bolts tighten, if required, after each movement is made over the location,
- Removed when permanent repairs are made, but no longer than 24 hours after installation.

Maximum Allowable Speed over a Temporary Rail Gap Repair	
Maximum Speed	**Maximum Gap Range Allowed for 100 lbs / 115 lbs Rail**
10 mph	Up to 4” *(152 mm)* Gap
5 mph	4” to 8” *(100 mm to 203 mm)* Gap **or** any Curve

Figure SUB-PART D – 34 – Maximum Allowable Speed with a Temporary Gap Rail Insert

6.7.1 Rail – SUPERVISED Movements over Rail Breaks

If the condition of the rail break, splice bars, and supporting ties, can be visually observed as the train or engine operates over the break, use the following flow chart to determine the appropriate action:

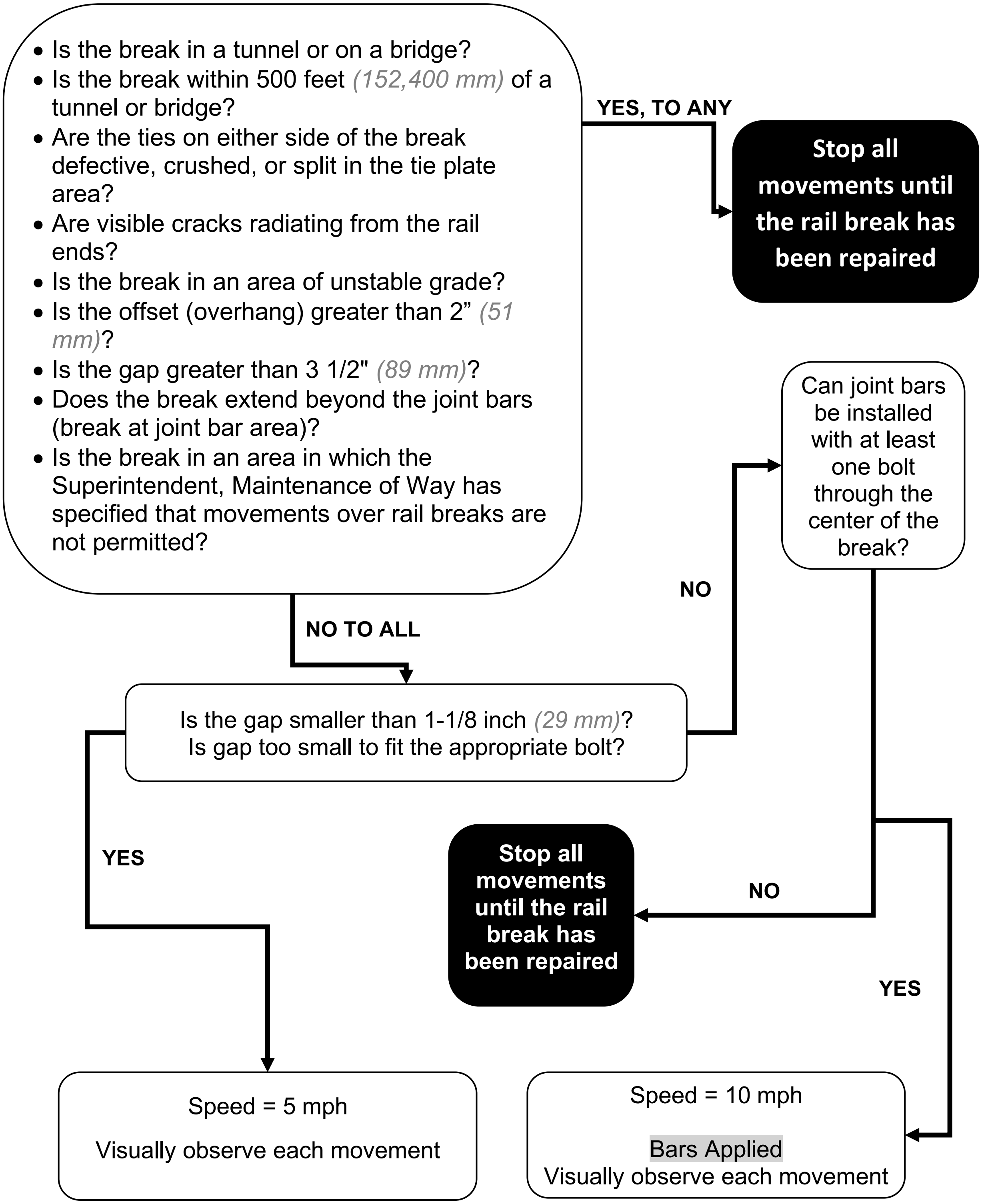


Figure SUB-PART D – 35 – Movement Over Rail Breaks - SUPERVISED

6.7.2 Rail – UNSUPERVISED Movements over Rail Breaks

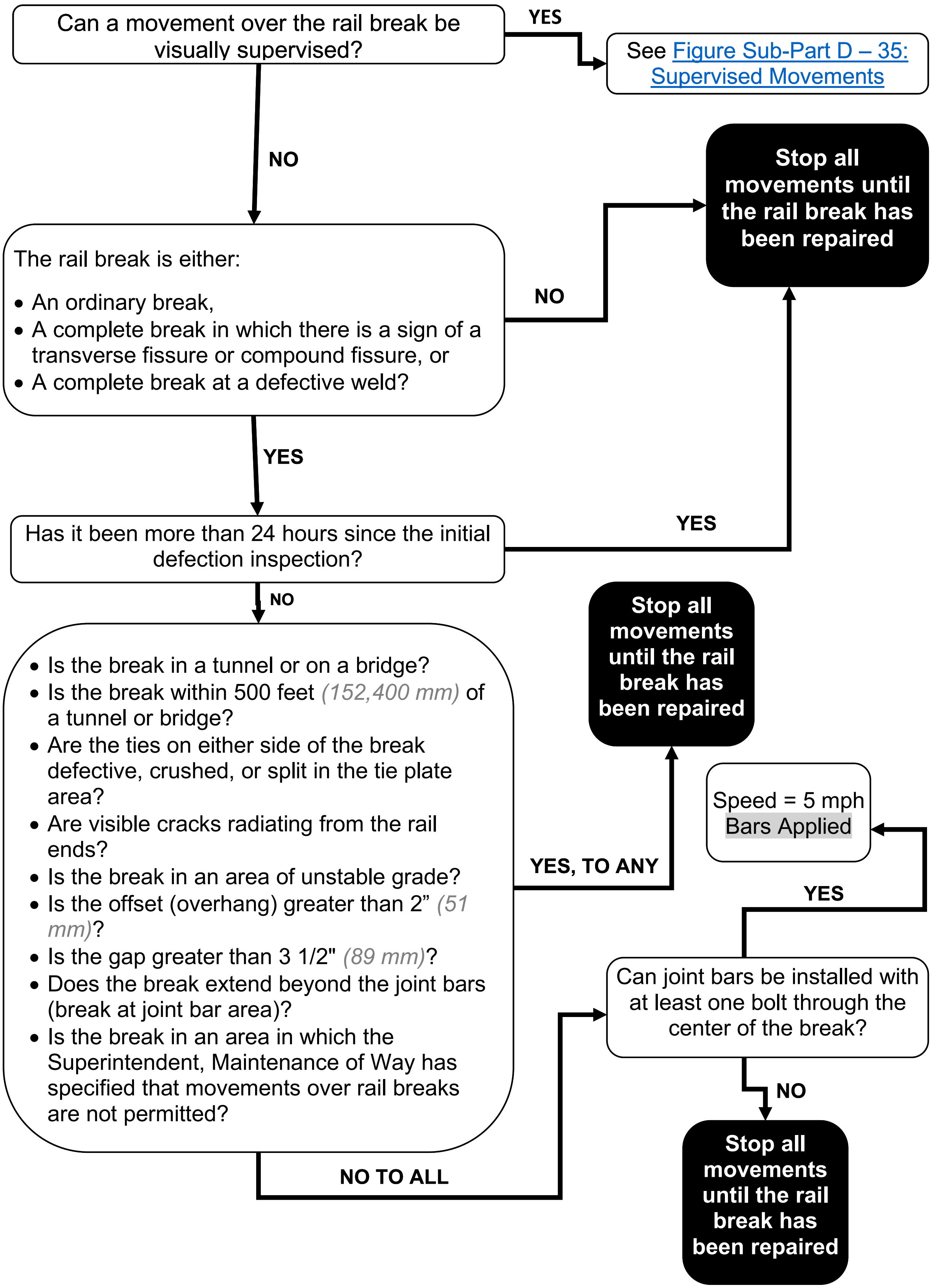


Figure SUB-PART D – 36 – Movement Over Rail Breaks – UNSUPERVISED

6.8 Rail – Inspection of Broken Rail

a) When any broken rail is found on a main track or siding, the Track Maintenance Foreman or whichever employee first arrives at the location, must inspect the track for 300 feet *(91,440 mm)* in each direction from the break, looking for pieces of equipment and for damage to the rail or track, e.g., wheel marks.

6.9 Rail – Rail Surface Management Plan

a) 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.

b) The following criteria shall be used in restricting the operating speed over Corrugation, Crushed Heads, Localized Surface Collapse, and Rail End Batter until such time as they can be corrected.

<table>
<tr><th colspan="2">Depth of Surface Defect</th><th rowspan="2">Remedial Action
(NOTE: Section 6.9 c) for Class 3 and higher in addition to the below)</th></tr>
<tr><th>Rail Wear is
0% to 75%
of Vertical Condemning Limit
(100 lbs – Less than 5/16” vertical wear
115 lbs – Less than 1/2" vertical wear)</th><th>Rail Wear is
Greater Than 75%
of Vertical Condemning Limit
(100 lbs – 5/16” or greater vertical wear
115 lbs – 1/2" or greater vertical wear)</th></tr>
<tr><td>Less than 3/16”
(<5 mm)</td><td>Less than 1/8”
(<3 mm)</td><td>Monitor until Repaired</td></tr>
<tr><td>3/16” to 5/16”
(5 mm to 8 mm)</td><td>1/8” to 3/16”
(3 mm to 5 mm)</td><td>TSO 30 mph until
Repaired or Replaced</td></tr>
<tr><td>Greater than 5/16”
(>8 mm)</td><td>Greater than 3/16”
(>5 mm)</td><td>TSO 10 mph until Repaired or Replaced</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="2">Corrugation, regardless of length or depth, that prevents a valid internal search for defects by rail flaw test equipment.</td><td>Speed restricted to Class 1 until
Repaired (e.g., grinding) and Retested, or
Replaced, or
Rail Flaw Detection Tested</td></tr>
</table>

Note: *The vertical condemning limit for 100 lbs is 7/16” vertical wear and 115 lbs is 11/16” vertical wear.*

Figure SUB-PART D – 37 – Rail Surface Defects (inches and millimetres)

c) Crushed Heads, Localized Surface Collapse, and Rail End Batter on Class 3 track and higher, measuring 1/8” *(3 mm)* or greater will be monitored by local forces monthly until repaired or replaced.

d) A record of inspection location, date and measurement taken must be maintained.

e) Crushed Heads, Localized Surface Collapse, and Rail End Batter defects shall be determined using a straight edge and a taper gauge per the following diagrams. Management of corrugation is dependent upon ability perform a proper test to detect internal rail defects.

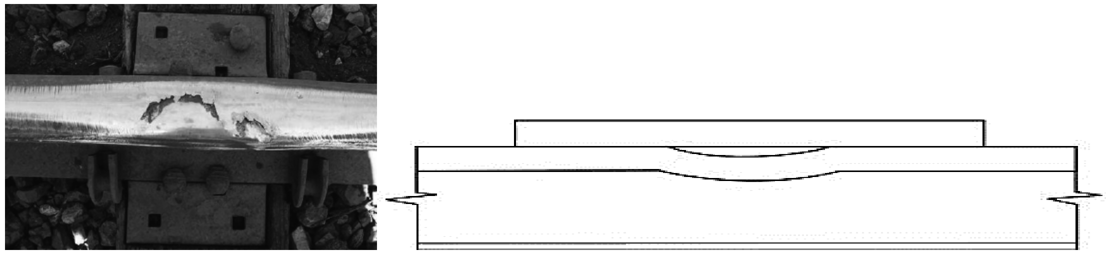


***Figure SUB-PART D – 38 – Crushed Head** (left) **and Straight Edge Placement** (right)*

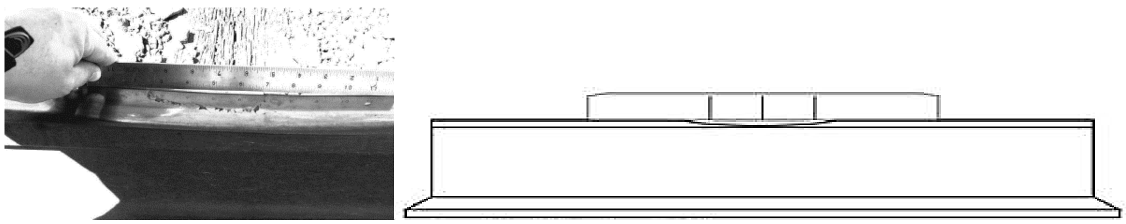


Figure SUB-PART D – 39 – Localized Surface Collapse Straight Edge Placement

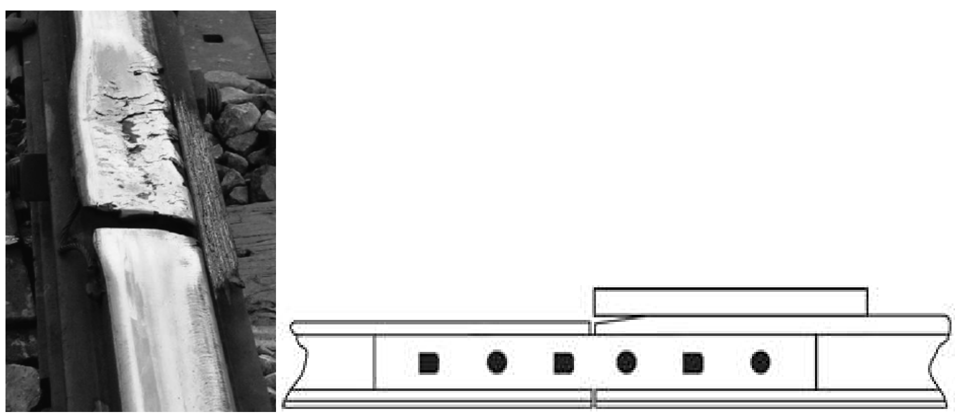


***Figure SUB-PART D – 40 – Rail End Batter** (left) **and Straight Edge Placement** (right)*

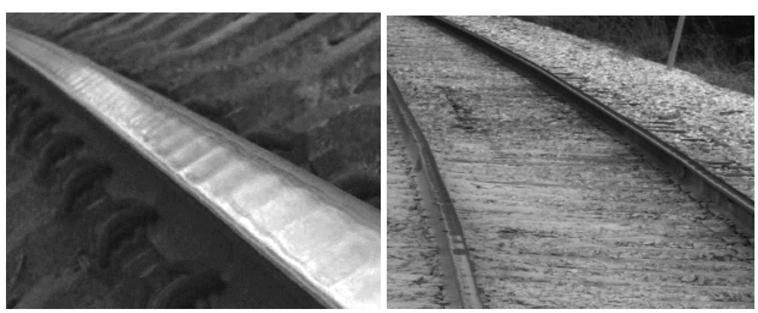


Figure SUB-PART D – 41 – Corrugation Example

6.10 Rail – Identification

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

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

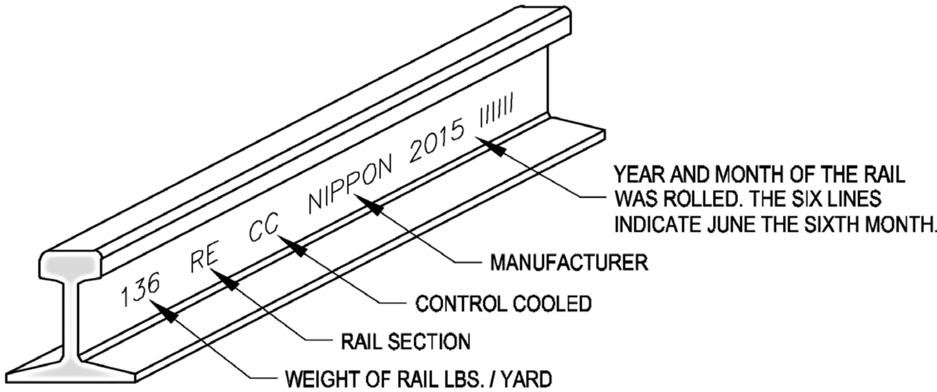


Figure SUB-PART D – 42 – Rail Branding

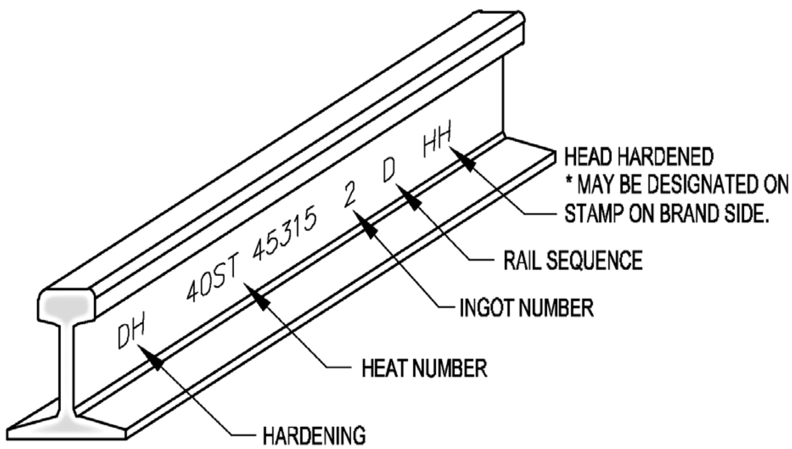


Figure SUB-PART D – 43 – Rail Stamping

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

iii. Rail hardness is identified by branding or stamping:

Branding / Stamping	Rail Hardening
Blank	Standard Strength
SS	Standard Strength
3HB	Standard Strength
IH	Intermediate Hardness
IHHS	Intermediate Hardness High Strength
HH	Head Hardened
FHH	Fully Hardened
DHH	Deep Head Hardened

Figure SUB-PART D – 44 – Rail Hardness Branding / Stamping

6.11 Rail – Removal

a) When removing a defective rail, remove the full length of the rail if the following apply:

i. Non-Mackie or non-control-cooled rails are being removed from the track because of transverse fissures

ii. Mackie or control-cooled rails are being removed from the track because of:

- Vertical split heads outside the joint area
- Transverse fissures or transverse defects accompanied by gross distortion of the rail section (for example, heavy flow or evidence of rail shelling)

b) In territory laid with Mackie, CC or VT rail keep only rail with the corresponding brands or stamps on the rail racks.

c) For each rail removed from the track because it is broken or has a defect, document the information in the applicable record. The exception is rail defects found and reported by the rail flaw detection cars.

d) Rail removed from track that is defective or that is otherwise unfit for relay in track, and cannot be improved by treatment, must be classified, and marked as scrap (XXXX). It must be stored for removal in a location that is apart from the racks where maintenance and relay rail plugs are stored.

6.12 Rail – Wear Limits and Rail Management Design Zones

See Appendix A

6.13 Rail – Classification

a) When released from track, rail must be properly classified to ensure the best possible use with these general rules,

- New Rail
  - New rail is laid in primary main lines.
- Premium Rail
  - New Premium Rail is laid where authorized by the Director, Rail Infrastructure,
  - Premium Rail has an increased resistance to wear because of its chemical composition and special hardening process,
  - Premium Rail should not be mixed with Intermediate Rail due to the different wear rate.
- Intermediate Rail
  - Intermediate Rail is used in the majority of applications at *Ontario Northland* due to our relatively low annual gross tons of traffic.

b) The classification, description and marking of rail are as follows;

RAIL		
Classification	**Description**	**Marking**
New Rail	Rail not previously used in service, to be laid where allowed	N/A
Main Line Rail	Rail previously in service that is fit for relay in Main Lines	One white spot
Branch Line Rail (Agrium and Iroquois Falls Subdivisions)	Rail previously in service that is fit for relay in main track on Branch Lines	Two white spots
Yard, Siding and Pagwa Spur Rail	Rail previously in service that is fit for relay in subsidiary tracks	Three white spots
Repair Rail	Rail previously in service that is fit for repair of defective rails in Main or Branch Lines	Orange “R”
Scrap Rail	Rail that is unfit for relay due to wear or internal defects	Four “X” (XXXX)

Figure SUB-PART D – 45 – Marking of Rail Released from Track

c) Any partly worn rail that is intended to be re-used in track <u>must</u>,

- Be center marked for lifting,
- Be classified,
- Have the vertical and gauge wear values written on the web of the rail,
- Be neatly stacked, rail section, in identifiable stands for each. For rail stands along the right-of-way, ensure the area allows for accessibility year-round but doesn't interfere with operations,
- Have the latest ultrasonic test time information marked on the web of the rail approximately 3' (three feet) from the end of the rail by minimum of two-inch-high letters with a paint stick. The marking will indicate "UTT" and the date of the last ultrasonic test, preferably on the gauge side.
  - Rail which has <u>not</u> been UTT tested and is to be used in track, shall
    - Have a Class 1 speed restriction placed, and
    - Be inspected weekly, until it has been ultrasonically tested.

d) Main Line Rail

- Main Line Rail released from track is classified as follows;
  - The rail is a 115 lb or heavier section,
  - The rail is without known defects,
  - The rail's wear is not more than the limits for Main Line rail shown on Figure Sub-Part D - 45,
  - The rail's end batter is 1/16 inch *(2 mm)* or less,
  - For previously worn jointed rail only, the clearance between the back of the new joint bars and the web of the rail is 3/16 inches *(5 mm)* or more – measured at the lower fillet,
  - The rail is 20 feet *(6,096 mm)* or longer unless it has been cut shorter for a special purpose.
- Unless authorized by the Director, Rail Infrastructure, only 115lb RE rail will be used for relay rail in Main Line or Branch Line track programs.

RAIL CLASSIFICATION
115 lb. RE Rail

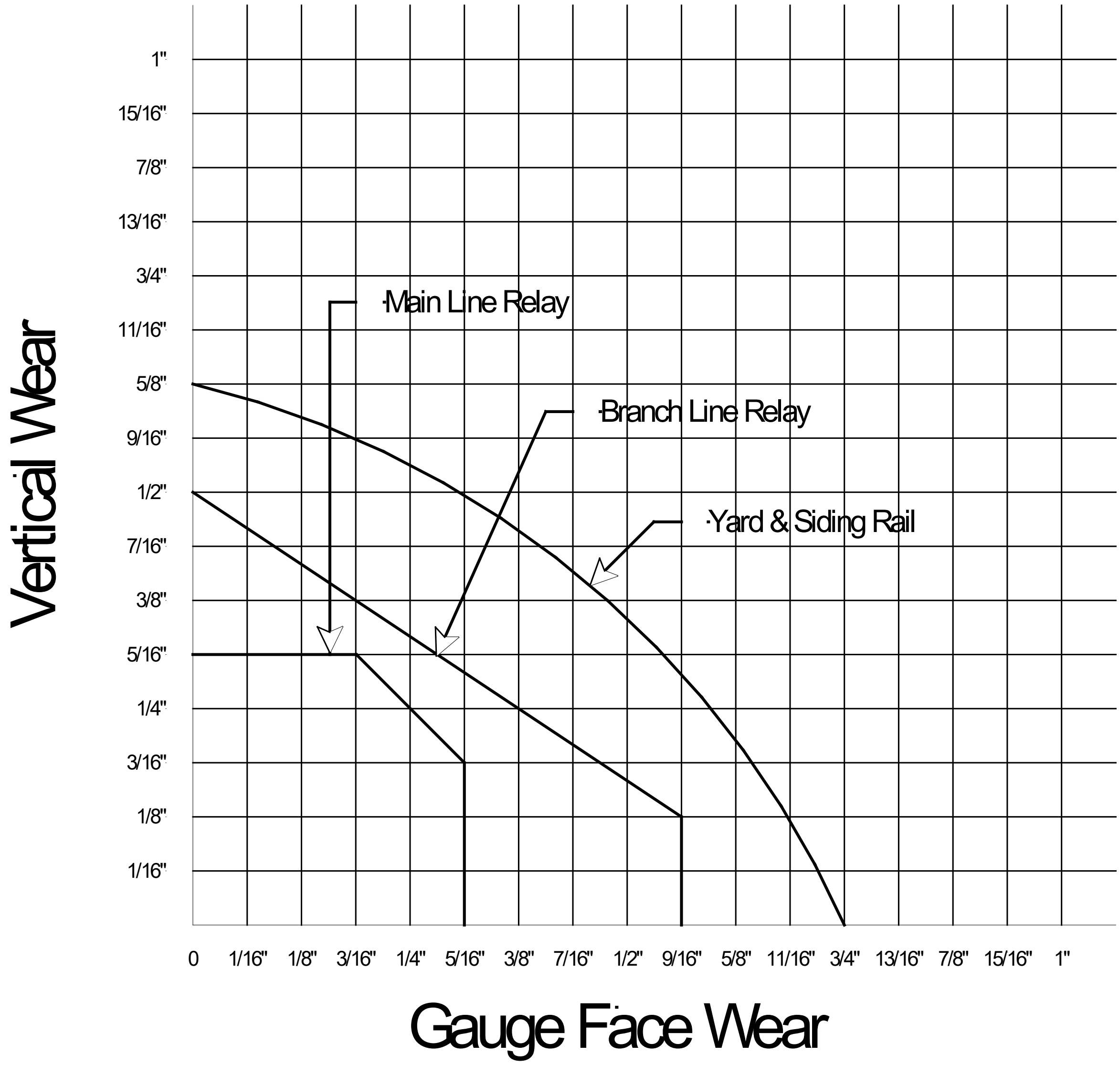


Figure SUB-PART D – 46 – 115 lb RE Rail Wear (Vertical and Gauge)

e) Branch Line Rail

- Lighter rail may be used as Repair Rail in Branch Lines when used for repair purposes.
- Branch Line Rail released from track is classified as follows;
  - The rail is a 115 lb or heavier section (lighter rail may be classified as branch line rail when required for repair purposes on existing branch lines),
  - The rail is without known defects,
  - The rail has only bends that can be straightened easily,

- The rail wear is not more than the limits identified for Branch Line Rail in Figure Sub-Part D - 46,
- The rail's end batter is 1/8" *(3 mm)* or less,
- For previously worn jointed rail only, the clearance between the back of the new joint bars and the web of the rail is 1/8" *(3 mm)* or more, measured at the lower fillet,
- The rail is 20' or longer unless it has been cut shorter for a special purpose.

f) Yard and Siding Rail released from track is classified as follows;

- The rail is an 85lb or heavier section (lighter rail may be classified as siding rail when required for repair of existing sidings or yard tracks),
- The rail is without known defects, sharp bends or excessive wear which make it unsuitable for use,
- The rail is 20' or longer unless it has been cut shorter for a special purpose,
- The rail wear is less than the limits permissible for Yard and Siding Rail as identified in Figure Sub-Part D - 46.

g) Repair Rail

- Repair Rail released from track is rail of suitable length and wear condition so that it will fit in curves or tangent track without producing a condition of rail end mismatch.
- Repair Rail must not exceed limits of Line B wear in Appendix A.

h) Scrap Rail

- Scrap Rail is any rail with defects that would render it unsuitable for use in track,
- Rail of any weight with wear exceeding Line C wear in Appendix A is considered Scrap Rail

6.14 Rail – Marking Rail Removed from Track

a) Rail released from track will be marked according to Figure Sub-Part D – 45,

b) All rail removed from track must be handled in one of the following ways:

i. If not suitable for re-use (scrap), then
   - The rail must be marked as scrap by marking four X's (e.g., XXXX) on the rail.

ii. If suitable for re-use and 10 MGT or less traffic has run over the rail since it was last ultrasonically tested, then
   - The rail must be marked to identify its length and grade classification.
   - Grade Classifications are contained in Sub-Part D – Section 6.13.

iii. If more than 10 MGT of traffic has run over the rail since the last ultrasonic test,
   - The rail must be retested prior to being identified for re-use.
   - Grade Classifications are contained in Sub-Part D – Section 6.13.

iv. If the rail has a detected defect, then
   - The rail must be marked as per rail flaw detector instructions.

v. Defects which are cut out must be marked as scrap.

c) The classification markings will be placed on the web of the rail approximately 4’ from the end,

d) Rail released that has low head wear, but excessive end batter is to be classified to the higher classification and marked for cropping,

e) Rail to be cropped should be painted on the appropriate end in orange paint for approximately one foot,

f) Repair Rails should have their head wear measurements marked on the top of the rail, near one end using a permanent paint stick or other device immediately over the “R”.

6.15 Rail – Dye Penetrant Testing (DP)

The use of dye penetrant testing on rail ends is recommended to ensure that defects have been removed when making rail repairs or changing rail.

DP kits may include cleaning solvent, dye penetrant spray and developing spray. Keep DP kit warm during cold weather for best use. Always follow the instructions of the manufacturer.

Figure SUB-PART D – 47 – Dye Penetrant Testing Kit

a) Any time the in-track rail (parent rail) is saw cut when repairing or replacing rail, careful examination of the adjacent rail ends should be performed by the use of dye penetrant to ensure that defects do not exist in the parent rail.

b) Confirmation that defects do not exist in the parent rail ends will be achieved by:

i. Dye penetrant testing of the exposed rail ends remaining in track (parent rail), or

ii. Dye penetrant testing of the ends of the rail that came out of track. This method may help speed up the repair.

Note: Method (i) is preferred.

c) Where rail ends have not been confirmed to be defect free by the use of dye penetrant, a 10-mph speed restriction should be considered until the rail ends have been DP tested or ultrasonically tested.

i. This speed restriction may only be removed under the authority of the Track Supervisor (Inspector), after it has been ascertained that the rail has been tested.

d) Recommended use of Dye Penetrant (DP) follows;

i. Clean the saw cut surface by spraying the cleaner solvent then wiping the surface with a clean rag.

Figure SUB-PART D – 48 – Cleaning of Saw Cut Rail Surface

i. Apply Dye Penetrant Spray to the saw cut rail surface and let it stand for approximately 5 minutes or until dry,

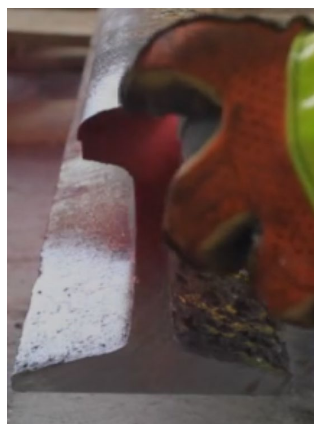


Figure SUB-PART D – 49 – Application of the Dye Penetrant Spray

ii. Then spray some cleaner solvent onto a rag and clean the dye penetrant from the saw cut rail surface.

Figure SUB-PART D – 50 – Cleaning the Dye Penetrant Spray from the Rail Surface

iii. Shake Developer Spray for approximately 1 minute and apply to the saw cut rail surface.

iv. Let dry.

v. Red lines or spots showing through the white developer will indicate defects remaining in the rail.

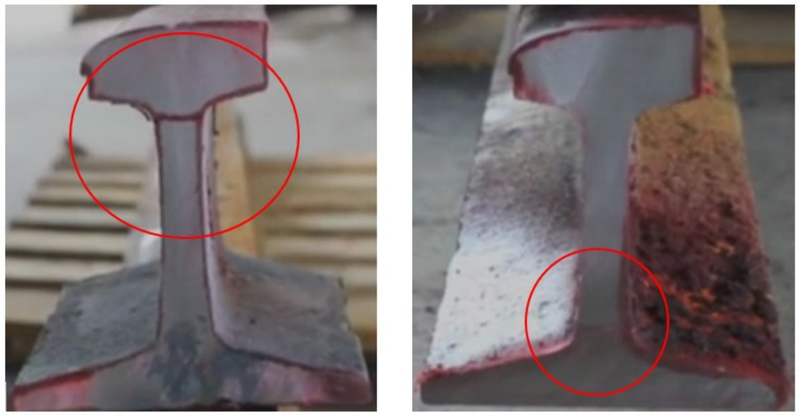


Figure SUB-PART D – 51 – Dye Penetrant Developer Indicating Rail Defect Remain

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

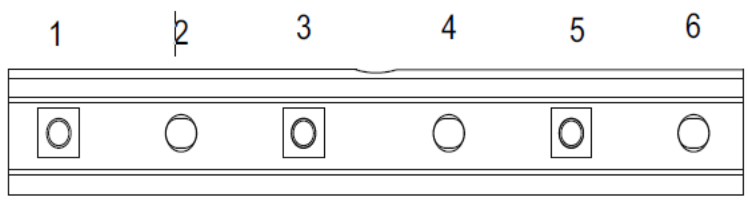


Figure SUB-PART D – 54 – Example of 6-Hole Joint Bar Bolted

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,

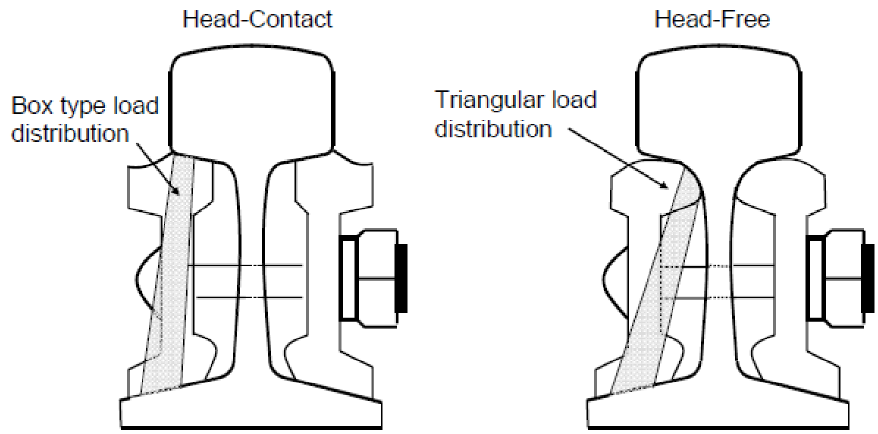


Figure SUB-PART D – 55 – Conventional and Head-Free Joint Bar Design Load Difference

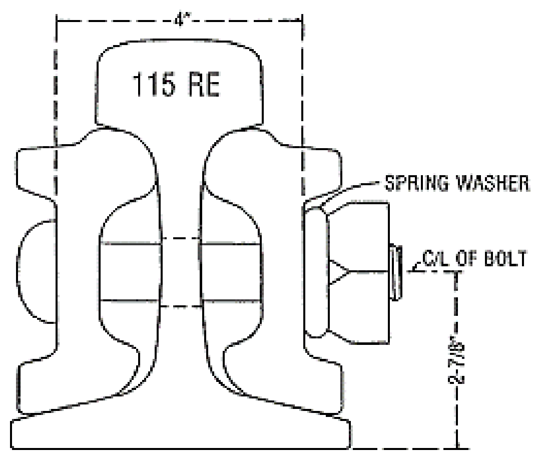


Figure SUB-PART D – 56 – Joint Bar Assembly for 115 RE

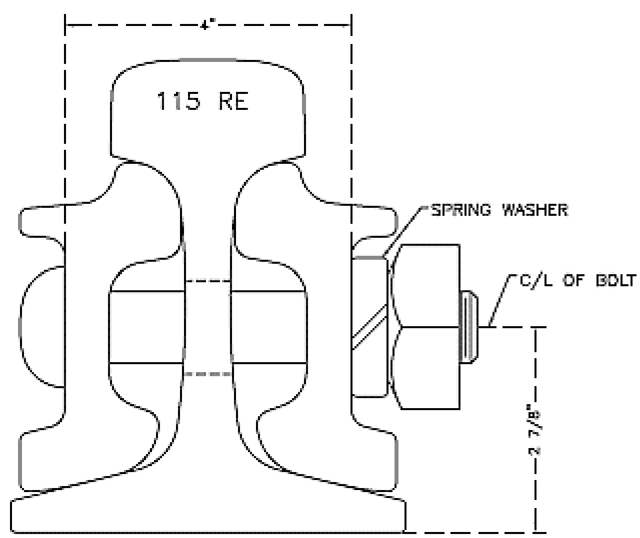


Figure SUB-PART D – 57 – Clearance Joint Bar Assembly for 115 RE

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:

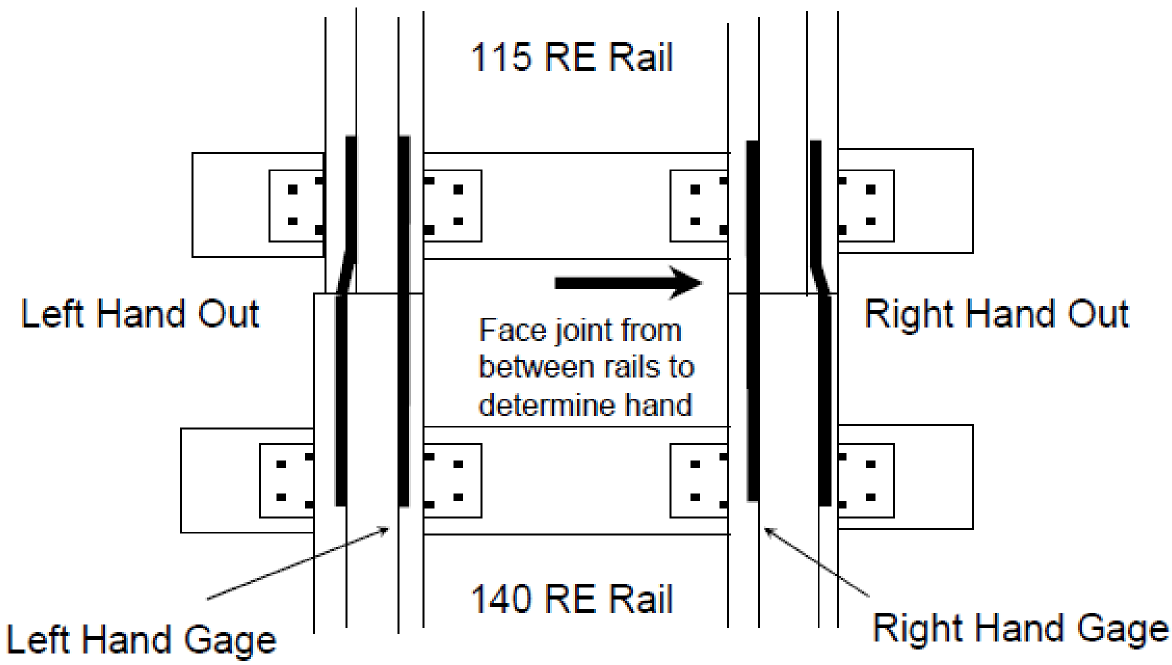
- Directional (Right or Left hand) compromise bars are used where a difference in the width of the head between two sections requires the offsetting of the rail to align the gauge side of the rail.

- 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.

   Note (2026-01-30):
   Only to be used during a Movement Over a Rail Break.

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.

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7. Continuous Welded Rail (CWR) Management Plan

7.1 CWR – Responsibilities

a) All track forces must properly protect and promptly report any unusual conditions observed developing in CWR to the Track Supervisor (Inspector) or District Manager.

b) All supervisory personnel including Track Maintenance Foremen and Track Supervisors (Inspectors), on whose territory CWR is laid, must be familiar with the causes, high-risk conditions, and work as well as slow order requirements to avoid track buckles as summarized in the Sub-Part D – Section 7.8 – CWR – Buckled Track.

c) All employees responsible for the maintenance or inspection of CWR must be trained and qualified in the maintenance of CWR.

d) Effective January 1, 2026, the PRLT at Ontario Northland is 90°F *(32.2°C)* and the PRLTR is 90°F plus 15°F *(32.2°C plus 8.4°C)*.

- Up to December 31, 2025, the PRLT is 85°F *(29.4°C)* and the PRLTR is 85°F plus 15°F *(29.4°C plus 8.4°C)*.

As a guideline, on a sunny day, the rail temperature can be 30°F, or 17°C warmer than the ambient temperature. Cloud cover, wind and precipitation can reduce this difference.

7.2 CWR – Handling and Unloading CWR (Recommended Method)

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

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

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

1. **Planning for Rail Renewal**
   i. Pre-project planning (conducted months prior to the job)
      - Includes emergencies, work environment, materials required, project impediments, work site access, etc.

   ii. Pre-project planning (conducted weeks before the job)
      - Includes track protection requirements and work blocks

   iii. Pre-block planning (conducted prior to the work)
      - Includes material and equipment readiness, job briefing, field level risk assessment.
2. **Preparation**
   i. Overhead contact systems shall be de-energised and grounded on each side of the working limits prior to commencing the loading or unloading of any rail.

ii. Preparation is key to safely and efficiently unloading rail. In addition, to all the planning and recognized "Best Practices" involved, the following essential preparation will help maintain a safe and productive work environment. Unloading CWR has many inherent risks associated with it. It is therefore essential that a proper and thorough job briefing be performed. The job briefing(s) and Field Level Risk Assessment will include the entire unloading gang, AND the work train crew. It is of utmost importance that all employees engaged in the unloading of CWR have a clear understanding of:

- The type of track protection and work limits provided
- The work to be performed
- The roles and responsibilities of all employees involved
- The identification of all immediate or potential hazards and identifies controls to minimize the risk associated with the identified hazards.
- A communication plan must be established for all personnel involved in the unloading process. An understanding of this plan must be confirmed with all employees
- Utilization of the proper tools for the job
- The proper procedures for unloading CWR as outlined in this recommended method.

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

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

v. Rail Unloading Hardware

Figure SUB-PART D – 59 – Rail Shoe (used to pull rail through the threader box)

Figure SUB-PART D – 60 – Rail Grip (used to anchor rail to track structure)

Figure SUB-PART D – 61 – End of One Rail Connected to the Beginning of Another Rail Being Unloaded

Figure SUB-PART D – 62 – Do Not Use Chains or Pigtails for Rail Unloading; Use Nylon Slings or Steel Cables

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

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

viii. Ensure all location details are known, including:

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

x. Obstructions at unloading area (crossings, bridges, turnouts, steep embankments, high-degree curves, etc.).

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

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

3. <u>Set Up Ramp and Threader Cars</u>

i. To place the CWR beside the track, two specialized cars are utilized to guide the rail into position.

- Ramp Car: Contains adjustable height rollers (movable tables) to match the height of the tier from which rail is being unloaded. This allows the proper angle to be maintained for rail fed through the threader car. This prevents the rail from binding or kinking.
- Threader Car: Used to guide rail off the rail train to its final position on the shoulder of the track. It does so by threading it through adjustable roller "threader boxes" mounted on the sides of the car.
- Anchor Car: The anchor car secures the rail in place during transit. This car is located near the mid-point of the train. The rail is held place on the anchor car by a plate that is secured with bolts. The electric impact wrench supplied in the toolbox on the anchor car can be used to remove the bolts.

ii. Threading Rail

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

<u>Step 1:</u> Spot end of threader car at beginning of desired rail-unloading location.

<u>Step 2:</u> Attach rail shoe to leading end of the rail to be unloaded.

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

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

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

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

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

4. Unloading Rail

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

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

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

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

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

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

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

ii. Place rail as close to the location of installation as possible.

iii. When practicable, unload rail 6 feet or more from the centerline of track

iv. Separate and offset rail ends to allow by-pass if the rail expands

v. Minimize the number of cuts in a string

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

- Stop the train; do not try to connect the second string until the movement has come to a complete stop. An additional string can be connected to the trailing end of a string being unloaded. This connection is depicted in Figure SUB-PART D – 60 of this document.

- The speed of the movement while threading the second or trailing rail must be slow and controlled (not to exceed 5 mph).
- The rail shoe must fit entirely over the face of the trailing rail. The length of cable or nylon sling between two rails connected to be unloaded must not exceed three feet. The operator of the ramp car must ensure that the rail being pulled from the rail train is properly supported as it approaches the threader car.

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

- Only qualified employees are to utilize oxy-acetylene torches
- Perform supplemental Job Briefing (conditions changed)
- Identify personnel required to be in the vicinity and ensure all other employees are clear of the area.
- Identify the "line of fire" of the suspended rail, looking ahead to the point at which the cut is complete, where will the rail fall, where will the rail swing.
- Designate and equip employees to watch for sparks and extinguish embers, hot slag or fires that may ignite.

5. **Moving to the Next Unloading Location**

i. Secure remaining rail on train prior to moving to a new location

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

iii. Limiting the amount of travel between unloading points, e.g., unloading rail at locations that are near one another, can greatly reduce the amount of set up time required. However, DO NOT leave rail in the threader boxes unless moves are short. When traveling with rail in the threader boxes, restrict speeds to a maximum of 15 mph if train is making a reverse movement and 25 mph if train is making a forward movement. Please ensure that the locomotive engineer is aware that no sudden stops are to be made at any time. All movements must come to a controlled stop. If rail is fully on the racks (not in the threader box) and anchors and plates applied, the train may travel at track speed.

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

Figure SUB-PART D – 63 – CWR Rail Unloading Scenarios

7.3 CWR – Before Laying

Lay CWR only if:

7.3.1 Ballast in CWR

a) The ballast is of sufficient quantity and quality to restrain the track laterally under dynamic loads imposed by railroad equipment and thermal stress exerted by the rails.

7.3.2 Ties in CWR

a) The tie condition and spacing is sufficient to ensure that gauge, surface, and alignment can be maintained to within the limits for the specific class of track as prescribed in Sub-Part C, Section 2.

7.4 CWR – Laying

7.4.1 Rail Temperature: When Laying CWR

a) Unless advised otherwise by the Director, Rail Infrastructure, effective January 1, 2026, the PRLT (preferred rail laying temperature) at ONTC is 90°F *(32.2°C)*,

   - Up to December 31, 2025, the PRLT is 85°F *(29.4°C)* and the PRLTR is 85°F plus 15°F *(29.4°C plus 8.4°C)*.

b) CWR will be installed and anchored within the PRLTR (preferred rail laying temperature range). At ONTC, effective January 1, 2026, this is the PRLT plus 15°F (90°F to 105°F / *32.2°C to 40.5°C*). If this cannot be achieved, the rail must be destressed.

   - Up to December 31, 2025, the PRLT is 85°F *(29.4°C)* and the PRLTR is 85°F plus 15°F *(29.4°C plus 8.4°C)*.

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

- 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, or
- Use an approved infrared sensor held 18" from the rail web is acceptable,

d) When rail temperature is below the minimum preferred rail laying temperature, heat CWR to the preferred laying temperature or pull CWR so it reaches the same length it would be if it was unrestrained at the preferred laying temperature. Ensure even distribution heat over the length of the rail installed to ensure uniform expansion.

e) Use rail vibrators or tap the tie plates to assist rail movement

f) On concrete tie track, monitor heat to avoid damaging pads or insulators

g) Where rail is installed below the preferred rail laying temperature, for example when laying rail in cold weather and the PRLT cannot be achieved, the rail must be restressed before the rail temperature reaches the PRLT or 40 °F above the temperature at which the rail was laid, whichever is lower. If this can not be completed prior to the rail temperature increase an inspection should be conducted in the heat of the day, applicable speed restrictions placed until destressing can occur.

h) Monitoring the movement of rail when installing CWR:
   - Prior to making the first cut, or breaking a joint of a previous day's relay, place a match mark from the field side base of the rail that will remain in track to an unanchored tie plate.
   - Measure the rail temperature and length of the rail to be installed.
   - Determine the total expansion required from the table of APPENDIX A based on the difference between the PRLT and the current rail temperature.
   - All previous temperature markings on the rail must be painted over.
   - Place match marks, on the field side web, at 200-foot intervals.
   - Write the distance (usually 200-foot stationing), distance interval, date, pre-heat rail temperature, rail movement at the 200-foot station and rail anchoring temperature at each station on the field side web.
   - String (leg) number, relay date, pre-heat rail temperature, anchored temperature, and string length will be written at the end of each string, on the field side web, and documented in the applicable record.

7.4.2 Joints: When Laying CWR

a) Bolt each joint in CWR with at least four bolts, and with at least two bolts in each abutting rail.

b) Use standard, compromise, or high relief six-hole joint bars in CWR territory where an approved design exists.

c) Use six-hole joint bars with at least four bolts installed on standard joints that are planned to be eliminated through field welding. To facilitate welding, the two middle holes of the joint should not be drilled. A joint gap not exceeding 3/8" *(9.5 mm)* is to be left.

d) Use six bolts per joint on joints located in turnouts, diamonds, crossovers, and bridges, as well as in compromise joints and insulated joints.

e) Transitions to existing rail will have vertical and gauge mismatch appropriate for the class of track.

7.4.3 Anchoring: When Laying CWR

a) Rail anchors or clips must be installed immediately behind the rail heater at the PRLT.

b) Rail anchored within the PRLTR should not require further adjustment.

c) Rail anchored below the PRLT must be adjusted or protected before hot weather.

   i. If CWR is installed at a temperature more than 40°F below the PRLT, track must be inspected, and applicable speed restrictions applied prior to the rail temperature reaching the PRLT.

d) Box anchor CWR at every second tie for restraint in both directions, this includes where joints are planned to be field welded in Class 3 through Class 5 track.

e) Anchors may not be applied where they will interfere with signal or other track appliances, where they are inaccessible for adjustment or inspection or on rail opposite a joint.

f) For Class 1 through Class 5 track, where joints will not be field welded, box anchor every tie for 200’ in each direction from the joint.

g) For Class 1 and 2 track, the Director, Rail Infrastructure may exempt the requirement to box anchor every tie for the first and last 200’ of each CWR string.

h) Box anchor jointed track connected to CWR strings every tie for 200’. When necessary, install additional anchors on the jointed track to prevent track movement.

i) Anchor rail through turnouts and other special track work connected to CWR according to the applicable Standard.

j) Box anchor each approach to a turnout and each approach to a track crossing (diamond) at every tie for a distance of 200’ away from the turnout or track crossing.

k) Wayside Inspection Systems (WIS) should be box anchored every tie for a minimum of 100’ *(30,480 mm)* in each direction,

l) When installing CWR, insulated joints (poly or pre-bond) are to be box anchored every tie 200’ in each direction.

m) Do not allow trains to pass over unanchored CWR except in an emergency. Then, the following must be done:

   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 movements through or near the work location.

7.4.4 Tie Plates: When Laying CWR

a) Use double-shoulder tie plates for rail lengths longer than 90’ and rail weight 100 lb or heavier.

7.4.5 Spiking: When Laying CWR

a) Use spike lengths and spiking patterns that meet the requirements outlined in Sub-Part D – Section 4 – Spikes.

b) Each spike hole of the tie will be plugged, preferably with chemical plugging compound

7.5 CWR – After Installation

7.5.1 Documentation of CWR Laid

a) Prepare and retain for 3 years a record of all CWR strings laid indicating:

i. Date,

ii. String number,

iii. Weight of rail,

iv. Manufacturer,

v. Year of rail,

vi. Temperature at which the rail was laid,

vii. Mileage location, and

viii. Whether the string was E or W rail.

7.6 CWR – Bridges

7.6.1 Bridge Considerations and CWR

a) Do not lay CWR on any bridge, unless the Director, Rail Infrastructure has confirmed the bridge conditions meet the requirement for laying CWR,

b) Bolted joints in connecting strings of continuous welded rail must not be located on bridges. Also, they must not be located on roadbed approaches within 300’ of the ballast walls at either end of the bridge.

7.6.2 Anchors for CWR on Bridges

a) If CWR is to be laid on a bridge, the Director, Rail Infrastructure will provide an anchor plan for that bridge.

b) On open deck bridges with CWR on the approaches, box anchor every tie for a distance of at least 200’ starting 20’ back from the back wall on each approach.

7.6.3 Fastenings for CWR on Bridges

a) The installation of all new and replacement decks on open deck bridges is the responsibility of the Director, Rail Infrastructure and is to be carried out in accordance with applicable standards.

7.7 CWR – Maintenance

7.7.1 Surfacing and Lining in CWR Territory

a) Where the track will be surfaced by tamping machine, at a rail temperature of 50°F *(10°C)* or lower:

   i. The employee responsible for the surfacing work must set reference stakes over the full length of each curve of 3° or greater before track is surfaced. Set 3 or more stakes no more than 200’ apart and clear of work activity so they will not be disturbed.

   ii. The Track Supervisor (Inspector) must ensure that reference measurements are taken 1 week after each curve is surfaced.

   iii. The Track Supervisor (Inspector) must ensure that all curves with an average inward movement of 1” *(25 mm)* or more are corrected before hot weather arrives. This is done by restoring the curve to its proper alignment, or by cutting the rail and re-stressing it.

b) Where it is necessary to surface track when the rail temperature is, or is expected to be, more than 15°F above the preferred rail laying temperature (PRLT) perform additional track inspections while surfacing and behind surfacing work.

c) Do not spike line in CWR territory if possible. Never spike line track when the rail temperature is above the preferred rail laying temperature.

d) Refer to Sub-Part C, Section 13.5 – Surfacing and Lining – Ballast Stabilization if a ballast stabilizing machine (e.g., Dynamic Track Stabilizer) is being utilized.

7.7.2 Ballasting and Undercutting in CWR Territory

a) When track has been skeletonized, take steps to restore the track to its original line as soon as possible.

b) Where the track will be skeletonized at a rail temperature of 70°F *(20°C)* or lower:

   i. The employee responsible for the ballasting or undercutting work must set reference stakes over the full length of each curve before track is surfaced. Set 3 or more stakes no more than 200’ apart and clear of work gang activity so they will not be disturbed.

   ii. The Track Supervisor (Inspector) or Manager must ensure that reference measurements are taken 1 week after each curve is surfaced.

   iii. The Track Supervisor (Inspector) must ensure that all curves with an average inward movement of 1” *(25 mm)* or more are corrected before hot weather arrives. This is done by restoring the curve to its proper alignment, or by cutting the rail and re-stressing it.

c) Do not permit the movement of trains over skeleton track, except for work trains unloading ballast. The work train operations may be made at 5 mph and only after ensuring that all ties are spiked, and all rail anchors are applied.

d) When new ties are installed, re-apply anchors in accordance with the ONTC's standard anchor pattern.

e) As a guideline if the total raise in CWR territory will be more than 4", perform the raise in at least 2 lifts. Allowing enough time between lifts to permit rail traffic to compact the ballast.

f) Refer to Sub-Part C, Section 13.5 – Surfacing and Lining – Ballast Stabilization if a ballast stabilizing machine (e.g., Dynamic Track Stabilizer) is being utilized.

7.7.3 Joints for Maintenance of CWR

a) Bolt each joint in CWR with at least four bolts, and with at least two bolts in each abutting rail.

b) When tightening bolts, ensure that the joint bars are seated properly and tighten bolts securely.

c) Replace missing bolts as soon as conditions permit.

d) Use standard, compromise, or high-relief six-hole joint bars in CWR territory unless otherwise specified.

7.7.4 Temporary and Permanent Joints: Maintenance and Inspection in CWR

CWR is defined as any rail with a length of over 400'.

Where CWR currently exists, or where new or partly worn CWR is being installed, the intent should be to maintain the CWR in existing lengths or to create or increase the length of CWR by eliminating permanent and temporary rail joints.

a) Temporary joints within or joining adjacent lengths of CWR must comply with Part 1, Section 3.56 which indicates they,

- Have all holes are drilled and bolted using a 6-hole joint bar with 4 bolts installed in the outer most holes of the joint to facilitate welding.
- A joint gap not exceeding 3/8" *(10 mm)* is to be left.
- Must be welded or made into Permanent Joints within 3 (three) years of being installed.

b) Permanent joints within or joining adjacent lengths of CWR must comply with Part 1, Section 3.56 which indicates the following,

- Permanent Joints are fully drilled and bolted using a 6-hole joint bar, at a minimum.
- Every tie is box anchored for a minimum of 200' *(6,100 mm)* in each direction.

c) Records of the location, date of installation, date of inspection, and date of removal of all temporary joints must be maintained by the District Manager.

d) As per Sub-Part F, Section 10, a walking track inspection of all joints will be done yearly at a minimum.

7.7.5 Spikes for Maintenance or Upgrading of CWR

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

b) Existing spiking patterns may remain in place until a rail relay is performed.

c) 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.

7.7.6 Anchors for Maintenance of CWR

a) Existing anchor patterns may remain in place until a rail relay is performed.

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

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

d) Where replacement rails are installed, re-apply, or replace the anchors that were removed. Box anchor every tie on both the repair rail and the adjoining CWR for 200’ each direction. Anchors must bear on the same tie when box anchoring on every tie.

e) 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. Record these trouble areas and forward the information to the Track Supervisor (Inspector) and the District Manager.

7.7.7 Tie Plates for Maintenance of CWR

a) Replace missing or broken tie plates as necessary to effectively maintain gauge and to ensure proper support of the rail.

7.7.8 Shims for Maintenance of CWR

a) Do not use shims with total thickness greater than 2-1/2” *(64 mm)* in CWR territory, unless protected by a slow order restricting trains to less than 2/3 the authorized timetable speed.

b) Further protection may be required when shims are installed in sensitive locations such as at the approaches to bridges, the spirals in curves, at or near turnouts and at road crossings,

c) Do not remove shims if the rail temperature is more than the preferred rail laying temperature.

7.7.9 Maintenance of Thermal Stress in Rail

Continuous welded rail may drift into tension or compression, so that it is stress free at some temperature outside the preferred rail laying temperature range, as a result of such activities as track surfacing, tie renewals, ballast cleaning, track lining, and curve rail renewal.

Even if the track is not worked on, the rail can shift and go out of destress as a result of rail breaks, emergency brake applications, worn or defective anchors, poor quality or insufficient ballast, Permanent Slow Order locations, or soft subgrade. On vertical curves and gradients, rail is generally seen to move slowly downhill, resulting in an excessively low stress-free temperature at the bottom and an excessively high stress-free temperature at the top.

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

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

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

d) The MW Supervisor (Inspector) will be responsible for the locations and amounts of rail that is added or removed.

e) Any locations where rail is added below the PRLTR, the rail should be destressed prior to a rail temperature increase greater than 40°F or 22°C above the RLT.

f) Restress CWR laid at temperatures below the minimum preferred rail laying temperature range when rail heaters are not available before the rail temperature reaches 40°F above the temperature at which the rail was laid.

g) Restress CWR laid at temperatures more than 15°F above the maximum preferred rail laying temperature before winter. Where it is not possible to restress CWR laid at temperatures more than 15°F above the maximum preferred rail laying temperature before winter, then take other action such as apply additional rail anchors, fully drill and bolt joints, or apply slow orders to mitigate the risks of pull aparts, of rail string-lining and of rail tipping in plates at low temperatures.

h) See Appendix B for Destressing and Restressing Rail – Recommended Methods.

7.7.10 Repair of Pull-Aparts, Broken and Defective Rails in CWR

a) When repairing pull-aparts, broken or defective rails, to the extent that is practicable, ensure that the amount of rail that is put in the track equals the amount of rail removed.

b) It is very critical to remove rail added during cold weather repairs before the rail temperature exceeds the adjusted rail laying temperature.

c) Documentation of the information in the applicable record is required for each pull-apart and for each repair of CWR that involves the adding or removing of rail.

d) Monitor repairs where rail was added or removed as temperatures change and protect track with a slow order if required.

e) At locations where a pull apart has occurred a second time within the same season, fully drill and bolt the joint and box anchor every tie for a minimum of 200’ in both directions.

7.7.11 Repairing Pull-Apart of 3” or Less – Method 1

At a minimum, include the following steps, or alternatively the steps listed in Method 2 below, for the repair of a pull-apart of 3” or less:

a) Use a rail puller to pull the rail together.

b) Apply a minimum of 4 bolts (2 bolts in each abutting rail) in each joint.

c) Re-apply or replace displaced anchors.

d) Document the information in the applicable record.

7.7.12 Repairing Pull-Apart of 3” or Less – Method 2

At a minimum, include the following steps, or alternatively the steps listed in Method 1 above, for the repair of a pull-apart of 3” or less:

a) Cut in a permanent replacement rail of a minimum 12’ in length.

b) Lay the replacement rail with the maximum allowable joint gap.

c) Use six-hole joint bars at each joint, where applicable.

d) Apply a minimum of 4 bolts (2 bolts in each abutting rail) in each joint.

e) Re-apply or replace displaced anchors.

f) Document the information in the applicable record.

7.7.13 Repairing Pull-Apart of More than 3 inches

At a minimum, include the following steps for the repair of a pull-apart of more than 3”:

a) Cut in a permanent replacement rail of a minimum 12’ in length.

b) Lay the replacement rail with the maximum allowable joint gap.

c) Use six-hole joint bars at each joint, where applicable.

d) Apply a minimum of 4 bolts (2 bolts in each abutting rail) in each joint.

e) Re-apply or replace displaced anchors.

f) Document the information in the applicable record.

7.7.14 Repairing Broken Rail (not detected by Rail Flaw Detector)

At a minimum, include the following steps for the repair of a broken rail:

a) Cut in a permanent replacement rail of a minimum 12’ in length.

b) Install proper joint gaps as per Sub-Part D – Section 6.16.1.

c) Use six-hole joint bars at each joint, where applicable.

d) Apply a minimum of 4 bolts (2 bolts in each abutting rail) in each joint.

e) Re-apply or replace displaced anchors.

f) Document the information in the applicable records.

7.7.15 Repairing Defective Rails (detected by Rail Flaw Detector) with a Replacement Rail

At a minimum, include the following steps for repairing a defective rail with a replacement rail:

a) Cut in a permanent replacement rail of a minimum 12' in length.

b) Install proper joint gaps as per Sub-Part D – Section 6.16.1

c) Use six-hole joint bars at each joint, where applicable.

d) Apply a minimum of 4 bolts (2 bolts in each abutting rail) in each joint.

e) Re-apply or replace displaced anchors.

f) Document the information in the applicable record.

7.8 CWR – Buckled Track

This section lists the Requirements for inspection, track work and slow orders to reduce the risk of track buckling in CWR territory (and as applicable in joint track territory).

a) Except in cases of emergencies, no out-of-face surfacing and lining, rail replacement or tie renewal will be performed if the rail temperature is above the PRLTR.

b) As a guideline, rail temperature will be 25 to 30°F above the ambient temperature.

c) Track buckling is a constant threat during times of high or rapidly rising temperatures. It is of particular concern on CWR territory in the spring and early summer.

7.8.1 Indicators of Potential Track Buckle

a) Watch for indicators of potential track buckling problems such as:

   i. Wavy rail.

   ii. New line deviations, such as short flat spots in curve or kinks in tangent track.

   iii. Gaps or voids in ballast at end of ties.

   iv. Rail base not properly seated in the plates.

   v. Rail running through the anchors that may require restressing, resetting anchors and/or installing additional anchors.

   vi. Churning of ballast caused by tie movement resulting in gauge and line kinks.

   vii. Longitudinal movement of switch point in relation to stock rail, resulting in improper switch adjustment.

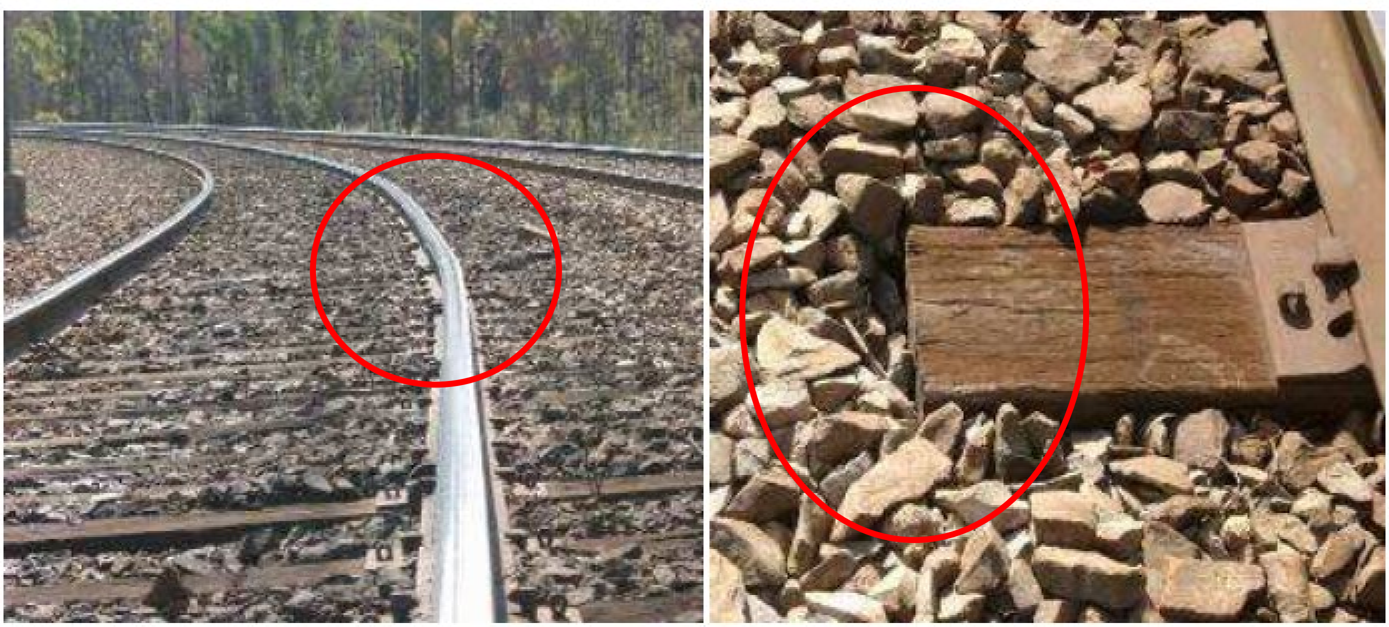

Figure SUB-PART D – 64 – Small Misalignment in Curved Track ***(left)*** **and Evidence of Misalignment with Movement at Tie Ends** ***(right)***

7.8.2 Locations Prone to Track Buckling

a) Pay particular attention to the following locations that are more prone to track buckles:

   i. Curves
   ii. Bridge approaches
   iii. Grade crossings
   iv. Crossings with other railroads (diamonds)
   v. Bottom of a heavy grade
   vi. Spots where the subgrade is soft or wet
   vii. Rock cuts where rail temperatures may be extremely high
   viii. Areas having a history of lateral instability
   ix. Recently disturbed track e.g. tie replacements, surfacing, new turnouts, etc.
   x. Locations where track work has been undertaken in cold weather and rail has not been adjusted, rail anchors not applied, or ballast not restored
   xi. Previous track buckle not permanently repaired

7.8.3 Protection of a Track Buckle or Imminent Track Buckle

a) A track buckle is an emergency situation. When a track buckle is detected, immediately take the following steps until the condition is corrected:

   i. Stop all traffic through the area until temporary / permanent repairs are complete, or
   ii. Have a qualified employee inspect the buckled location, determine that the track is safe for the passage of trains, and then supervise the passage of each train over the location at a maximum of 10 mph until temporary repairs are complete.

      - When there are indications that a track buckle may be about to occur (see Sub-Part D – Section 7.8.1), immediately take the following steps to protect train traffic until the condition is corrected:
        - Place a 10-mph slow order, or
        - Stop rail traffic if the situation warrants.

b) Inspect track protected by a heat slow daily while the order is in effect.

c) Conduct inspections during the heat of the day.

7.8.4 Temporary Repair of a Track Buckle

a) Place the track in the best possible alignment where the track will not move and where it will provide clearance for train operation at 10 mph.

b) Protect temporary repairs with a 10-mph slow order until permanent repairs are complete.

7.8.5 Permanent Repair of a Track Buckle

a) Take corrective actions that address the root cause, prevents recurrence, and allows for train operation at authorized timetable speed. Permanent repairs could involve:

- Apply new or additional anchors,
- Add ballast to shoulder and cribs,
- Replace defective ties
- Tamp, surface, line and regulate,
- Cut out rail and restress.

b) A qualified Track Supervisor (Inspector) must re-inspect permanent repairs to track buckles in the heat of the day and verify the effectiveness of repairs before returning track to authorized timetable speed.

c) When rail is removed in repairing a track buckle, document the information in the applicable record.

7.8.6 Track Buckle Reporting

a) The track condition and its repair(s) must be documented in the applicable record.

- A Track Buckle Report is no longer required.

7.9 CWR – Temporary Speed Restrictions Account Work

7.9.1 General Requirements

a) Requirements apply to jointed track territory as applicable.

b) Place a temporary speed restriction as per Figure SUB-PART D – 65 – Temporary Speed Restrictions for Track Work.

c) Speed restrictions ensure safe train operations until the affected track stabilizes. Restrictions need to stay in place to allow the ballast to consolidate, rail compressive forces to equalize and the subgrade to compact.

d) Take more restrictive measures when conditions warrant.

7.9.2 Responsibility for Placing Speed Restrictions

a) During the work or before returning the track to service, the qualified foreman / supervisor in charge must ensure the following:

i. Adequate gauge, surface, and alignment have been established.

ii. Sufficient crib and shoulder ballast is in place.

iii. The rail is properly anchored.

iv. Turnout is within standards.

7.9.3 Speed Restrictions Length

a) To minimize running rail and other dynamic forces, trains must have time to brake and adjust slack before entering the disturbed track.

b) To ensure trains reach the desired speed before entering the affected track, place speed restrictions at least 0.1 mile in each direction from the outside limits of the affected track.

c) For heavy grades, sharp curves, or substandard track conditions, extend speed restrictions farther from the work limits, if needed.

7.9.4 Speed Restriction Requirements while Carrying Out Track and Switch Tie Renewals

Apply the following speed restrictions in order to prevent track buckling while carrying out track and switch tie renewals:

a) When traffic must pass before all ties are fully plated, spiked, and anchored, and before all newly installed ties are tamped, ballast cribs filled, and shoulders pulled up the following must be done:

   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.

b) When tie renewals are complete, before traffic can pass ensure that conditions laid out in Figure SUB-PART D – 65 – Temporary Speed Restrictions for Track Work satisfied and place the associated restrictions:

Temporary Speed Restrictions for Track Work				
Type of Work	**Temperature**	**TSO in CWR without Dynamic Stabilizer**	**TSO in CWR with Dynamic Stabilizer**	**TSO in Jointed Rail**
Rail Laying (Continuous (out-of-face))	Any	1 train at 10 mph then inspect, if ok, then, 1 train at 25 mph then inspect, if ok, then track speed	N/A	1 train at 25 mph then inspect, if ok, then track speed
Spot Tie Renewal Spot Surfacing Shoulder Cleaning	At or above PRLT *(85°F or greater)* *(Effective 2026-01-01 - 90°F or greater)*	2 trains at 25 mph then inspect, if ok, then track speed	N/A	1 train at 25 mph then inspect, if ok, then track speed
	Below PRLT *(less than 85°F)* *(Effective 2026-01-01 - less than 90°F)*	Inspect If ok, then track speed	N/A	Inspect If ok, then track speed
Mechanized Tie Renewal Continuous Surfacing *Turnout Replacement Ballast Cleaning / Undercutting Track Surfacing and Lining	At or above PRLT *(85°F or greater)* *(Effective 2026-01-01 - 90°F or greater)*	1 train at 10 mph, then inspect, if ok then, 10 trains at 25 mph, then inspect, if ok, then track speed	2 trains at 30 mph, then inspect, if ok then track speed.	1 train at 10 mph then inspect, if ok, 5 trains at 25 mph then inspect, if ok, then track speed
	Between PRLT and 40°F below the PRLT *(Between 45°F and 85°F)* *(Effective 2026-01-01 - between 50°F and 90°F)*	1 train at 10 mph, then inspect, if ok, then, 5 trains at 25 mph, then inspect, if ok, then track speed	Inspect, if ok then track speed.	1 train at 10 mph then inspect, if ok, 2 trains at 25 mph then inspect, if ok, then track speed
	40°F or more below the PRLT *(45°F or lower)* *(Effective 2026-01-01 - 50°F or lower)*	2 trains at 25 mph, then inspect If ok, then track speed	Inspect, if ok then track speed.	1 train at 25 mph then inspect, if ok, then track speed

Note 1: Train is defined as freight or a mixed train; Passenger trains are not to be counted for provisions of this table.
Note 2: Do not remove speed restrictions in the heat of the day.
Note 3: In the interpretation of Maximum Speed, the Timetable may dictate a more restrictive speed.
Note 4: Work performed to address an URGENT defect(s) must be inspected by Quality Assurance personnel, per Sub-Part C, Section 8 – URGENT Defects.
***Reminder:** If it is a newly constructed mainline, a Category 1 yard turnout, or a Special Track Work a 10 mph TSO applies until a **Detailed Turnout Inspection** has been completed, in addition to the required TSOs noted above.

Figure SUB-PART D – 65 – Temporary Speed Restrictions for Track Work

c) Before placing any speed restrictions, a qualified Foreman or Track Supervisor (Manager) must inspect all track work.

d) Once the required trains have passed over the track, re-inspect the track in the heat of the day before returning the track to authorized timetable speed. The qualified employee will modify / remove the slow orders.

IMPORTANT: There may be conditions where further speed restrictions are required. The person in charge of the work must ensure that field inspections on the completed work are carried out and that areas of concern are identified and protected.

e) Do not increase speeds in the heat of the day.

f) For spot tie replacement by hand in CWR territory, it is not necessary to apply a speed restriction if **all** the following conditions are satisfied:

SPEED RESTRICTIONS – SPOT TIES	
CONDITION	**MAXIMUM SPEED**
1. At most two adjacent ties are replaced, and 2. The four ties on each side of the replaced ties are undisturbed; and not hanging, anchor pattern is complete, and anchors are in good condition, effective and tight, and 3. Installing new ties should disturb the track as littles as possible, jacking of track should be to minimum, base of plates on newly installed ties upon completion of install should be even with (0" below or at more 1/4" *(6 mm)* above) base of plate on adjacent undisturbed tie, and 4. The ambient temperature is less than 80°F *(27°C)* and is expected to stay less than 80°F *(27°C)* for 48 hours, and 5. Newly installed ties are fully plated, spiked, anchored, and tamped. Cribs are full and shoulders restored.	**Authorized Timetable Speed**

Figure SUB-PART D – 66 – Speed Restrictions - Spot Ties

If any of the above 5 conditions are not satisfied, the appropriate speed restrictions as laid out in Figure SUB-PART D – 65 – Temporary Speed Restrictions for Track Work are to be applied.

7.9.5 Speed Restriction Requirement when Surfacing and Lining in CWR Territory

Apply the following speed restrictions in order to prevent track buckling while surfacing and lining:

a) When traffic must pass before all ties have been tamped and run outs made and before all cribs have been filled with ballast and all shoulders have been pulled up the following must be done:

    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.

b) When surfacing and lining, before traffic can pass ensure that the conditions are satisfied and place the associated speed restrictions detailed in Figure SUB-PART D – 65 – Temporary Speed Restrictions for Track Work

c) Before placing any speed restrictions, a qualified Foreman or Track Supervisor (Inspector) must inspect all track work. Once the required trains have passed over the track, re-inspect the track in the heat of the day before returning the track to timetable speed.

    IMPORTANT: There may be conditions where further speed restrictions are required. The person in charge of the work must ensure that field inspections on the completed work are carried out and that areas of concern are identified and protected.

d) Do not increase speeds in the heat of the day.

e) When surfacing by hand or by machine in CWR territory, it is not necessary to apply a speed restriction if **all** the following conditions are satisfied:

SPEED RESTRICTIONS – SPOT SURFACING	
CONDITION	**MAXIMUM SPEED**
1. The surfacing performed is restoration of the track surface, cross-level and alignment through short stretches of track, not more than 19' 6" *(5,900 mm)* in length, when a continuous raise is not necessary, and 2. The lift is 1" *(25 mm)* or less, and 3. The track is not identified as a high-risk track buckle location, and 4. The track is tangent or of curvature less than 1° 30 min. and the ambient temperature is less than 80°F *(27°C)* and is expected to stay less than 80°F *(27°C)* for 48 hours, or The track is of curvature 1° 30 min. or more and the ambient temperature is less than 70°F *(21°C)* and is expected to stay less than 70°F *(21°C)* for 48 hours.	**Authorized Timetable Speed**

Figure SUB-PART D – 67 – Speed Restrictions - Spot Ties

If any of the above 4 conditions are not satisfied, the appropriate speed restrictions as laid out in Figure SUB-PART D – 65 – Temporary Speed Restrictions for Track Work are to be applied.

7.9.6 Speed Restriction Requirements when Ballasting and Undercutting in CWR Territory

Apply the following speed restrictions in order to prevent track buckling while ballasting and undercutting:

a) When traffic must pass before all ties have been spiked, all rail anchors have been applied and all ties on the newly ballasted track and run outs have been tamped the following must be done:

   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.

b) Where track is re-ballasted by skeletonizing track, before traffic can pass ensure that the conditions are satisfied and place the associated speed restrictions detailed in Figure SUB-PART D – 65 – Temporary Speed Restrictions for Track Work

c) Before placing any speed restrictions, a qualified Foreman or Track Supervisor (Inspector) must inspect all track work. Once the required trains have passed over the track, re-inspect the track in the heat of the day before returning the track to timetable speed.

   IMPORTANT: There may be conditions where further speed restrictions are required. The person in charge of the work must ensure that field inspections on the completed work are carried out and that areas of concern are identified and protected.

d) Do not increase speeds in the heat of the day.

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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.

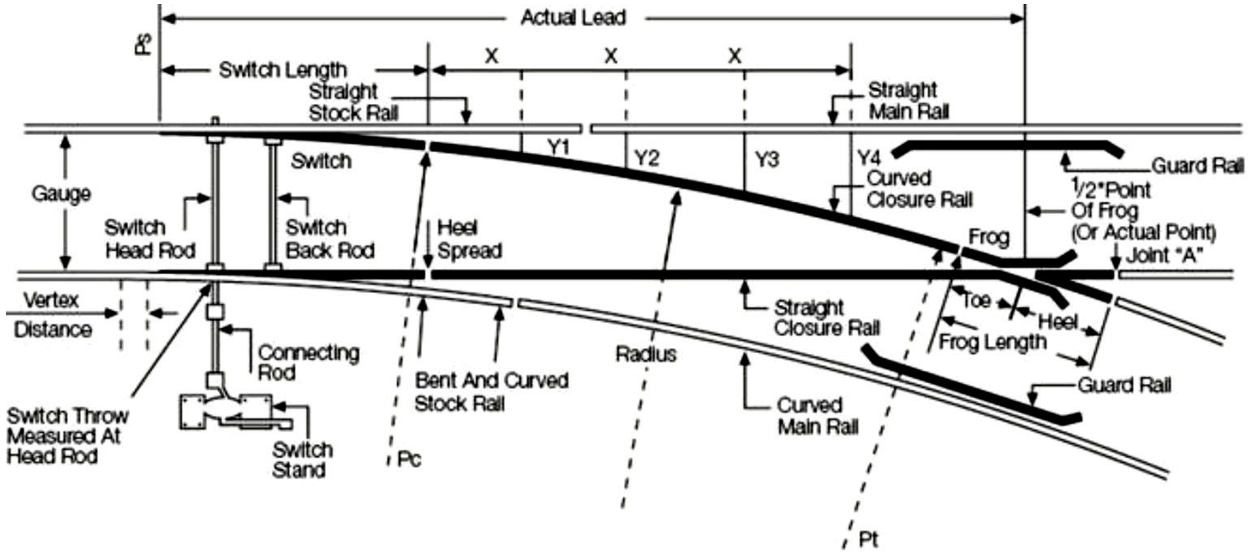

Figure SUB-PART D – 68 – Turnout Components

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.

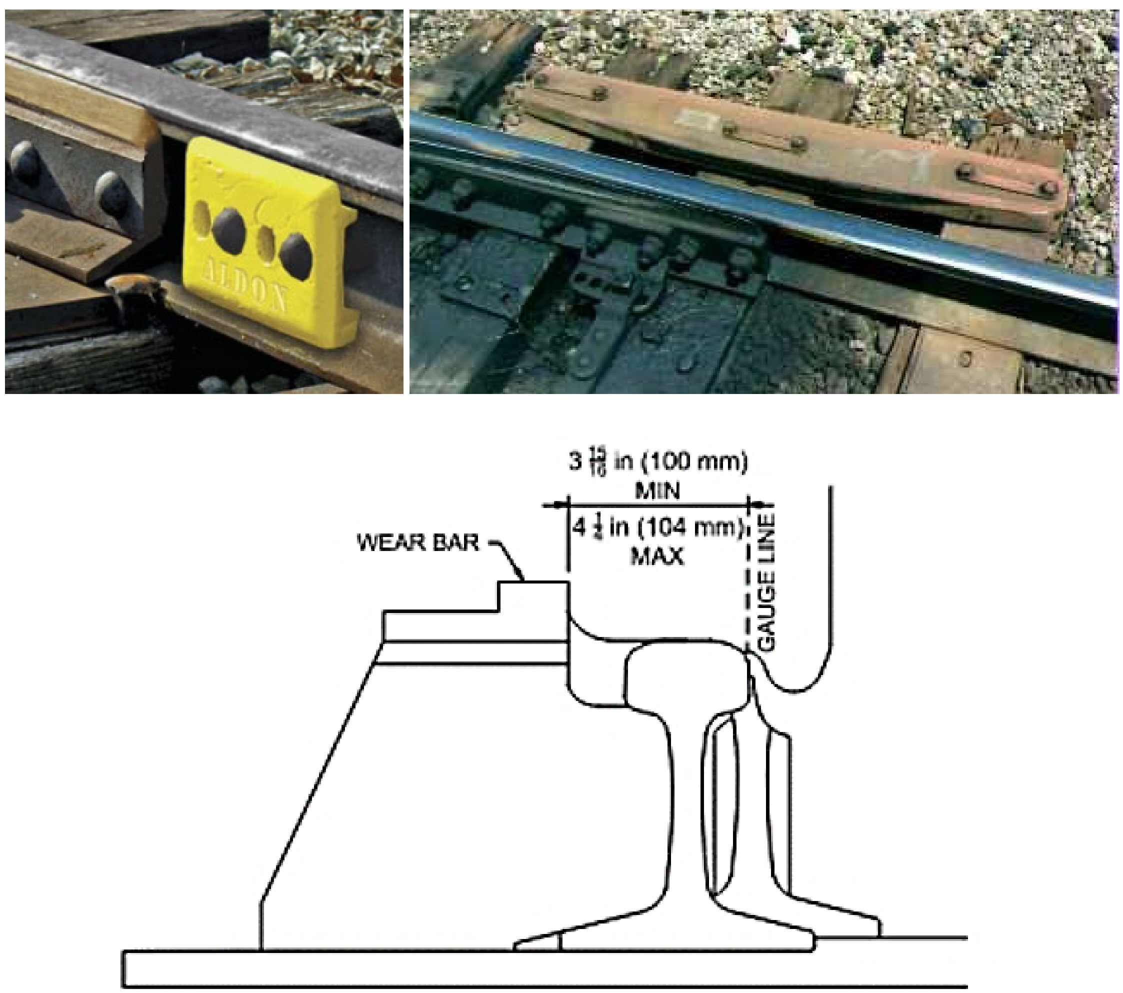

Figure SUB-PART D – 69 – Examples of Switch Point Protector and Switch Point Guard

ii. The limits for adjustable switch point guard bar settings are 3-15/16” *(100 mm)* minimum to 4-1/4” *(108 mm)* maximum. Always follow manufacturer's recommendations for adjustment and maintenance.

iii. 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,

iv. 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.

v. 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) <u>Ballast,</u>

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

i) <u>Locks and keeper requirements are as follows,</u>

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. <u>Switch Point Locks:</u>

- 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.

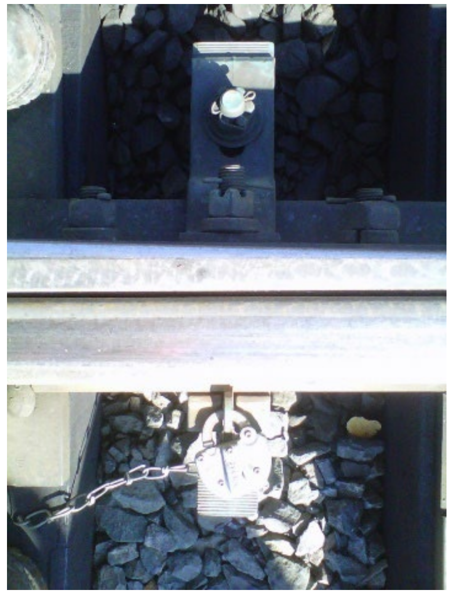

Figure SUB-PART D – 71 – Switch Point Foot Pedal Lock

8.4 Turnouts and Track Crossings – Maintenance

8.4.1 General Maintenance of Turnouts

a) The Signal Maintainer shall be present when any planned work, which may interfere with the functioning of the signal apparatus, is being performed.

b) Insulation in switch rods, and gauge plates shall be maintained in good condition at all times.

c) Switch stands, switch plates, connecting rod bolts, and spring frogs shall be kept properly lubricated to provide easy movement and to protect against excessive wear.

d) Switch stands, targets, masts, connecting rods and all other component parts must be kept in good operating condition and must have defective parts repaired or replaced immediately.

e) The application of heat or mechanical methods to repair bent or twisted switch stand masts is not permitted.

8.4.2 Switch Stand

a) Check the switch lock or keeper.

b) Check that the stand is securely fastened to the headblock ties.

c) Ensure that mast bearing areas are well lubricated.

8.4.3 Switch Target

a) Check the condition of reflectorized targets.

8.4.4 Eyebolt

a) Check the relative movement between the handle and top casting, and between the top casting and mast. When the relative movement becomes so great as to require excessive extension of the eyebolt from the mast barrel, the switch stand must be replaced.

b) When excessive eyebolt wear affects the quality of service provided by the switch stand, replace it – return the old one to the Yard for rebuilding.

8.4.5 Connecting Rod

a) Inspect the connecting rod for excessive wear in bolt holes.

b) Check connecting rod bolts to ensure that the nut and cotter pins are in place.

Near Point	Far Point	Crank Eye on Stand	Clevis on Connecting Rod
Fits Properly	Too Tight	Screw In	Screw In
Fits Properly	Too Loose	Screw Out	Screw Out
Too Tight	Fits Properly	Screw In	Screw Out
Too Loose	Fits Properly	Screw Out	Screw In
Too Tight	Too Tight	Screw In	None
Too Loose	Too Loose	Screw Out	None

Figure SUB-PART D – 72 – Switch Adjustment

8.4.6 Switch Rods

a) Switch rods and transit clips should have sufficient clearance so as not to contact the side of the tie or the slide plate.

b) Check switch rods for excessive wear in bolt hole areas.

c) Check insulation in insulated rods.

d) Check for excessive wear on rod clips, rod clip bolts and on the connecting rod bolt.

8.4.7 Switch Points and Stock Rails

a) Gaps in switch points, regardless of size, are unacceptable.

b) Points must fit tightly against the entire planed portion of the stock rail.

c) Metal flow on switch points and stock rails shall be kept ground off to maintain proper gauge and to prevent chipping of these parts.

- Flow should not exceed 1/16” *(2 mm)* on switch point or gauge side of stock rails.

d) Stock rail on the turnout side must be properly bent to provide a good fit for the switch point.

e) Chipped or broken switch point tips must not have a thickness greater than 3/16” *(5 mm)*,

f) Switch point tip is not less than 1/2" *(13 mm)* below the top of the stock rail,

g) Switch points are square to each other and not overhang the gauge plate by more than 1” *(25 mm)*.

h) Every effort must be made to replace the defective switch point and stock rail.

i) A mainline switch point will only be welded upon the direction of the Superintendent, Maintenance of Way.

j) Switch points are manufactured such that the running surface is higher than the stock rail, as measured at the location where the distance between the gauge side of the stock rail and gauge side of the switch point, when tight against the stock rail, is 4-1/2” *(114 mm)* as shown in Figure Sub-Part D – 73. This ensures the proper vertical clearance as shown in Figure Sub-Part D - 74.

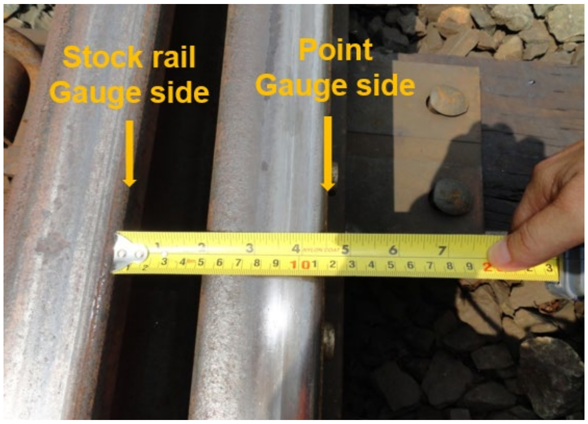

Figure SUB-PART D – 73 – 4-1/2” Point

Figure SUB-PART D – 74 – Effective Vertical Clearance at the Switch Point

- When this vertical dimension is reduced by wear to 3/16” *(5 mm)*,
  - The location must be monitored for signs of wheel contact on the stock rail.
  - Where contact is evident, the switch point must be renewed.

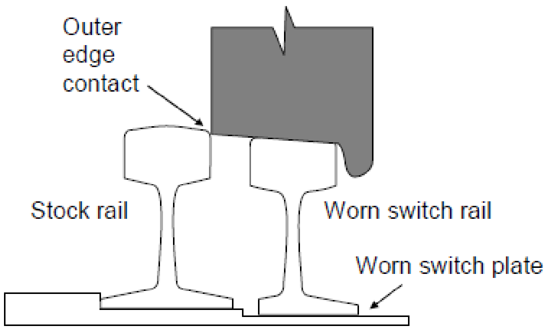

Figure SUB-PART D – 75 – Wheel Contact of Stock Rail

- In a new installation, the top of the point will be at least 1/4” *(6 mm)* above the top of the stock rail at the 4-1/2” *(114 mm)* point between the switch point and stock rail.
  - To provide the proper vertical clearance when the switch point is worn, it is necessary to use a stock rail that is equally worn.

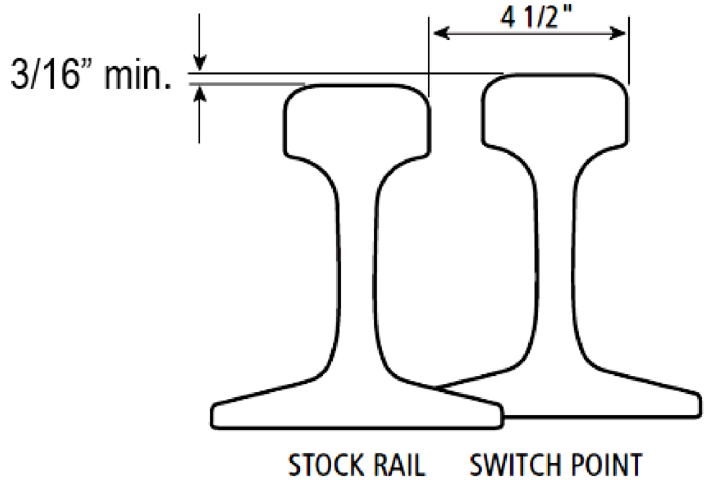

Figure SUB-PART D – 76 – Switch Point / Stock Rail Minimum Clearance

k) Ensure that points and stock rails are of the same rail section (e.g., Samson point with Samson stock rail)

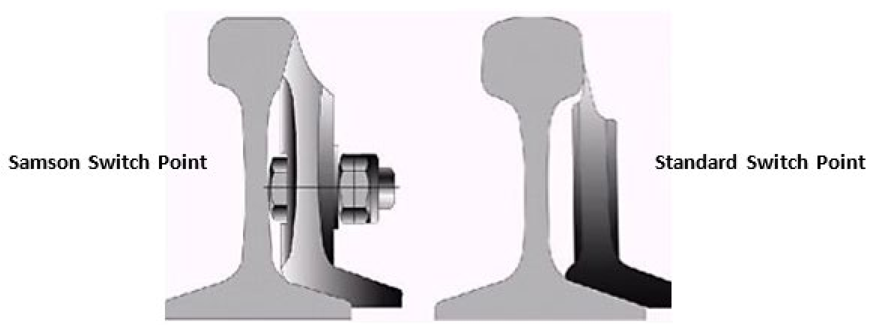

Figure SUB-PART D – 77 – Samson vs. Standard (“knife-edge”) Switch Point and Stock Rail

8.4.8 Ties

a) Maintain good tie condition under the heel assembly.

b) Ties must be installed and maintained in accordance with the layout shown on the standard plan.

c) Check the number of ties in the turnout. During major tie renewals, the number must be brought up to standard.

d) Ties are to be square to the through track in lateral turnouts.

e) Ties are to be well tamped throughout the turnout.

f) Ties must hold surface, line and gauge and are no longer useable when they are:

   i. Broken through,

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

iii. Plate cut more than 2” of the tie thickness, or

iv. So deteriorated that the tie plate or base of rail can move laterally 1/2 inch relative to the tie.

8.4.9 Tie Plates

a) Broken, bent or missing plates are to be replaced

b) Shoulder plates, or plates with cut rail seats, worn to the extent that the seat width is more than the nominal design width by 1/8 inch *(3 mm)* must be replaced.

c) Gauge plates with defective insulation must be reported to the Signal Maintainer.

d) Rails are to be properly seated in the gauge and riser slide plates and that rail braces are tight and well driven, but not overdriven to the extent that rail is canted inward.

e) Riser slide plates and spring frog plates are to be properly lubricated to permit free movement of switch points and spring wing rail.

f) All other plates are properly seated with shoulders bearing firmly against the rail base.

8.4.10 Heel Blocks

a) Replace bolts where required and maintain them in a tight condition.

8.4.11 Cotter Pins

a) All cotter pins are to be in place.

8.4.12 Frogs

A frog is a track component used at the intersection of two running rails to provide support for wheels and passage for their flanges, thus permitting wheels on either rail to cross the other intersecting rail.

a) General:

i. Ensure that frogs are maintained in accordance with the appropriate standard plan and instructions for frog maintenance.

ii. Check the frog for alignment and lateral movement.

iii. If the frog is removed, you must remove the guard rail as well or protect against it.

iv. Frog is supported throughout on well tamped and sound ties.

v. Evaluate cracks or breaks in frog castings or rail defects in the non-running portion of wing rails in terms of their potential effect on the safe passage of rolling stock. In particular, when making the evaluation:

- Determine if there is a loss or imminent loss of wheel guidance due to a loss of functional integrity.
- Should not consider cracks or breaks in a manganese frog casting that do not affect the safe passage of rolling stock to be a defective condition. If a severe crack, or a series of cracks, creates a condition where the breaking out of a piece of the casting is imminent,
- Cracks or wear that develop into a loss of functional integrity should be addressed.

b) <u>Guard Rails at the Frog:</u>

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

i. Guard rail bolts and fasteners must be intact and tight.

ii. Guard rail wear surfaces must not be worn more than 5/8” *(16 mm)*.

iii. <u>Guard Check Gauge Purpose:</u> Ensures wheels are able to pass through the frog without one of the wheels (the right wheel in Figure SUB-PART D – 78) striking the frog point.

- In Figure SUB-PART D – 78, there are two key dimensions:
  - “Wheel check,” is the distance between the two wheels plus the wheel flange thickness at the gauge line (5/8” below the running surface); and
  - “Guard check gauge,” is the distance between the gauge line of a frog to the guard line (a line along the side of the flangeway nearest to the center of the track and at the same elevation as the gauge line) of its guard rail or guarding face, measured across the track at right angles to the gauge line (a line 5/8” below the top of the center line of the head of the running rail, or corresponding location of the tread portion of the track structure).
- As the example illustrates in Figure SUB-PART D – 78, guard check gauge must be greater than or equal to the measurements in Figure SUB-PART D – 79, so there will be a “flange-frog point gap” between the right wheel and frog point interface, when the left wheel flange passes against the guard rail. This ensures the right wheel does not strike the frog point. The distance between the guard rail and the gauge side of the running rail should be 1 7/8”.

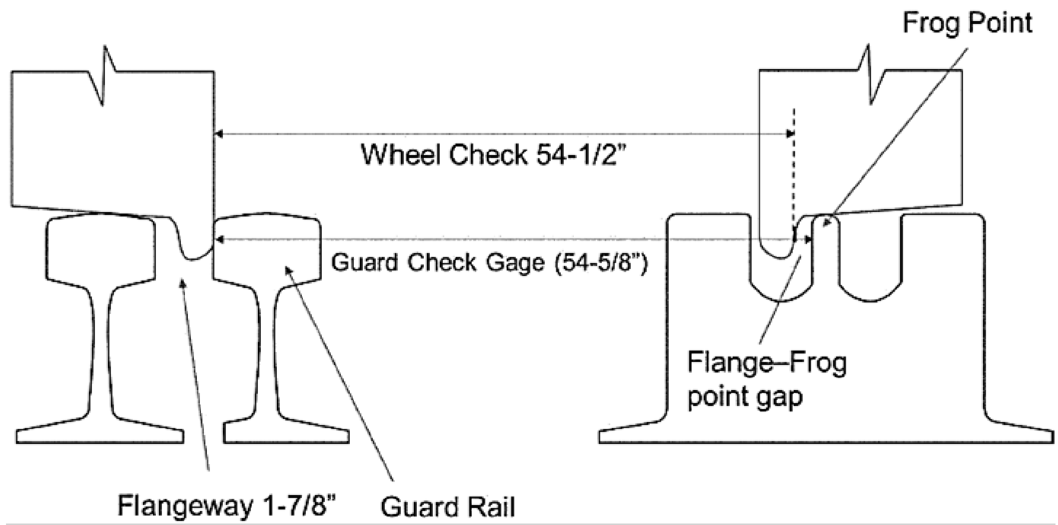

Figure SUB-PART D – 78 – Guard Check and Guard Face (account for Wheel Measurement)

iv. Guard Check and Guard Face Lateral Settings: Must be within the limits prescribed in Figure SUB-PART D – 79 and further illustrated in Figure SUB-PART D – 80 when measured at the 1/2" point of frog:

Class of Track	Guard Check Gauge MINIMUM	Guard Face Gauge MAXIMUM
1	**54 1/8”** *(1,375 mm)*	**53 1/4”** *(1,353 mm)*
2	**54 1/4"** *(1,378 mm)*	**53 1/8”** *(1,349 mm)*
3, 4	**54 3/8”** *(1,381 mm)*	**53 1/8”** *(1,349 mm)*
5	**54 1/2"** *(1,384 mm)*	**53”** *(1,346 mm)*

Figure SUB-PART D – 79 – Guard Rail Lateral Limits (inches and millimeters)

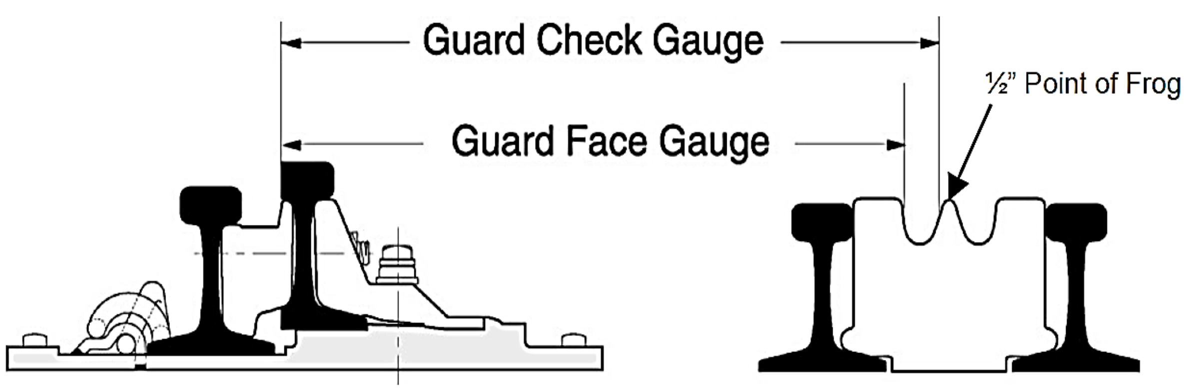

Figure SUB-PART D – 80 – Guard Check Gauge and Guard Face Gauge Measurement Locations

c) Frog Point:

i. Check for wheel flange contact on the point.

ii. Check whether the point is worn vertically to the maximum wear limit allowed by standard plan at the actual point of the frog.

iii. The maximum wear limit is 1/2" *(13 mm)* from the top of the frog. If worn to the maximum it must be repaired or replaced.

- Measurement is taken by use of a straight edge and a special gauge for point wear.

iv. If a frog point is chipped, broken, or worn more than 5/8” *(16 mm)* down and 6” *(152 mm)* back, restrict operating speed over the frog to not more than 10 mph.

Note: Ensure the guard rail is within standards. Possible result of a severely worn frog point and a worn or loose guard rail is that a wheel may “hit” the point and climb to the wrong side of the frog.

d) Tread Portion of Frog:

i. If the tread portion of the frog casting is worn down 3/8” *(10 mm)* or more below the original contour, operating speed must be limited to 10 mph until the frog is repaired or removed.

ii. The tread of the frog is considered to be any portion that is contacted by the tread of the wheel except for portion of the frog from the actual point to a position 6 inches back towards the heel.

iii. As shown in Figure SUB-PART D – 81, the measurements of the portion of the tread further back than the 6-inch position may be taken by placing a straightedge positioned longitudinal or transverse. Figure SUB-PART D – 81 shows a rail bound manganese frog design with an actual frog point that is 3/16” lower than the tread portion.

- A frog built without manganese (e.g., composed of ‘T’ rails called a bolted rigid frog) will have a point with a similar profile. Called a depressed point, the tread will taper up to the top of the rail profile in the direction toward the frog heel in a distance equal to one-half the frog number in inches, but not less than 5 inches.

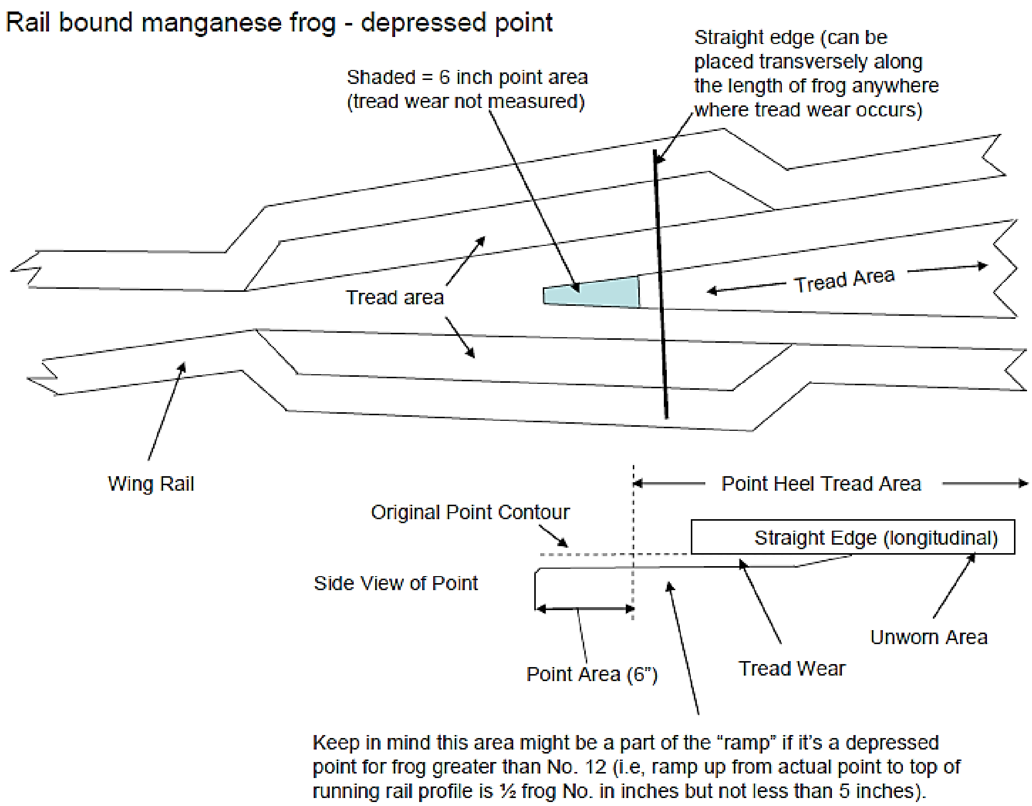

Figure SUB-PART D – 81 – Tread Portion

e) Bolts:

i. Check for loose bolts in the frog and in the rail joint connections.

f) Flangeways of Frog:

i. The flangeway depth must not be less than 1-1/2" *(38 mm)*.

ii. At higher speeds with a flangeway depth of less than 1-1/2" *(38 mm)* the wheel flange could "bottom out" in the flangeway and result in severe damage to the frog.

iii. Inspecting with a Check Gauge:

- If the check gauge contacts the bottom of the flangeway, worn frog surfaces must be repaired or the frog removed.

iv. Inspecting with a Straight Edge and Measuring Tape:

- If you do not have a check gauge, place a straight edge across the frog at the area of concern.
- Measure the space between the underside of the straight edge to the bottom of the flangeway and the space between the underside of the straight edge and the tread.
- As shown in Figure Sub-Part D - 82, subtract the tread value from the flangeway value to obtain the actual flangeway depth.

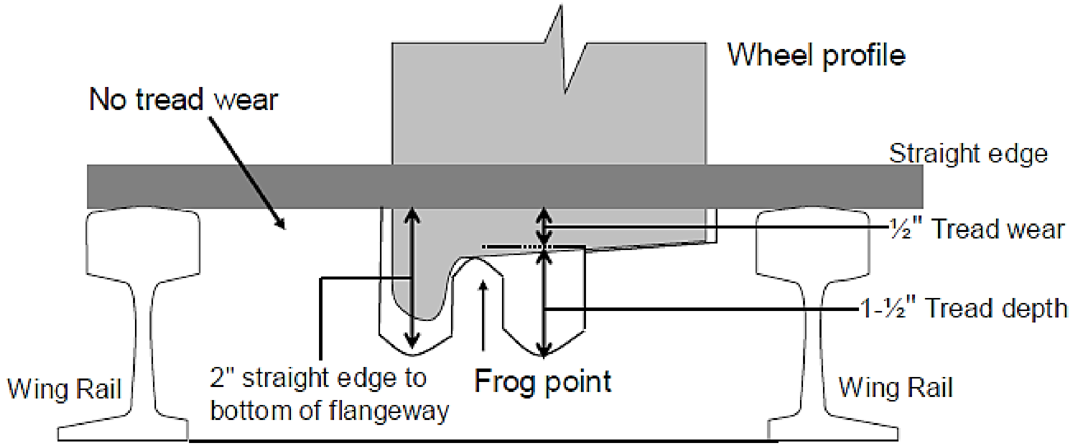

Figure SUB-PART D – 82 – Flangeway Depth Measurement with a Straight Edge

g) <u>Self-Guarded Frogs</u>

i. Check that the side wear measurement on raised self-guarded frog does not exceed 3/8” *(10 mm)*.

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

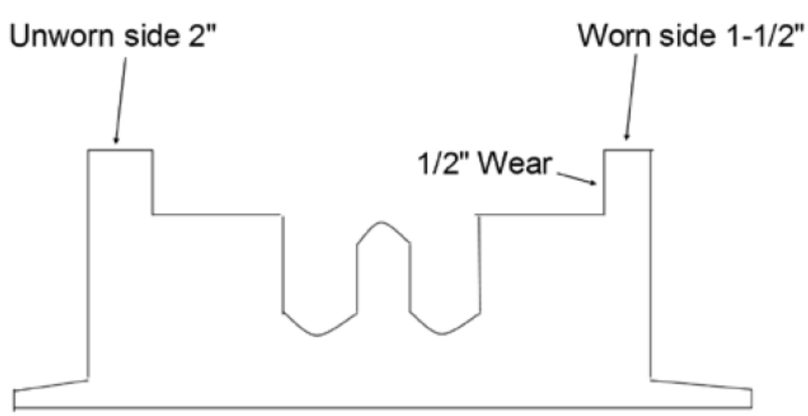

Figure SUB-PART D – 83 – Self-Guarded Frog – Raised Guard Wear Example

ii. Self -Guarded Frogs are <u>not</u> permitted in tracks where speeds exceed 15 mph.

- Speeds in excess of this can result in excessive lateral forces such as wheels ‘kicking’ or in extreme cases, wheels climbing up the raised guard.

iii. If repairs are made to a self-guarded frog without removing it from service, the guarding face must be restored before rebuilding the point.

- This precaution is necessary due to the potential for a wheel flange striking the frog point.

h) Spring Frogs

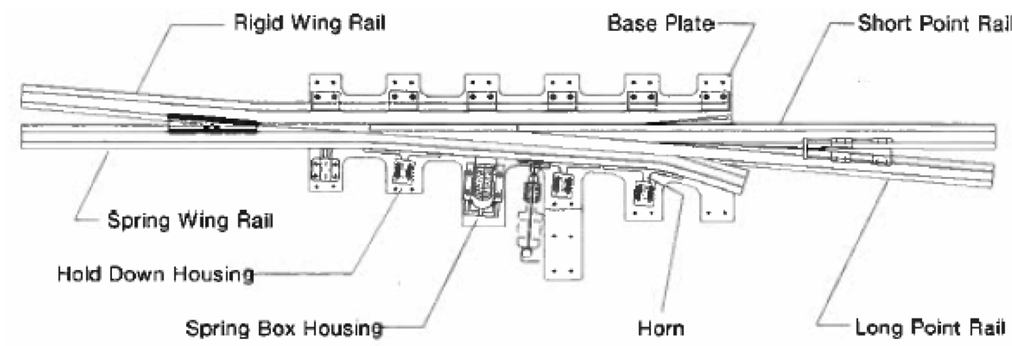

Figure SUB-PART D – 84 – Spring Frog

i. Do not put any part of your body between the spring wing rail and the point rail unless the spring is securely blocked open.

ii. Care must be taken when lifting the frog with a tamper as the rail base hooks may bend the frog base plate. Hand jacks MUST be utilized on the outside rails of the turnout to assist in lifting the frog.

iii. Where hand tamping of ties is performed, only 16” on either side of the rail is to be tamped; the centre of the tie must not be tamped.

iv. Check for loose deck bolts on the hold-down housings and brace stops.

v. The toe of each wing rail must be solidly tamped and fully and tightly bolted

vi. Ensure that a clearance of 1/16 inch *(2 mm)* to 1/4 inch *(6 mm)* is in place between the top of the horn and the hold-down housing. The top of the horn must be parallel to the inside of the top of the housing.

vii. Check to see that the spring wing rail bears evenly on all base plates. This can be checked by noting wear marks on the plates.

viii. When the wing is fully opened, the flangeway opening is at least 1-3/4” *(45 mm)* but not more than 1-7/8” *(48 mm)*.

ix. Having a 3/8” *(10 mm)* to 1/2" *(12 mm)* gap between the frog point and the wing rail. Beyond the tip, the wing rail and frog body shall be a tight fit.

x. The retarder shall hold the wing open for 1 to 3 minutes.

xi. Check the toe block assembly for:

- Correct bearing of the spring wing rail with respect to the block.
- Cracks in the toe block.
- Bolt hole cracks in the spring wing rail (the bent and counter-bored joint bar must be removed).
- Excessive wear on the shoulder bolts, sleeve, or bolt holes in the rail.

xii. Check the spring for sufficient tension. The nut on the spring bolt should be adjusted to a torque of not less than 10 lbs. and not more than 15 lbs. The correct assembly housing is shown on the standard plan.

xiii. Ensure that cotter pins are in place at both ends of the spring bolt.

xiv. Check that the spring wing rail is in correct contact with the point rail.

xv. The outer edge of a wheel tread may not contact the gauge side of the spring wing rail.

xvi. Before leaving the work site, clean the spring wing rail plates.

xvii. Apply a lubricant to the base plates.

xviii. Check the operation of the wing rail to ensure that the base plate has not restricted the horn clearance.

xix. Check to make sure the wing rail closes without sticking.

8.4.13 Bolts

a) Ensure that the bolts throughout the complete turnout are installed according to Standard Plan. They must be tightened to full specifications approximately 6 weeks after initial installation and annually after installation.

b) When installing bolts in turnouts, lubricate bolts by completely immersing the threads of bolts in new / used motor oil.

c) When installing guard rail bolts, the tapered washer should be installed on the guard rail side.

d) All new special track work 100 lb. or less will be assembled using Grade 5 bolts. All new special track work 115 lb. or greater will be assembled using Grade 8 bolts,

e) Grade 5 bolts can be identified by three (3) radial lines on the head of the bolt. Grade 8 bolts have six (6) radial lines,

f) Whenever grade 8 bolts are used, each bolt must be equipped with a hardened steel washer.

Note: All torques listed are for lubricated bolts using a graphite-based lubricant.

Size of Bolt (inches)	1”	1 1/16”	1 1/8”	1 1/4"
Torque – ft - lbs	670	850	1200	1600

Figure SUB-PART D – 85 – Torque to be Applied to Grade 5 Bolts for Special Track Work

Size of Bolt (inches)	1”	1 1/4”	1 3/8”
Torque – ft - lbs	840	1675	2500

Figure SUB-PART D – 86 – Torque to be Applied to Grade 8 Bolts for Special Track Work

8.4.14 Gauge

a) Measure track gauge throughout the turnout at locations from 4 to 6 ties apart, starting 10' ahead of the turnout. This includes the entire siding curve leading from the turnout track.

b) Maintain gauge throughout the balance of the turnout. If there is evidence of movement of the tie plates, then consider and calculate the gauge under load.

c) Gauge is measured between the heads of the rails at right angles to the rails in a plane 5/8 inch *(16 mm)* below the top of the rail. Standard gauge is 56-1/2 inches *(1,435 mm)*.

d) 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 ¾" *(1,467 mm)*
3	56" *(1,422 mm)*	57 ¾" *(1,467 mm)*
4 and 5	56" *(1,422 mm)*	57 ½" *(1,461 mm)*
Yard Track Category 1 & Category 2	55 3/4" *(1,416 mm)*	57 ¾" *(1,467 mm)*
Yard Track Category 3 & Category 4	55 3/4" *(1,416 mm)*	58" *(1,473 mm)*

Figure SUB-PART D – 87 – Gauge (inches and millimeters)

e) Variation in Gauge is when the gauge is less than 56" *(1,422 mm)* and the change in gauge over a distance of 20' or less on either side of the defective location exceeds 1-1/2 inches *(38 mm)*, train speed must be reduced according to Class 1 track speed.

8.4.15 Rails

a) Examine rails for surface defects and signs of internal defects.

8.4.16 Rail Anchors

a) Check that track is properly anchored adjacent to and through turnouts, in accordance with the ONTC standard plan.

b) Adequate rail anchors must be installed to resist rail movement and / or skewing of switch points.

8.4.17 Ballast

a) Good ballast and proper drainage are necessary in order to maintain good surface and line through the turnout. Ensure there is even ballast section with tie cribs full, except in the switch point area during the winter.

b) Ballast section is in accordance with the standard plan.

c) A good drainage ditch should be present on both sides of the track.

8.4.18 Surface

a) Observe surface irregularities by sighting along the underside of the head of rail. Start well before the switch points and move ahead as necessary to observe the entire length of the turnout.

b) Pay special attention to the surface of the turnouts, particularly at the frog since the surface has a direct effect on service life.

8.4.19 Alignment

a) Observe irregularities in alignment of turnouts in tangent track by sighting along the gauge side of the rail, on the frog side of the turnout, from a position well before the switch points.

b) Search for irregularities in alignment of turnouts in curved track by observation or by stretching a 62-foot cord along the gauge side of the outer rail of the curve and measuring the offsets at the center of the cord.

c) Observe the curved closure rails for uniformity of curvature.

8.4.20 Cross Level

a) Measure cross level throughout the turnout at locations from 4 to 6 ties apart.

b) Maintain cross level to match the cross level of the track in which the turnout is located.

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.

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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.

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2. Right of Way Maintenance

2.1 Right of Way Maintenance – General

a) Right of Way and adjoining properties of ONTC must be kept free of clutter and debris,

b) Employees must be vigilant for items such as rock or mud slides and slope failures that may affect safe train operations,

c) Areas near culverts or underground services and approaches to bridges must be monitored for signs of hidden failures affecting subgrade stability,

d) Signs of trespassers on the right of way are to be monitored, and action taken if required.

2.2 Right of Way Maintenance – Material

a) Material must not be stored or left in a position where it will interfere with train operations and employee movements,

b) Short heavy pieces of material such as rail plugs and joint bars must not be left where they could be placed on tracks by vandals,

c) Caution must be exercised during the preparation of or carrying out of program work to ensure material is not left in areas where it could cause a hazard,

d) If required, notices advising of potential hazards from material shall be issued to the RTC for placement on Daily Operating Bulletins,

e) Ties, other material, track units, machines or unattended equipment, should not be placed in areas where they may;

   i. Interfere with site lines,

   ii. Are subject to vandalism or fire,

   iii. May cause environmental impact.

2.3 Right of Way Maintenance – Winter Snow and Ice Removal

a) Snow and ice that may interfere with trains operations or employee movement must be removed or made safe as soon as practicable,

b) Areas prone to ice buildup such as crossings must be monitored and addressed in a timely fashion so as not to allow light equipment to derail,

c) Care must be taken when cleaning around power switches, hot box detectors and signals so as to not cause damage to equipment and connections for our wayside inspection and advance warning systems. Refer to Appendix N – Wayside Inspection Systems for more information,

   i. Most signal installations have markers installed to warn of equipment that can be damaged by wings.

   ii. These markers are located directly in front of, or beside, the item that is at risk of being struck.

   iii. The marker is **not** to be struck or plowed over by the wing of snow clearing equipment.

iv. Wings must be raised and / or pulled in to clear the marker and the equipment it is protecting. NO EXCEPTIONS

Figure SUB-PART E – 1 – Signals and Communications Utility Markers

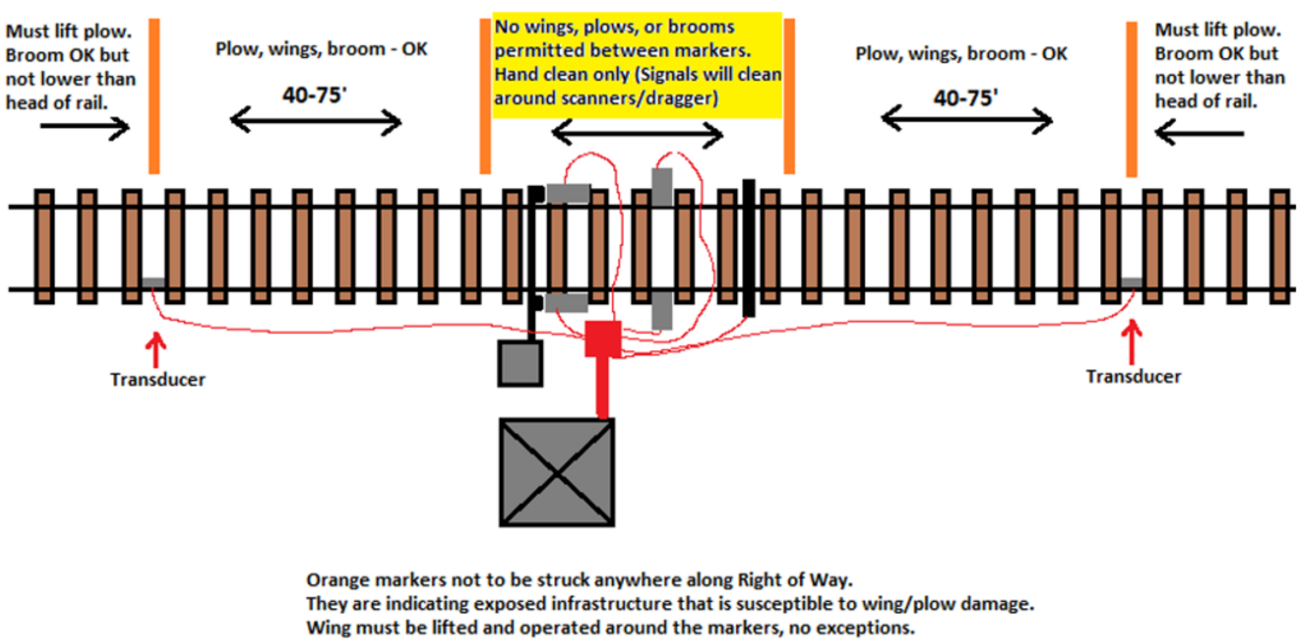

Figure SUB-PART E – 2 – Snow Clearing Diagram around Hot Box Detectors

d) Track wires connecting to rails are often just inches below the ballast.

e) The Danger Zone for damaging track wires is 30' to 70' from the edge of the roadway.

f) Immediately after the Snow Fighter has cleared the roadway, the Operator(s) should stop and adjust the wings to a height that will not continuously expose the ballast.

g) Do not move ahead with downward pressure on wings and/or move ballast with the wings within the Track Wire Danger Zone.

h) For active warning system crossing locations where snow cannot be removed without continuous downward pressure through the 30' to 70' Danger Zone (e.g., ice and snow build-up), a Signal Maintainer should be present to locate and protect the wires.

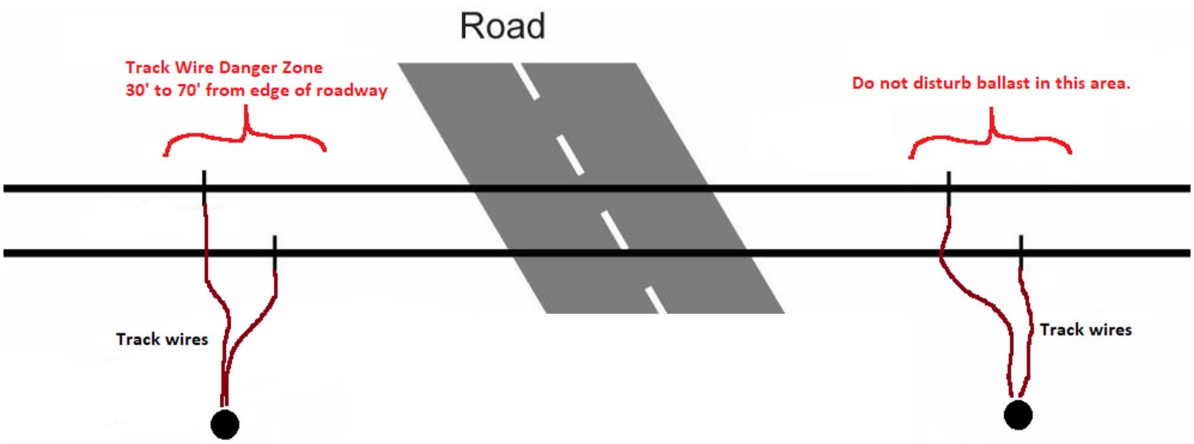

Figure SUB-PART E – 3 – Track Wires in Crossing Circuits

i) Snow must not be piled in areas where it will interfere with sight lines needed for safe train, vehicular or pedestrian movement.

j) Ensure snow is not piled or built up around warning systems where it will interfere with the proper operation. Some examples include,

   i. Snow must not be allowed to accumulate or build up near / under the gate where it could negatively impact its correct operation.

   ii. Snow should not bury or bury the gates' oblong counterweights, as this they may prevent proper operation of the gates.

Figure SUB-PART E – 4 – Snow Beginning to Accumulate Around Warning System Gate and Counterweights

k) Radio controlled switches have marked ‘protection zones’ (P ZONE) where only the plow and wings (set no lower than the head of the rail) are to be used between up to the switch air blower nozzles.

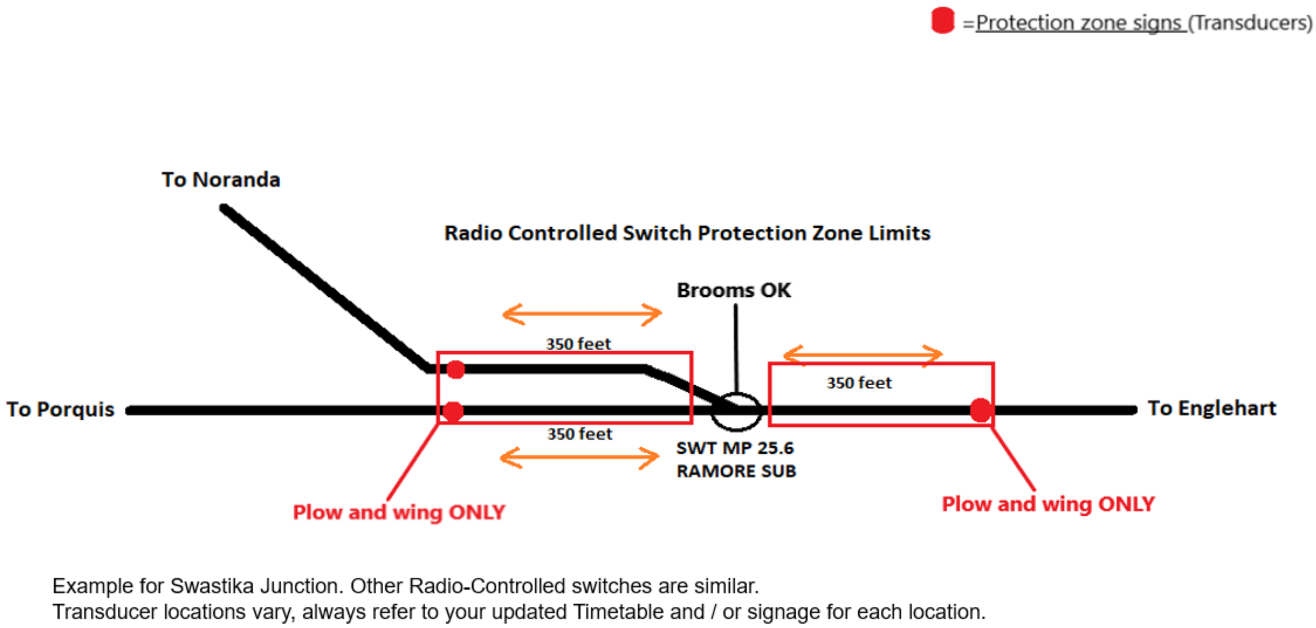

Figure SUB-PART E – 5 – Snow Clearing Operations / Radio Controlled Switches

l) Transducers are marked with ‘P ZONE’ signage in the field and are approximately the same height as a joint bar.

Figure SUB-PART E – 6 – Snow Clearing Operations / Transducer and ‘P ZONE’ Signage Example

m) Brooms can be used from the air blower nozzles up to and including the frog; using the plow and brooms as normal when outside of the zone.

Figure SUB-PART E – 7 – Snow Clearing Operations / Cold Air Blower Nozzles Example

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3. Fire Risk Mitigation and Hazard Reduction Plan

3.1 Fire Risk – General

a) Transport Canada has issued Rules for the Control and Prevention of Fires on Line Works, including, the Railway Extreme Heat and Fire Risk Mitigation Rules. These, in addition to additional provincial and federal requirements, require all Railways to have methods in place to prevent the starting of fires and to control fires that may be started or progressed to the railway right-of-way.

b) If a fire on a line work is detected or reported (e.g., employee, public), it must be communicated per Section 3.5 below and steps must be taken to extinguish or control the fire as soon as possible. This may include,

   i. Reasonably actioned with fire suppression equipment available (e.g., fire breaks, shovels, and backpack pumps / water pumps on fires of flame lengths < 1.5 m), and / or,

   ii. Communication (through rail traffic control) and / or deployment of appropriate emergency response resources (e.g., first responders, fire services).

c) If a fire service is attempting to extinguish or control a fire on a line work, a railway company must, at the request of the fire service and without delay, provide the fire service with reasonable assistance. The assistance may, depending on the circumstances, include the provision of transportation to the fire.

d) It is the responsibility of the Railway Company to extinguish all fires,

   i. On the railway right of way irrespective of the manner in which the fires were started, and;

   ii. Off the railway right of way that were started as a result of railway operations.

3.2 Fire Risk – Fire Plan

a) ONTC has developed a Fire Prevention and Preparedness Plan in consultation with the Ontario Ministry of Natural Resources and Forestry, and the Société de protection des forêts contre le feu (SOPFEU) for Quebec, and is updated no less than once every five (05) years,

b) The Plan is communicated to relevant municipal and other levels of local government, including Indigenous communities and the Société de protection des forêts contre le feu (SOPFEU) for Quebec.

   i. Comments, feedback and other engagement resulting from the communication that are received through any of the corporate website 'contact us' modes or directly must be retained for no less than six (06) years,

c) It is the responsibility of the Director, Rail Infrastructure to update the Fire Plan as required and to ensure that all concerned are provided with current copies.

   i. The Plan is distributed across the system and available within the various shared files (e.g., OneDrive) along with other fire prevention and suppression documents.

   ii. Contractors on or about the property are to ensure they have our Plan and applicable documentation available. This is communicated during contractor orientation training.

3.3 Fire Risk – Working during Fire Season

a) The Plan outlines precautions and restrictions which must be implemented for work undertaken during the fire season in addition to fire services contact information and the arrangement of protection during suppression efforts.

  i. The precautions are also contained in Appendix "G" Ontario Guidelines for Modifying Railway Operations in response to Fire Danger,

  ii. There are multiple risk categories outlined for industrial operations, each identifying a different level of risk or operations causing a fire to ignite in a forest area, and which depends on the level of stoniness of the worksite per Part I – Section 3 – Interpretations,

    - Very high fire risk operations,
    - High fire risk operations,
    - Moderate fire risk operations,
    - Low fire risk operations.

b) It is the responsibility of each Manager, Track Supervisor (Inspector), Foreman (including Welders, Gang), Equipment Operators, Contractors or any other Employee in Charge while performing work, to know the current hazard level, apply the proper precautions, hazard reductions and/or restrictions.

  i. Fire danger levels are available through the Canadian Wildland Fire Information System (CWFIS), Ministry of Natural Resources and Forestry (ONMNRF) for Ontario and the Société de protection des forêts contre le feu (SOPFEU) for Quebec, reports fire danger levels.

  ii. If more than one fire danger level is shown for the area, the fire danger level for the area is the highest indicated level.

  iii. If a fire danger level is not available for the area, the fire prevention measures that are set out in the Plan for at least a moderate fire danger level.

c) The Superintendent, Maintenance of Way will ensure that a sufficient number of employees receive the appropriate training required under the Plan, and includes,

  i. The protocol to determine fire risk for the location's conditions, type of work occurring, and fire suppression equipment and / or adjustments to shifts that may be required,

  ii. Fire prevention and suppression techniques, such as hazards (e.g., fuels, weather, environmental conditions, health, and safety, etc.), water application, fire break construction and maintenance, fire pump inspection, operation and troubleshooting along with proper hose handling (e.g., SP105/106 for rail operations).

d) The Superintendent, Maintenance of Way will ensure that proper equipment in good working order is supplied where required, prior to the start of the fire season.

  i. Documentation of any fire suppression equipment maintenance performed must be kept for at least five (05) years.

  ii. Fire suppression equipment must be conducted annually and records indicating date of inspection and name of the person who conducted the inspection must be kept for at least five (05) years.

e) Persons operating machinery or equipment in a forest area during fire season are,

i. To have a fire extinguisher, in serviceable condition and rated at least 6A 80 BC, on equipment or machinery or within 5 m from it,

ii. To check and remove daily any accumulation of flammable material, safely disposing it,

iii. To ensure any machinery or equipment left in a forest area during fire season while not in operation are to ensure it is placed or left in an area free from any flammable material,

iv. To ensure there has been no modification or altering of a muffler or other spark-arresting device.

f) Persons operating power saws in a forest area during fire season are,

i. Not to be started during fire season within 3 m of where it was fuelled,

ii. Not to be placed on any flammable material while the engine is operating or hot enough to cause combustion,

iii. To have a fire extinguisher available, in serviceable condition, rated for ABC type fires and have a minimum of 225 grams of dry chemical,

iv. To ensure there has been no modification or altering of a muffler or other spark-arresting device.

g) Brushing operations, if instead of piling,

i. Must mulch or chip the flammable material and disperses the resulting chips or mulch, or,

ii. Must remove the flammable material.

3.4 Fire Risk – Production Grinding During Fire Season

3.4.1 Notification of Fire Service and Records

a) The manager in charge of the work must notify the fire service that is responsible for the area at least 24 hours in advance but not more than 48 hours in advance.

b) Records of notification must be kept which identifies,

i. Date, time and manner in which the notification was provided;

ii. Name of person(s) who was contacted at the fire service; and

iii. Recommendation(s) that was provided to us by the fire service; and

iv. If a recommendation(s) was not followed, the reason(s) for not following it.

3.4.2 Prevention Measures

a) Prevention measures as outlined in our Fire Plan, requirements for additional inspections and application of temporary speed restrictions per Sub-Part F – Inspections, must be adhered to for the fire danger level for that area.

b) If there are multiple areas with differing fire risks, the most restrictive of them will apply.

c) Employees who conduct high-risk work or supervision of contractors who conduct high-risk work must have received the training on the prevention and control of fires.

3.4.3 Fire Suppression Equipment

a) Employees and/or contractors who are conducting the work are to be equipped with the fire suppression equipment as set out in our Fire Plan for the fire danger level for that area.

   i. At a minimum,

      - 1 water delivery system with a minimum of a 3,750-litre water supply, and
      - 4 backpack pumps located where the rail production grinder is operating

b) If there are multiple areas with differing fire risks, the most restrictive of them will apply, when determining fire suppression equipment required.

3.5 Fire Risk – Reporting of Fires

a) The individual in charge will immediately report wildfires and suppression efforts of wildfires to the Rail Traffic Controller who will advise fire services using the appropriate number if required (e.g., MNRF – Ontario wildland fire, SOPFEU – Quebec wildland fire, 9-1-1 – Ontario or Quebec).

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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.

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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.

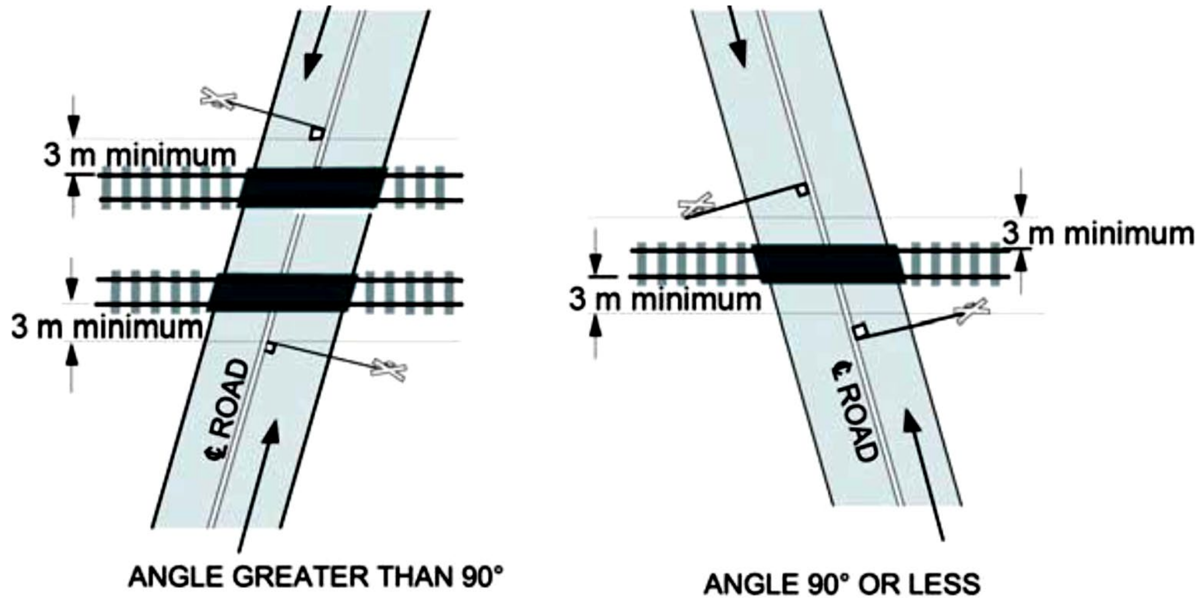

Figure SUB-PART E – 9 – Location of Railway Crossing Signs

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.

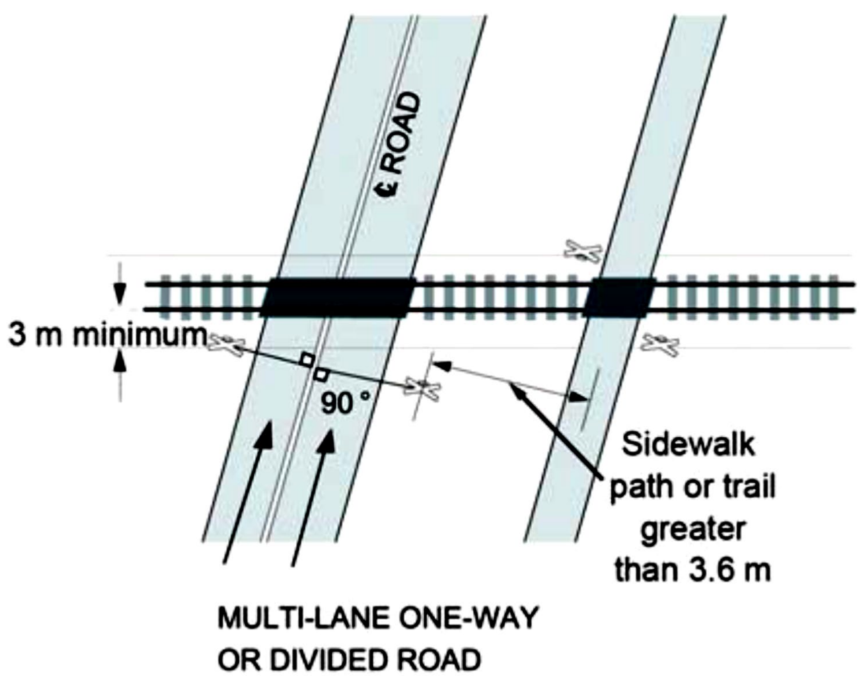

Figure SUB-PART E – 10 – Location of Railway Crossing Signs (Sidewalk, Path, Trail > 3.6 m)

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.

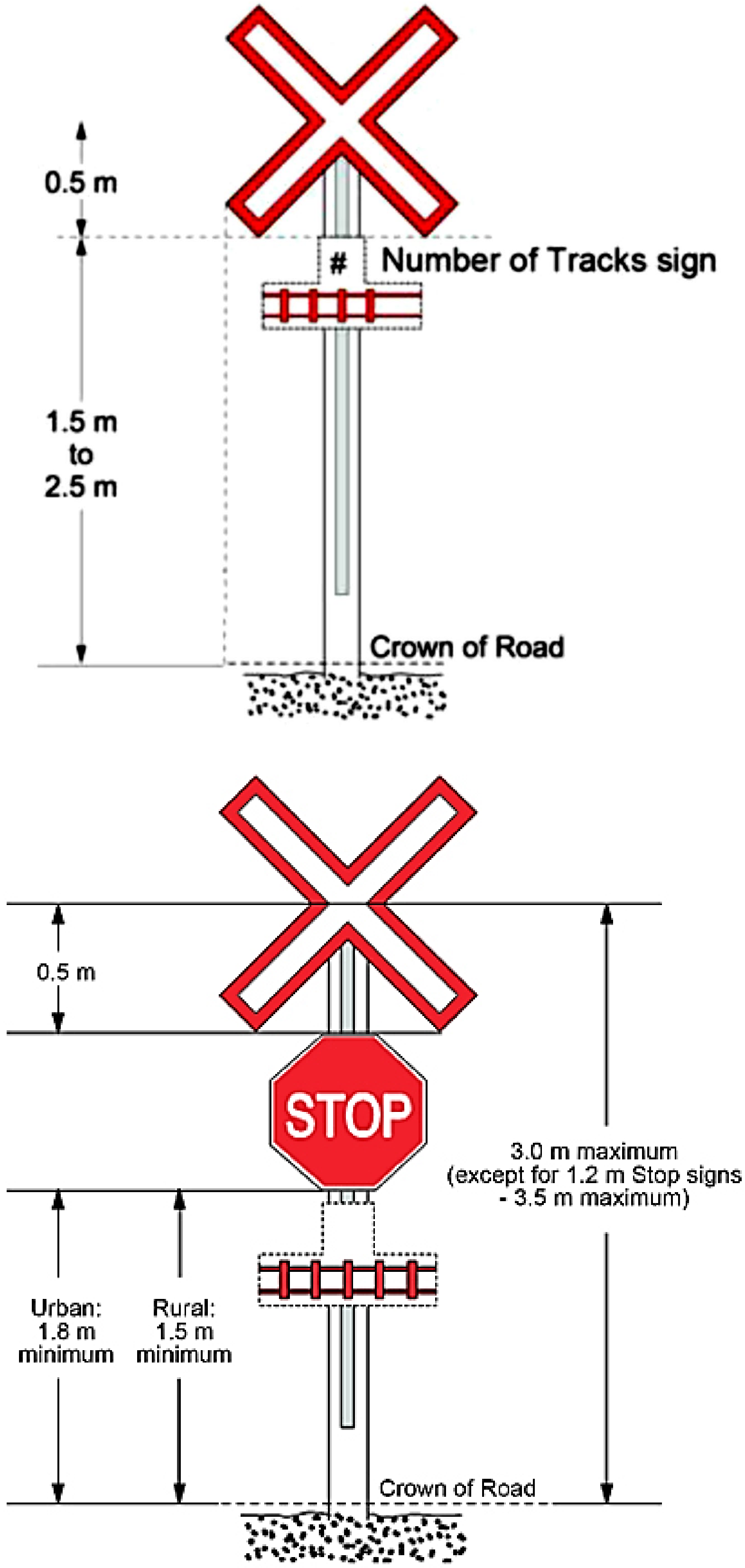

Figure SUB-PART E – 11 – Rail Crossing Signs (# of Track)

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 *(50 mm)* to 3 inches *(75 mm)* deep, and
    - 2-1/2 inches *(65 mm)* to 4-3/4 inches *(120 mm)* wide (for grade crossings other than public sidewalks, paths, or trails designated by the road authority for use by persons using assistive devices),
    - 2-1/2 inches *(65 mm)* to 3 inches *(75 mm)* wide (for public sidewalks, paths, or trails designated by the road authority for use by persons using assistive devices).

ii. Road Crossing Surface:

- The planking and/or other road surface used between the rails, and for a distance of at least 20 inches *(500 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 20” *(500 mm)* beyond and on both sides of the traveled portion of the roadway (measured at right angles to the roadway) as shown in as shown in Figure Sub-Part E – 13.

- 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 20” *(500 mm)* as shown in Figure Sub-Part E – 13.

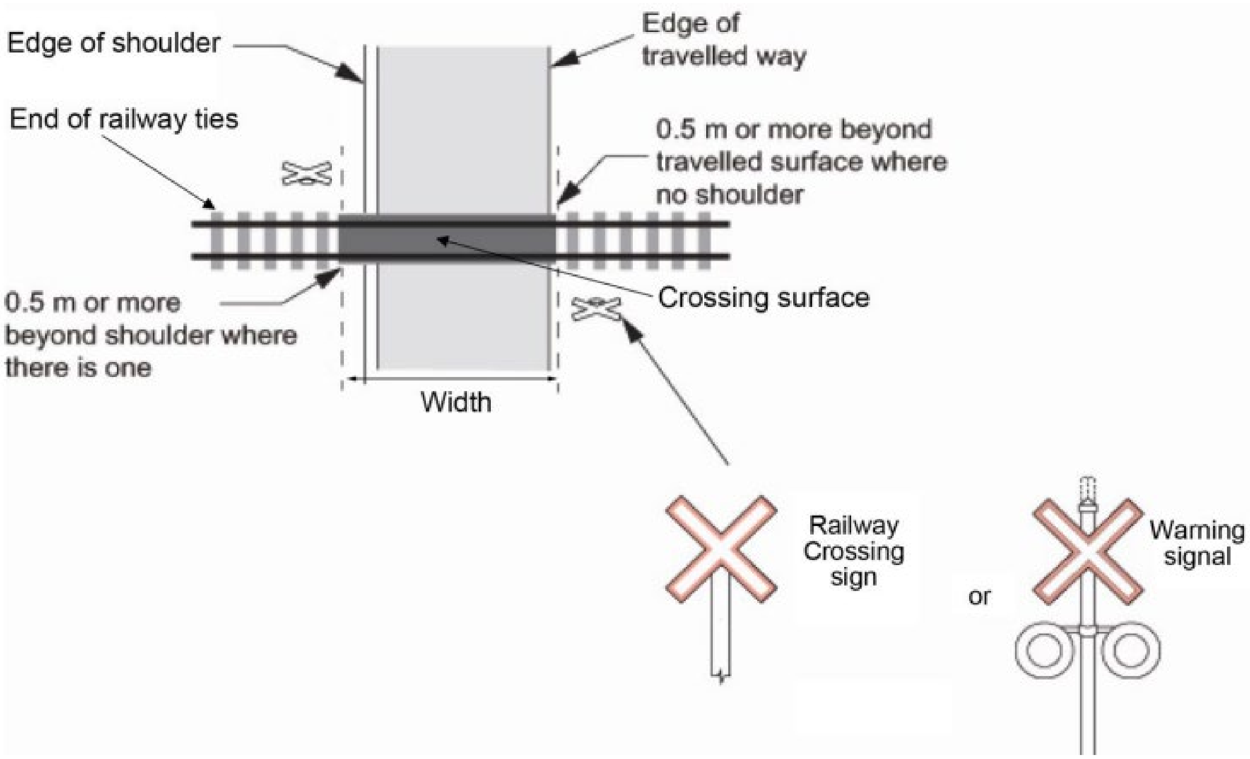

Figure SUB-PART E – 13 – Crossing Surface with No Shoulders

- With Sidewalk: Where there is a sidewalk within 40” *(1,000 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 20” *(500 mm)* beyond the sidewalk on both ends of the crossing as shown in Figure Sub-Part E – 14.

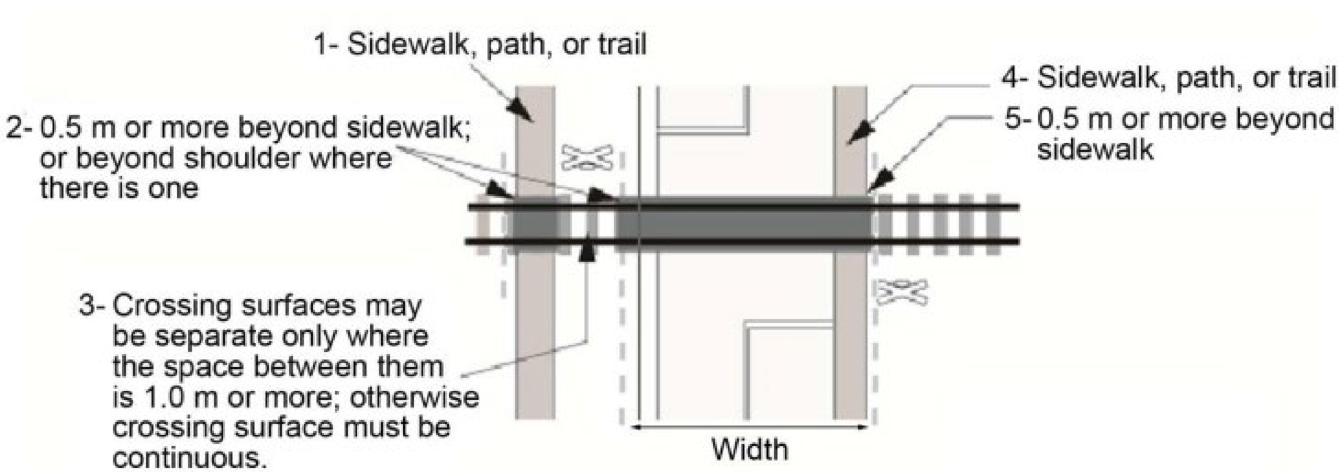

Figure SUB-PART E – 14 – Crossing Surface with a sidewalk, path or trail

- Roadway Surface and Top of Rails (grade crossings other than public sidewalks, paths, or trails designated by the road authority for use by persons using assistive devices): 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.
- Roadway Surface and Top of Rails (for public sidewalks, paths, or trails designated by the road authority for use by persons using assistive devices): The top of the rail must not be more than 1/2" *(13 mm)* above the crossing surface or below the crossing surface more than 1/4" *(7 mm)*.
- Approach Grade: Refer to Transport Canada's Grade Crossing Standards.

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:

- Restricted crossings may only be a maximum of 2” *(50 mm)* below or 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.

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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.

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SUB-PART F. INSPECTION

1. Scope

a) The method chosen for, and the frequency of track inspections must ensure that the track is safe for operation at currently authorized speeds. All unsafe conditions found during inspection that cannot be corrected immediately must be properly protected.

b) All track Classes 1 through 5 must be inspected in accordance with the requirements as prescribed herein.

c) The District Manager responsible for the territory has the responsibility and authority to order additional inspections if they are required for safe railway operations.

d) In the event of a fire, flood, severe storm or any other occurrence that may have damaged the track structure, an inspection must be made of the track involved as soon as possible after the occurrence and, if possible, before the operation of any train and equipment movements.

e) Inactive tracks must be secured in a manner that must prevent use by movements and must be inspected before being used to ensure the track is compliant and safe for all movements at the authorized speed.

2. Frequency of Track Inspections

a) The minimum requirements for track inspections are shown in Figure SUB-PART F – 1 – Designated Inspection Frequency Definitions**.** These minimum requirements do not eliminate the Track Supervisor's (Inspector's) responsibility to carry out or arrange for additional inspections when conditions call for additional inspections. The maximum number of days between inspections differs for Rail Flaw Detection and is identified in Sub-Part F – Section 15 – Rail Flaw Detection.

DESIGNATED INSPECTION FREQUENCY	DESIGNATED INSPECTION FREQUENCY MEANS
Twice weekly	A minimum of two inspections each week (Sunday to Saturday) and: • with no more than 3 days between days of inspection in a week, and • with no more than 3 days between the day of inspection in one week and the next day of inspection in the following week.
Weekly	A minimum of one inspection each week (Sunday to Saturday) and: • with no more than 10 days between days of inspection.
Twice monthly	A minimum of two inspections each month (between the 1st and last day of each month) and: • with no more than 20 days between days of inspection in a month, and • with no more than 20 days between the day of inspection in one month and the next day of inspection in the following month.
Monthly	A minimum of one inspection each month (between the 1st and the last day of each month) and: • with no more than 40 days between days of inspection.
Quarterly	A minimum of one inspection each quarter (January 1st to March 31st, April 1st to June 30th, July 1st to September 30th, October 1st to December 31st) and: • with no more than 100 days between days of inspection.
Three times annually	A minimum of one inspection each 4 months (January 1st to April 30th, May 1st to August 31st, September 1st to December 31st) and: • with no more than 180 days between days of inspection.
Twice annually	A minimum of one inspection each 6 months (January 1st to June 30th, July 1st to December 31st) and: • with no more than 225 days between days of inspection.
Annually	One inspection each year (January 1st to December 31st) and: • with no more than 400 days between days of inspections.

Figure SUB-PART F – 1 – Designated Inspection Frequency Definitions

b) All track except Yard Track and Inactive Track must be visually inspected at the minimum frequency specified in the following table:

CLASS OF TRACK	ANNUAL TONNAGE (MGT)		
	< 5 MGT	5 – 15 MGT	> 15 MGT
Class 1	Monthly	Twice Monthly	Weekly
Class 2	Weekly	Twice Weekly	Twice Weekly
Class 3	Weekly	Twice Weekly	Twice Weekly
Class 4 & 5	Twice Weekly	Twice Weekly	Twice Weekly

Figure SUB-PART F – 2 – Designated Minimum Visual Track Inspection Frequency

and,

i. In the case of Class 1 track where passenger trains are operated, track must be inspected weekly or before use of passenger traffic if the track is used less than once per week.

ii. In the case of Class 2 and 3 track, where passenger trains are operated, track must be inspected at least twice weekly or before use of the passenger traffic.

3. Methods of Inspection

a) Track inspection methods include walking or using track inspection vehicles. Inspections by a track inspection vehicle must be done at speeds that will allow the person making the inspection to visually inspect and evaluate the track for compliance to the MTR.

b) Track must also be inspected by train. Inspection by train will provide a view of the track and right-of-way and will give an indication of ride quality but is not included in the count of required inspections by Transport Canada. The Track Supervisor (Inspector) must inspect the main track on his or her territory once every quarter, preferably from the engine of one of the faster trains on his territory.

c) Walking inspections should be carried out in such a manner that priority locations and areas of known problems such as those outlined in Figure Sub-Part F – 5 are monitored.

d) Walking inspections of public and private crossings shall be undertaken annually.

e) Mechanical, electrical, and other track inspection devices may be used to supplement visual track inspections.

f) When inspecting track, a Track Supervisor (Inspector) may inspect up to two tracks at one time provided that:

i. The visibility of the Track Supervisor (Inspector) remains unobstructed by any cause and that the second track is not centered more than 30' from the track upon which the Track Supervisor (Inspector) is traversing.

ii. Each track that requires weekly or more frequent inspection must be traversed by the vehicle or inspected on foot on at least once every two weeks, and each siding and crossover must be traversed by the vehicle or inspected on foot at least once every month.

4. Warning Signs

a) When inspecting track, pay particular attention to;

i. The adequacy of the ballast section at culverts, ballasted deck bridges, bridge abutments and locations where vehicles may have been driven along the right of way or where foot paths may cross tracks,

ii. Defective / broken joint bars,

iii. Loose, bent, frozen, broken, and missing track bolts,

iv. Signs of rail moving through anchors. Look for anchors in one direction not bearing against the ties. The base of the rail may be scored,

v. Signs of track moving with the traffic current. Look for anchored ties moving towards non-anchored ties,

vi. Short flat spots in the curve alignment or line kinks in the tangent track. By digging out one tie end at a time, determine whether the ties are hanging,

vii. Signs that the base of the rail is not seated uniformly on the tie plates due to debris, ice, snow or other material. In addition, improperly stressed rail tends to tilt on the tie plates,

viii. High spikes.

5. Track Inspection – Items, Methods, Actions

Item	Inspection Method: Walking Observe For:	Inspection Method: Track Inspection Vehicles Observe For:	Inspection Method: Train Observe For:	Remedial Action
Track Geometry	Irregular alignment or surface, too many cross levels, wide gauge, etc. ***Refer to Sub-Part C – Track Geometry***	Irregular alignment or surface, excessive or repeated cross levels, wide gauge, etc. ***Refer to Sub-Part C – Track Geometry***	Irregular alignment or surface, excessive cross level, loss of elevation, rock and roll symptoms, ride quality.	Immediately place a speed restriction to protect train movements against all Urgent defects. All Urgent defects must be correct or protected immediately. Do not remove speed restrictions until the Urgent defects have been checked on the ground and corrective actions taken. Inspect and correct Near Urgent and Priority defects as soon as practicable. ***Refer to Sub-Part C – Track Geometry***
Rail	Broken, vertical or horizontal split heads, piped rail, crushed heads, corrugation, wear, shelling, engine burns, rail end defects, discolouration, rust streaks, damaged by equipment. **Refer to Sub-Part D – Section 6.4 Defects and Protection Codes**	Broken, vertical split heads, crushed heads, engine burns, discolouration **Refer to Sub-Part D – Section 6.4 Defects and Protection Codes**	Broken	Protect track according to Rail Flaw Detection Codes. **Refer to Sub-Part D – Section 6.4 Defects and Protection Codes**
Rail Joints	Broken, bent, cracked joint bars, insulation defects, missing end posts, in insulated joints.	Broken joint bars.	N/A	Joint bar cracked or broken between the middle two bolt holes must be replaced or Movement Over Broken Rails policy must be applied. Inspection according to joint inspection policy

Figure SUB-PART F – 3 – Track Inspection Items, Methods and Actions

Item	Inspection Method			Remedial Action
	Walking Observe For:	Track Inspection Vehicles Observe For:	Train Observe For:	
Turnouts	According to **Sub-Part D – Section 8 – Turnouts and Track Crossings**	Misalignment or damaged components. **Sub-Part D – Section 8 – Turnouts and Track Crossings**	Ride Quality	According to **Sub-Part D – Section 8 – TurnoutsSub-Part D – Section 8 – Turnouts and Track Crossings**
Diamond Crossings	According to **Sub-Part D – Section 8 – Turnouts and Track Crossings**	Misalignment or damaged components. **Sub-Part D – Section 8 – Turnouts and Track Crossings**	Ride Quality	According to **Sub-Part D – Section 8 – Turnouts and Track Crossings**
Beaver Dams and Culverts	Watercourse or culvert blocked.	Watercourse or culvert blocked.	Watercourse or culvert blocked.	Any change or blockage of a watercourse, or sudden change in depth of water, must be reported to the District Manager immediately.
Drainage	Ditches or culverts blocked, hanging ties.	Ditches or culverts blocked.	High water.	If drainage ditches or culverts are found blocked, immediately contact Rail Traffic Controller to arrange for safe operation of trains and advise the District Manager. Check water levels, and if higher than normal for a particular location, make closer inspections to determine the reason.
Bridges	Irregular surface and line on bridge and approaches, structural damage.	Irregular surface and line on bridge and approaches, structural damage.	Irregular surface and line on bridge and approaches, structural damage.	Irregular surface and line, structural damage to bridge or any other irregularity must be reported to the District Manager and the Director, Rail Infrastructure immediately. If there is any doubt about the safety of trains, protect trains.
Cuts and Embankments	Incompetent slopes, erosion.	Incompetent slopes, erosion.	Incompetent slopes, erosion.	If slopes appear to be moving, or if severe erosion is occurring, or if rock falls are reaching track, immediately contact Rail Traffic Controller to arrange for safe operation of trains and advise the District Manager and the Director, Rail Infrastructure.

Figure SUB-PART F – 3 – Track Inspection Items, Methods and Actions (continued)

Item	Inspection Method: Walking Observe For:	Inspection Method: Track Inspection Vehicles Observe For:	Inspection Method: Train Observe For:	Remedial Action
Road Crossings	Loose, missing, or high planks or other surface material, high spikes, obstructed flangeways, missing or defective signs, malfunction of automatic protection, sight lines obstructed by vegetation.	Missing, or high planks or other surface material, high spikes, obstructed flangeways, missing or defective signs, malfunction of automatic protection, sight lines obstructed by vegetation.	Missing or defective signs, malfunction of automatic protection, sight lines obstructed by vegetation.	At all crossings, obstructed flangeways must be cleared as soon as possible. At any crossing used by the general public, any loose or missing planks, high planks, high spikes must be corrected immediately. For any other crossings, these defects must be corrected as soon as possible and the District Manager advised. Advise the District Manager when the sight lines required by ***Sub-Part E – Section 5.8 - Sightlines*** have been blocked by vegetation, etc.
Signal Equipment	Damaged or missing.	Damaged or missing.	Damaged or missing.	Crossing protection signals found not operating properly must be protected immediately and reported to Rail Traffic Controller and the Manager, Signals and/or Signal Maintainer. Damaged or missing appliances must be reported to the Manager, Signals and/or Signal Maintainer.

Figure SUB-PART F – 3 – Track Inspection Items, Methods and Actions (continued)

PRIORITY LOCATIONS FOR WALKING INSPECTIONS
Rail
a. Areas with high numbers of fatigue related rail defects (based on rail flaw detection reports and CWR Failure Reports) and in service rail failures, b. Rail defects protected by joint bars, c. Rail damage which has been alleviated by grinding, d. Areas approaching condemning limits for wear (based on rail wear limits), e. Location prone to overstressed rail, such as; i. Areas where rail repairs have been made (too little or too much rail installed), ii. Curves, iii. Areas of severe rail corrugation, iv. Areas of heavy brake application v. Areas of buffer rails or any joints adjoining CWR, vi. Areas of steep grades, vii. Areas of insufficient or damaged rail anchors, or significant rail movement, viii. Derailment sites or derailment damaged rail.
Joints
a. Cracked, b. Broken, c. Pumping.
Wood Ties
a. Clusters of defective ties, b. Gauge problem areas (13 mm (1/2”)) or greater dynamic wide gauge using data from Geometry Car), c. Excessive loss of cant as detected by Geometry Car, d. Areas prone to hanging ties, such as insulated joints, road crossings and bridge approaches, e. Areas of high or broken spikes, f. Areas with high dynamic braking and permanent slow orders.
Ballast
a. Sink holes, b. Mud pumping locations, c. Frost heave locations, d. Areas of weak ballast shoulders, e. Areas where recent program work has left ballast disturbed.
Roadbed / Slope Stability
a. Areas historically prone to track geometry problems (surface, line, cross level), b. Slope stability problems (slip, rock falls or mud slides).
Drainage
a. Areas prone to ponding water (beaver dams, drainage ditches, blocked culverts, etc.), b. Areas of high or increased surface run-off (near forestry operations, industrial development, high water tables, etc.), c. Areas prone to ice build-up under the plate, d. Culverts.
Transition Areas
a. Bridge approaches.
Derailment Areas
a. Substandard conditions or temporary repairs, b. Monitor until permanent repairs have been completed.

Figure SUB-PART F – 4 – Priority Locations for Walking Inspections

5.1 Track Inspections – Records

a) Each record of an inspection must be prepared on the day the inspection is made and signed by the person making the inspection.

b) Records must specify the track or tracks inspected, the date of inspection, method of inspection, location and nature of any deviation from the requirement of TSR, and the remedial action taken by the person making the inspection.

c) In the case of more than one track, track inspection record must indicate all track(s) included in the inspection and indicate which track(s) were traversed by the vehicle or inspected on foot.

d) An Inspection Report must be kept in the District Manager's office for a minimum of 2 years.

6. Hot Weather – Speed Restrictions, Inspections, Conditions

In all cases, due to the significant impact on train performance associated with hot weather speed restrictions, these restrictions and inspections are to be managed on a daily basis based on current information from Canadian Weather - Environment Canada.

6.1 Hot Weather – Speed Restrictions (applies to Class 3 and higher)

a) When ambient air temperatures are expected to reach 32°C and above, RTC / District Managers are to apply speed restrictions on

   i. All CWR territories, and

   ii. All jointed track territories will be evaluated with appropriate restrictions applied, at the District Manager's discretion, where there is,

      i. A history of track buckling without proper repair (destressing), or

      ii. Areas of known running or tight steel, or

      iii. Areas with improperly anchored track, or

      iv. Weak or disturbed ballast section, or

      v. Areas where heavy train braking regularly occurs.

b) Speed restrictions to be applied are,

   i. Freight Maximum: 30 mph

   ii. Passenger Maximum: 40 mph

c) The track must be inspected, preferably in the 'heat of the day', before the speed restriction is removed.

6.2 Hot Weather – Inspections (applies to Class 3 and higher)

a) When ambient air temperatures are expected to reach 32°C or above, daily hot weather track inspections must be arranged on,

   i. All CWR territories, and

   ii. All jointed track territories will be evaluated with appropriate inspections required, at the District Manager's discretion, where there is,

      i. A history of track buckling without proper repair (destressing), or

      ii. Areas of known running or tight steel, or

      iii. Areas with improperly anchored track, or

      iv. Weak or disturbed ballast section, or

      v. Areas where heavy train braking regularly occurs.

b) These track inspections should be arranged in the later part of the afternoon and/or during the 'heat of the day', where train movements are expected before the next track patrol occur.

c) Inspections are not required on days trains do not operate, however, should be arranged for before the next train.

d) Hot weather inspections may be suspended if the temperatures have stabilized, the previous inspections have shown that the track structure is stable and all other track conditions complies with the MTR.

6.3 Hot Weather – Conditions – Buckled Track

a) When there are indications that a track buckle may be about to occur, immediately take the following steps to protect train traffic until the condition is corrected:

   i. Place a 10-mph slow order, or

   ii. Stop traffic if the situation warrants.

b) Before removing a speed restriction or revising an existing speed restriction, a qualified Track Supervisor (Inspector) must inspect all repairs. Once the required trains have passed over the track as per Sub-Part D – Section 7.9, re-inspect the track in the heat of the day before returning the track to authorized timetable speed.

c) Sub-Part D – Section 7.8 – CWR – Buckled Track, which is part of the CWR Minimum Requirements, describes signs that indicate lowered track resistance and/or conditions under which track is likely to buckle. Sub-Part D – Section 7.8 – CWR – Buckled Track must be read with this section when dealing with buckled track.

d) Additional attention should also be given to track recently disturbed (for example: switch cross tie installations, new scanner and new turnout installations, surfacing and lining activities). Care should be taken not to disturb track that is solidly bedded at points where buckling is likely to occur. Faulty conditions must be corrected as soon as possible.

e) Additional attention should be given to track where pull-aparts or broken rails have occurred during cold weather and it was necessary to add rail to close the gap, the rail laying temperature will have changed. This makes the track more likely to buckle. This condition must be corrected by re-stressing before warm weather arrives according to Sub-Part D – Section 7.8 – CWR – Buckled Track.

f) Pay special attention to CWR adjacent to fixed locations such as turnouts, crossings, and bridges.

6.4 Hot Weather – Conditions – Fire Risk

a) Refer to Sub-Part E, Section 3 – Fire Risk Mitigation and Hazard Reduction Plan – Prevention and Control of Fires on the Right of Way

7. Cold Weather – Speed Restrictions, Inspections, Conditions

In all cases, due to the significant impact on train performance associated with cold weather speed restrictions, these restrictions and inspections are to be managed on a daily basis based on current information from Canadian Weather - Environment Canada.

7.1 Cold Weather – Winter Operation Risk Mitigation Plan:

a) The Winter Operation Risk Mitigation Plan mentioned in Sub-Part F, Section 7.2 includes the requirements mentioned throughout Sub-Part F, Section 7 – Cold Weather and Sub-Part F, Section 15 – Rail Flaw Detection. Additionally, the following must be included to be considered a complete Plan,

   i. The implementation timelines which must:

      - Begin no earlier than the date the Winter Operation Risk Mitigation Plan is filed with Transport Canada; and
      - Remain in effect until March 31 23:59:59.

   ii. Mitigating measures to:

      - Ensure an equivalent level of safety, if an element of the Winter Operation Risk Mitigation Plan cannot be adhered to due to unforeseen circumstances.

   iii. Information on how temperature:

      - Will be communicated to train crews; and
      - Records will be retained for a minimum of one year from the date the Winter Operation Risk Mitigation Plan is implemented.

   iv. Using appropriate location information (subdivision name, mileage range and track identification, if applicable), information on:

      - If Broken Rail Detection Technology is present; and
      - The planned approach or frequency, including the maximum number of days permitted between each activity and criteria to establish the time interval, for:
         - Rail grinding to ensure proper detection of rail defects;
         - Rail flaw inspections during the implementation timelines defined in accordance with 7.1 d) i.; and
         - Visual inspections beyond what is prescribed in the Rules Respecting Track Safety.

b) The Winter Operation Risk Mitigation Plan must be approved by a professional engineer and filed annually with Transport Canada prior to operating at the maximum operating speeds permitted.

c) Records must be retained for a minimum of one year, to demonstrate that activities, inspections and mitigating measures required in the Winter Operation Risk Mitigation plan are being implemented.

d) Requirements for Broken Rail Detection Technology are as follows:

   i. Ensure that broken rail detection technology is able to accurately and consistently detect broken rail on live track and communicate the broken rail immediately to the relevant persons that can halt rail traffic;

ii. Make available to Transport Canada, upon request, a description of the Broken Rail Detection Technology, including its operating and maintenance processes;

iii. Develop mitigating measures to be taken that ensure an equivalent level of safety if the Broken Rail Detection Technology does not detect broken rails and/or report the information back to the relevant persons that can halt rail traffic; and

iv. Retain records, for a minimum of one year, of all the instances when mitigating measures are implemented as per paragraph 7.1 d) iii above. Such records must include the precise location, time, date, and duration of such instances.

e) Operating employees must be communicated to regarding where speed restrictions for Key Trains and Higher Risk Key Trains apply using appropriate location information, including subdivision name mileage ranges and track identification. This is not required when maximum track speed is lower than or equal to the speed of the restriction.

7.2 Cold Weather – Temporary Speed Restrictions

FOR FREIGHT AND PASSENGER TRAINS *(other than Higher Risk Key Trains)*		
Ambient Air Temperature and Locations	**Max. MPH Freight**	**Max. MPH Passenger**
-25°C *(-15°F)* or colder In areas requiring attention in cold weather due to rail condition	35 mph	35 mph
-35°C (-30°F) or colder In all Subdivisions	35 mph	35 mph

Figure SUB-PART F – 5 – Cold Weather Speed Restrictions for Freight and Passenger Trains other than Higher Risk Key Trains

FOR HIGHER RISK KEY TRAINS		
Conditions Ambient Air Temperatures	**Higher Risk Key Trains Max. MPH *Outside CMA Non-Signaled***	**Higher Risk Key Trains Max. MPH *Within CMA Non-Signaled***
Higher Risk Key Trains and WITHOUT a Winter Operation Risk Mitigation Plan		
April 1 to November 1	50 mph	30 mph
November 15 to March 31 > -25°C *(warmer than -25°C)*	25 mph	25 mph
November 15 to March 31 ≤ -25°C *(-25°C or colder)*	25 mph	25 mph
Higher Risk Key Trains and WITH a Winter Operation Risk Mitigation Plan		
Ambient Air Temperature > -15°C *(warmer than -15°C)*	50 mph	30 mph
Ambient Air Temperature ≤ -15°C *(-15°C or colder)*	25 mph *(see Note 1 below)*	25 mph

Note 1: For any subdivision or defined portion(s) of a subdivision identified in the Winter Operation Risk Mitigation Plan in accordance with Section 7 vi, the maximum operating speed for Higher Risk Key Trains operating outside of CMA limits may be increased to:

- 30 MPH in non-signaled territory without Broken Rail Detection Technology
- 40 MPH in non-signaled territory with Broken Rail Detection Technology

For all other subdivisions, or portions of a subdivision not identified in the Winter Operation Risk Mitigation Plan, the maximum operating speeds as listed above apply.

Figure SUB-PART F – 6 – Cold Weather Speed Restrictions for Higher Risk Key Trains

f) Track protected by cold weather speed restrictions must be inspected daily until temperature stabilizes and rail conditions indicate that daily inspection are not required.

g) Inspections are not required on days trains do not operate.

h) Temporary speed restrictions should be removed as soon as practicable once temperatures are above the applicable noted thresholds, but not before track has been inspected

i) Areas requiring attention in cold weather due to rail condition will be identified by:

   i. A list generated by the Superintendent, Maintenance of Way's office each year.

   ii. The District Managers may identify additional areas as required.

7.3 Cold Weather – Inspections

a) Cold weather track inspections are to be done on main track under the following conditions:

COLD WEATHER INSPECTION FREQUENCY		
Ambient Temperature	***Inspection Frequency**	**Tracks, which must be inspected**
-25°C (-15°F) or colder	Daily: Until temperature stabilizes and rail conditions indicate daily inspections are not required.	Track identified as requiring attention in cold weather due to rail condition
-35°C (-30°F) or colder	Daily	All main tracks
Temperature drops more than 25°C (45°F) in a 24-hour period.	Inspect track as soon as possible after sudden temperature drop.	All main tracks

Figure SUB-PART F – 7 – Cold Weather Inspection Frequency

*Additional track inspections should be considered during the first "cold snap" of the season.

7.4 Cold Weather – Conditions – Pull-Aparts

a) Appropriate slow orders or other protection must be provided during extreme cold weather when pull-aparts may occur because of high longitudinal forces in the rail. Rail joint pull-aparts are most likely to occur early in the winter when the temperature drops suddenly, or during extremely cold weather. Pull-aparts are most likely to occur where:

   i. Rail has been laid with too much expansion allowance, for example, when repair rails have been installed in hot weather. Refer to Sub-Part D. Track Structure, Section 6.16.1. Rail Expansion for proper gap allowance to be set depending on rail length and temperature.

   ii. Joints are not free to open because of corrosion and without lubrication

   iii. Sufficient rail anchorage has not been provided, or anchors have not been properly maintained, especially at the top of grades.

7.5 Cold Weather – Conditions – Icing Conditions Under Rail

a) During the winter months under snow conditions, inspections must look for icing between the tie plates and the base of the rail. Progressive ice build-up may cause the rail to cant resulting in wide gauge under trains.

b) The condition can be discovered to some extent by looking for a disturbance in the snow along the field side of the high or low rail of a curve.

c) A fresh snowfall may hide this disturbance, making additional checks essential.

d) In locations where ice build-up is likely to occur, such as track with curvature, turnouts and crossings, snow must be removed, and tie plates examined for ice build-up.

e) Icing is most likely to occur where one or more of the following conditions exist:

i. Hanging ties

ii. Center-bound track

iii. High spikes

iv. Corrugated rail

v. High ballast or build-up of sand in the tie cribs directly under the rail

vi. Where CWR was laid above the desired rail laying temperature, which causes CWR strings to cant inward creating space for ice formation between the base of the rail and the top of the tie plate.

8. Beaver Dams

a) Beaver dams located upstream from the track, in streams that flow under or near the track, represent a potential hazard. Track Maintenance Foremen and Track Supervisors (Inspectors) must arrange regular inspections of beaver dams on their territory and take the necessary protective action if conditions are hazardous. On certain territories, an aerial inspection of dams shall be performed in consultation with the Director, Rail Infrastructure.

b) An up-to-date list of beaver dams will be maintained on each Track Maintenance Supervisor's territory. The list should show:

   i. The subdivision mileage
   ii. The side of the track on which the dams are located
   iii. The number of dams
   iv. Whether the dams are upstream or downstream
   v. The distance of each dam from the track
   vi. Remarks regarding the condition of the dams
   vii. The date of the inspection.

9. High Water and Spring Run-Off Inspections

With the onset of spring flooding conditions, snowmelt run-off, ice movements and precipitation, the following steps need to be taken to prevent bridge and culvert washouts.

a) All personnel need be on the outlook for water related problems as a component of their regular duties. Locations of concern must be reported to the local District Manager so remedial action can be taken.

b) All employees must report the following conditions to the Track Supervisor (Inspector) or the District Manager:

   i. Inlet Conditions:

      - Watercourses with lower or higher than normal spring flow discharges. If creek discharges are less than usual or if debris and mud are evident in the flow, an upstream watercourse blockage may exist.
      - Flow constraints, such as debris build-up, at the culvert inlet should be removed to restore normal flow through the culvert.
      - Water ponding at the inlet to a culvert.
      - Water levels higher on one side of the track than the other side.
      - Any other abnormal condition.

c) Track Supervisors (Inspectors) must inspect bridges for track alignment and level during spring runoff.

d) Typical problems experienced by bridges in spring conditions of snowmelt and ice movements are:

   i. Scour conditions at substructures (piers and abutments). Eddying or dirty water around the substructure base may be a sign of scouring.

   ii. Failure of supports (particularly for trestle type bridges) due to ice loads or debris.

   iii. Loss of substructure support causing sway of bridges.

   iv. Settlement, sliding or rotation of substructures (piers and abutments).

   v. Inadequate bank protection during Spring run-off conditions.

   vi. Failure or poor condition of ice protection measures such as noses on piers or upstream protection structures.

10. Scheduled Rail Joint Inspection

a) A Walking Track Inspection must be completed on all jointed track.

   i. Exception: If joint bars are inspected electronically including the use of camera or other technology capable of detecting joint bar defects, a Walking Track Inspection of tangent track and curves less than 4° curvature in jointed track territory is not required; however, a Walking Track Inspection on all track with curves of 4° or greater must be completed.

b) A Walking Track Inspection must allow the Track Supervisor (Inspector) a clear view of all track components including rail, ties, fasteners and ballast.

c) Scheduled rail joint inspections must be conducted, at a minimum, as per the following:

JOINT INSPECTION FREQUENCY / WALKING INSPECTION	
TONNAGE CRITERION	**INSPECTION FREQUENCY**
Main track or sidings where tonnage carried is 10 million gross tons or less annually.	Yearly, with a maximum of 400 days between inspections.

Figure SUB-PART F – 8 – Walking Joint Inspection Frequency

d) When inspecting rail joints pay particular attention to:

   i. Broken rail ends.
   ii. Cracked or broken joint bars.
   iii. Loose, broken, bent and missing bolts.
   iv. Missing insulation or metal flow across the rail ends of insulated joints.
   v. Poor surface at joints.
   vi. Signs of track pumping, etc.

e) Joint bars that are cracked or broken must be replaced. On the occasion that the bars cannot be immediately corrected 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.

f) If a joint bar is cracked or broken between the middle two bolt holes it must be replaced, or the Movement Over Rail Break Policy must apply.

g) The District Manager is responsible for arranging more frequent inspections if conditions warrant.

h) Inspections must be done on the ground to ensure a close visual inspection for defect.

i) Rail joint inspections should be carried out behind surfacing gangs.

j) Rail joint inspections must be documented.

11. Turnout and Track Crossing Inspections

11.1 Turnout and Track Crossing Inspections – Background

a) The frequency of turnout inspections must ensure that the track is safe for operation at currently authorized speeds. All unsafe conditions found during inspection must be corrected immediately or properly protected.

b) The District Manager responsible for the territory has the responsibility and authority to order additional inspections if they are required for safe railway operations.

c) The inspections must be carried out by employees who are qualified in accordance with the *Transport Canada* *Track Safety Rules* and must be under the direction of the District Manager.

d) A Special Track Work includes railway crossings at grade.

11.2 Turnout and Track Crossing Inspections – Types

a) Turnout inspections are important to the safe operations of the ONTC Rail System. There are 3 types of turnout inspection.

   i. Routine Inspection – a visual inspection to assess general turnout condition and to identify defects.

   ii. Monthly Turnout Inspection – an inspection performed on foot to assess general turnout condition against a set checklist, to record exceptions and remedial action taken.

   iii. Detailed Turnout Inspection – an inspection performed on foot to assess condition of all parts of the turnout and to record all observations, exceptions, and remedial action taken.

11.3 Turnout and Track Crossing Inspections – Frequency

Turnout inspection must be done often enough to ensure the safety of operations over each turnout at authorized speed. Reference Sub-Part D – Section 8 – Turnouts and Track Crossings when inspecting Turnouts. Minimum requirements for turnout inspection are as follows;

11.3.1 Routine Inspection

a) Where practicable, all qualified employees should perform a routine inspection of a turnout every time a turnout is crossed.

11.3.2 Monthly Turnout Inspection

a) Every turnout must be inspected once per month on foot to assess the general condition of the Turnout or Special Track Work. If track is used less than once per month, each turnout must be inspected on foot before it is used. A Monthly Inspection is not required in any month that a Detailed Inspection is completed. The Track Supervisor (Inspector) or his/her qualified designate must make the inspections and document the findings.

11.3.3 Detailed Turnout Inspection

a) All main track turnouts and turnouts on signaled sidings or on other signaled tracks (including diamonds) must receive a detailed inspection on foot once annually. The Track Supervisor (Inspector) or his or her qualified designate must make the inspections and document the findings.

b) Each newly constructed turnout must receive a detailed inspection by the District Manager, or his or her qualified designate, in addition to the meeting the requirements noted in Sub-Part D – Section 7.9 – CWR – Temporary Speed Restrictions Account Work, before it is placed in service or a 10 mph speed restriction must be applied.

11.4 Turnout and Track Crossing Inspections – Protection of Defects

a) All unsafe conditions found during an inspection that cannot be corrected immediately must be properly protected.

11.5 Turnout and Track Crossing Inspections – Records

a) Monthly inspections of turnouts on all main track, and on turnouts on signaled sidings or other signaled tracks, must be documented in the applicable record.

b) Detailed Inspections of Turnouts must be documented in the applicable record.

c) Each record of an inspection must be prepared on the day the inspection is made and signed by the person making the inspection. Records must specify the track or tracks inspected, the date of inspection, method of inspection, location and nature of any deviation from the requirements of TSR, and the remedial action taken by the person making the inspection. In the case of more than one track, track inspection records must indicate all track(s) included in the inspection and indicate which track(s) were traversed by the vehicle or inspected on foot.

d) All records of monthly turnout inspections must be kept at the District Manager's office for at least 1 year after the inspection covered by the record.

e) All records of detailed turnout inspections must be kept at the District Manager’s office for at least 2 years after the inspection covered by the record.

11.6 Turnout and Track Crossing Inspections – Track Crossing (Diamond)

a) Inspection of all railway crossing at grade shall be conducted as follows;

   i. Every time the crossing is traveled over by hi-rail it shall be visually inspected for defects,

   ii. Crossings shall be inspected at least monthly on foot measuring gauge and looking closely at the condition of all components and an annual detailed inspection as noted in Sub-Part F, Section 11.3.3.,

   iii. Unsafe conditions on either railway which cannot be corrected immediately will be reported to the Rail Traffic Controller and proper action taken to protect traffic on both routes.

12. Yard Track Inspections

a) Maximum track speed on a yard track is 15 mph.

b) A yard must be designated as classified or unclassified.

c) Classified Yard must be classified into one of the four categories. These categories must be based on frequency of track use, volume of traffic and risk associated with the movement of trains and equipment. Railway companies must classify the category for each track and when requested, must provide a copy to a Railway Safety Inspector.

d) Categories for Yard Track must be based on the following criteria:

i. Category 1

- Heavily used tracks including:
- Through, bypass tracks and core routes.
- Lead tracks where movements are entering, leaving or travelling through a yard carrying more than 500 cars daily.

ii. Category 2

- Locomotive main shop lead tracks
- Main hump lead tracks
- Switching yard leads

iii. Category 3

- Moderately used tracks including:
- Industrial leads
- Switching yard tracks and receiving and departure tracks which are used to yard or depart trains.
- Tracks carrying more than 100 cars daily.

iv. Category 4

- Lightly used tracks including:
- Storage Tracks
- Shop Tracks
- Service Tracks
- Industrial Tracks.

12.1 Yard Track Inspections – Track

a) Unclassified yard track must be inspected monthly

b) All classified yard track must be visually inspected at the minimum frequency specified in the following table:

Yard Track

Designated Minimum Visual Inspection Frequency Table

Category	Type	Frequency
Category 1	Track	Twice monthly
Category 2	Track	Monthly
Category 3	Track	Quarterly
Category 4	Track	Twice annually

Figure SUB-PART F – 9 – Yard Track Inspection Frequency

c) In instances where a Yard Track cannot be physically traversed, a single track in Category 2, Category 3 or Category 4 may be inspected from a vehicle operated on an adjacent roadway provided the following conditions are met:

   i. The vehicle is operated by a person other than the Track Supervisor (Inspector).
   ii. The operating speed must allow the Track Supervisor (Inspector) to identify defects.
   iii. The visibility of the Track Supervisor (Inspector) remains unobstructed.
   iv. Any portion of track obstructed by equipment must be inspected on foot.
   v. The track being inspected is located within 30 feet (9.144 m) from the roadway.
   vi. If a track is inspected from an adjacent roadway, next required track inspection must be completed by operating the vehicle on track or by walking.

d) A vehicle, such as an All-Terrain Vehicle, straddling the track may be used to inspect yard tracks. This vehicle must be operated on the track being inspected at a speed that allows the Track Supervisor (Inspector) to identify defects.

12.2 Yard Track Inspections – Turnouts

a) Walking inspection of Yard Turnouts installations must meet the minimum frequency shown in the following table:

Yard Track

Designated Minimum Turnout Inspection Frequency Table

Category	Type	Frequency
Category 1	Turnouts	Twice Monthly
Category 2	Turnouts	Monthly
Category 3	Turnouts	Monthly
Category 4	Turnouts	Quarterly

Figure SUB-PART F – 10 – Yard Track Turnout Inspection Frequency

And,

b) Detailed inspection of all Yard Track turnouts in yard track of Category 1 must be completed annually.

12.3 Yard Track Inspections – Electronic Geometry

a) All tracks in Category 1 must be inspected annually for deviation in gauge and crosslevel using a Light Track Geometry Inspection Vehicle or other such device capable of measuring recording and evaluating these geometry parameters.

b) Track measurements obtained with these vehicles are considered static geometry measurements. Allowances must be made for any condition that could result in a greater measurement when the track is under load.

12.4 Yard Track Inspections – Rail Flaw

a) A continuous search for internal rail defects must be completed annually in all rails of Category 1 Yard Track.

b) A continuous search for internal rail defects must be completed annually in rail lighter than 100 lbs in leads of Category 2 Yard Track.

c) If an inspection cannot be performed, the maximum speed must be limited to 10 mph.

13. Inspection and Testing of Grade Crossing Warning Systems

13.1 Inspection and Testing of Grade Crossing Warning Systems – General

a) GCWS is defined as a Grade Crossing Warning System (or Railway Crossing Warning System) that consists of:

i. Flashing light signals with bell,

ii. Flashing lights,

iii. Automatic bells and gates installed and / or maintained by the Railway.

13.2 Inspection and Testing of Grade Crossing Warning Systems – Testing

a) The normal functioning of any rail crossing warning system shall not be interfered with in testing or otherwise, without first taking adequate measures to ensure the site is safe for employees, the public, vehicular traffic and train prior to performing tests and inspections. If the grade crossing warning system is equipped with gates, please ensure understanding of Sub-Part F, Section 13.3 below.

b) Grade crossing warning systems consisting of flashing light signals and bells, flashing lights, or automatic bells and gates shall be tested when installed, as required, and weekly thereafter.

» Weekly means, once per calendar week—Sunday to Saturday—with no more than 10 days between dates of inspection and documented in the applicable record.

c) Where track is used less than once per week, testing road crossing warning systems shall be as directed by the Superintendent, Maintenance of Way.

d) Track Supervisors (Inspectors) will be responsible for the performance of tests under this standard.

e) The following tests are to be performed at each crossing warning system by physically observing* from all relevant approaches and locations,

STEP 1. CHECK Power Out Light:

- Check power out indication is continually lit,
- If the light is extinguished, flashing or the power is off, the Rail Traffic Controller and the Signal Maintainer must be advised promptly, and highway traffic protected (note Section 13 f) below).

STEP 2. ACTIVATE Warning System:

- When road and railway traffic permits, manually operate the grade crossing warning system for one complete cycle (minimum of 20 seconds and / or operation of gates to horizontal position, if applicable) by opening the test switch to the MIDDLE position.

If Train Traffic:

- Visual inspection shall be performed at a safe distance from the rail.

STEP 3. CHECK Gates Descent (if applicable):

- Check both gates begin to descend after delay as specified in crossing warning system design. Gate descent must take between 10 to 15 seconds, and

- If not operating as intended or in a uniform manner, the Rail Traffic Controller and the Signal Maintainer must be advised promptly, and highway traffic protected (note Section 13 f) and Section 13.3 below).

STEP 4. CHECK Lights:

- Check lights are properly aligned for all roadway approaches,
- Check backgrounds and light units are in good condition,
- Check lights are clearly visible, and working as intended, and
- If not operating as intended (e.g., illuminated, proper sequence) or in a uniform manner, or lights are misaligned or damaged, the Rail Traffic Controller and the Signal Maintainer must be advised promptly, and highway traffic protected (note Section 13 f) below).

STEP 5. CHECK Bells:

- Check bell is ringing at an audible level, and
- If not operating as intended (e.g., not ringing) or in a uniform manner, the Rail Traffic Controller and the Signal Maintainer must be advised promptly, and highway traffic protected (note Section 13 f) below).

STEP 6. RESTORE Warning System:

If Train Traffic: Observe the warning system operation until the train has cleared the island track and the warning system ceases to operate.

If NO Train Traffic: Close test switch by placing in the down position.

STEP 7. CHECK Gates Ascent (if applicable):

- Check gate ascends to the vertical position within 6 to 12 seconds, and
- If not operating as intended or in a uniform manner, the Rail Traffic Controller and the Signal Maintainer must be advised promptly, and highway traffic protected (note Section 13 f) and Section 13.3 below).

STEP 8. DOCUMENT Weekly Test:

- Ensure date, time, initials/signature, and comments, if any, are documented.

*If a Signals and Communications employee is at the site, performing maintenance or has deactivated the crossing account work and the full test is not able to be completed, note this in the weekly inspection and document that the test will be performed by the S&C employee as part of the system's restoration to normal operation.

f) If the grade crossing warning system fails to operate or does not operate properly,

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.

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

GATE RELIEF OPTION: Per Sub-Part F, Section 13.3, to bring gates back up if not recovering,

- Apply crossing protection with the RTC,

- Put the test switch in the MIDDLE position,
- Once gates are in the horizontal position, place the test switch in the UP position

The gates should recover, and the lights and bell stay active.

- Signal Maintainer must be advised.

If Train Traffic: The test switch position must be put in the MIDDLE position to drop the gate arms providing the train a minimum of 20 seconds warning time. Observe the warning system operation until the train has cleared the island track and the test switch can be returned in the UP position to recover the gate arms.

[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 protection 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 protection 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.

13.3 Inspection and Testing of Grade Crossing Warning Systems – Gate Relief Option

To ensure functionality of the Gate Relief option at grade crossing warning systems equipped with gates, please make note of the switch positions below.

Always allow the gates to do their full cycle before moving the test switch to the next position.

For example, if the test switch is in the UP position and you want to place it in the DOWN position,

- Allow it to complete its cycle in the UP position, then
- Move to the MIDDLE position for its full cycle, then
- Place it in the DOWN position.

The same would apply if you wanted to go from the BOTTOM position to the TOP.

Going from UP to DOWN position or DOWN to UP position without allowing the MIDDLE position to cycle in its entirety, may incur damage to the mechanics.

TEST SWITCH IS DOWN | *Crossing is in its* ***NORMAL*** *operating state*

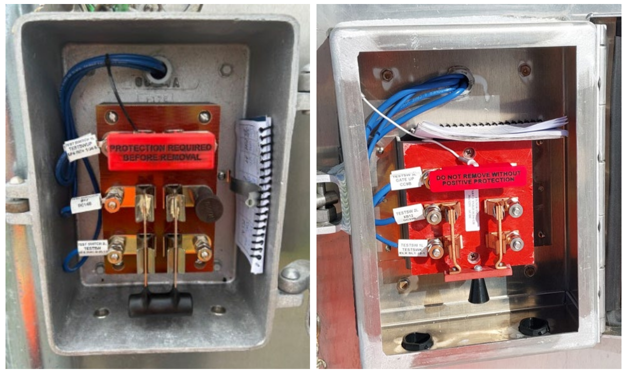

Figure SUB-PART F – 11 – Test Switches in NORMAL Position

TEST SWITCH IS IN THE MIDDLE |*Crossing is in its* ***MANUAL ACTIVATION*** *state (testing)*

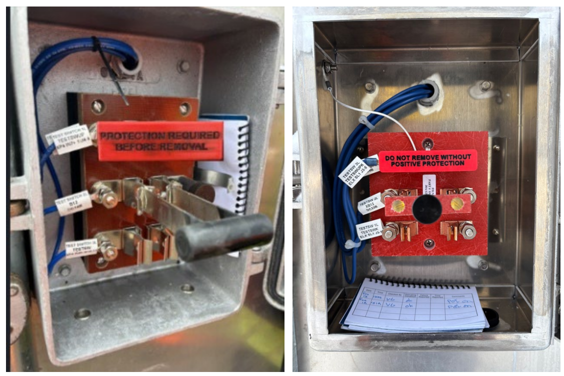

Figure SUB-PART F – 12 – Test Switch in MANUAL ACTIVATION Position

TEST SWITCH IS UP |*Crossing is in its* ***GATE RELIEF*** *state (gates are in the up position and lights and bell remain active)*

The Rail Traffic Controller must be advised promptly and crossing protection applied with a GBO, the Signal Maintainer must be advised promptly, and highway traffic protected.

- Used to clear traffic during crossing failure.
  - Gates will come up and lights will continue to flash, including the POI light,
  - Gates will not come back down if a train was to approach the crossing.

IMPORTANT: When using the Gate Relief option to clear traffic, a CROR qualified employee must stay on site until a qualified signal employee to place the crossing back in service.

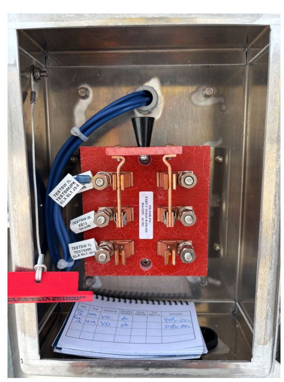

Figure SUB-PART F – 13 – Test Switch in GATE RELIEF Position

14. Track Evaluation Car

a) An Electronic Geometry Inspection vehicle is an automated track inspection vehicle used to measure, calculate, and record geometric parameters of the track. Two types of track geometry inspection vehicles defined below can be used to measure and evaluate track geometry.

i. Light Geometry Inspection Vehicle (LGIV)

- A Light Geometry Inspection Vehicle (LGIV) must be capable of measuring:
  - Alignment / Curvature
  - Super elevation / Cross level
  - Gauge
  - Railway Track Safety Rule parameters calculated from these measurements:
  - Track measurements obtained with these vehicles are considered static geometry measurements, as the vertical load applied to the track is limited to the weight of the hi-rail vehicle. Allowances must be made for any condition that could result in a greater measurement when the track is under load.

ii. Heavy Geometry Inspection Vehicle (HGIV)

- A Heavy Geometry Inspection Vehicle (HGIV) must have a vertical wheel load of 10,000 pounds and be capable of measuring:
  - Surface / Longitudinal Profile
  - Alignment / Curvature
  - Super elevation / Cross level
  - Gauge
  - Railway Track Safety Rule parameters calculated from these measurements
- Track measurements obtained with these vehicles are considered dynamic geometry measurements representative of the track in a loaded condition.

b) An Electronic Geometry Inspection of all track, except Yard Track and Inactive Track, must meet the minimum frequency shown in the following table:

Class of Track	Minimum Annual Geometry Inspection Requirements			
	< 5 MGT	5 – 15 MGT	15 - 35 MGT	> 35 MGT
Class 1	N/A	LGIV – Twice Or HGIV - Once	LGIV – Three times Or HGIV - Once	LGIV – Three times Or HGIV - Once
Class 2	LGIV – Twice Or HGIV - Once	LGIV – Three times Or HGIV - Once	LGIV – Three times Or HGIV Twice	LGIV – Quarterly Or HGIV Twice
Class 3	HGIV - Once	HGIV – Once	HGIV – Twice	HGIV – Twice
Class 4	HGIV – Twice	HGIV – Twice	HGIV – Twice	HGIV - Twice
Class 5	HGIV – Twice	HGIV – Twice	HGIV – Twice	HGIV – Three times
Crossovers*	LGIV – Twice Or HGIV - Once	LGIV – Twice Or HGIV - Once	LGIV – Twice Or HGIV - Once	LGIV – Twice Or HGIV - Once

Figure SUB-PART F – 14 – Electronic Geometry Inspection Frequency

* Track geometry inspection is not required on crossovers where track speed is 30 mph or less.

c) Missed Segment of Electronic Geometry Inspection

   i. If a portion of track cannot be inspected at the required interval, the railway must, before the expiration of time or tonnage limits:

      - Inspect that segment of track with a light geometry inspection vehicle and be governed by the results of that inspection or perform an additional visual inspection per week until the required track geometry inspection frequency can be met and, in the case of Class 3 to Class 5 track the next required track geometry inspection must be completed with a heavy geometry inspection vehicle, or

   ii. Reduce class of track to bring the track into compliance until such time as a valid track geometry inspection can be made.

d) All mainline track will be tested annually.

e) Additional tests will be as determined by the Director Rail Infrastructure.

f) Reporting of Remedial Action

   i. An URGENT and NEAR URGENT defect report will be created for each track section after completion of the geometry car run. These reports will be used for reporting of repairs made to the defect detected by the TEC.

ii. The Track Maintenance Foreman will identify on each report the date on which repairs are completed, and the name of the Foreman making the repairs.

iii. The Track Supervisor (Inspector) must personally verify that the correct repair has been made and that the track has been returned to standard. The Track Supervisor (Inspector) will verify this inspection by placing his initials, and date on the defect report along the right hand side in line with the defect number.

iv. The Track Supervisor (Inspector) shall provide weekly reports to the District Manager identifying the repairs made and those still outstanding until all defects have been repaired.

v. The final copy showing that all defects have been corrected will remain on file in the District Manager's Office for two (2) years after the inspection and for one (1) year after the defect is removed.

g) The District Manager or designate must accompany the Track Evaluation Car when it is testing primary and secondary main lines in their respective territories.

h) Immediately following the testing, the District Manager must discuss with the Track Supervisor (Inspector) both the test results and the corrective action to be taken.

i) Following each test, as soon as practicable, the Director Rail Infrastructure, Superintendent Maintenance of Way, and Training and Regulatory Affairs personnel will discuss the test results.

j) All track measurements made by the TEC are based upon measurements taken once for every foot of track for;

- Gauge
- Alignment
- Surface
- Crosslevel, and
- Curvature (by design)

15. Rail Flaw Detection

15.1 Rail Flaw Detection – Background

a) Rail is tested in track by induction or by ultrasonic rail flaw detector cars. The purpose of the testing is to discover internal defects that cannot be seen during routine track inspections.

i. Induction testing introduces a high-level, direct current into the top of the rail, establishing a magnetic field around the rail head. An induction sensor unit is then passed through the magnetic field. The presence of a rail flaw distorts the current flow and the magnetic field, and it is this distortion that is detected by the search unit.

ii. Ultrasonic testing uses sound waves that propagate at a frequency that is normally between 2.25 MHz (million cycles per second) to 5.0 MHz, above the range of human hearing. Ultrasonic waves are transmitted into the rail by transducers placed at various angles with respect to the rail surface. The ultrasonic waves produced by these transducers normally scan the entire rail head and web, as well as the portion of the base directly beneath the web. Internal rail defects are discontinuities in the material that constitutes the rail. These discontinuities act as a reflector to the ultrasonic waves, a portion of which are reflected back to the transducers. These conditions include rail head surface conditions, internal and visible rail flaws, weld upset/finish and known reflectors within the rail geometry such as drillings or rail ends. The information is then processed by the test system and recorded in the test data record.

15.2 Rail Flaw Detection – Frequency

a) A Rail Flaw Inspection must be made of all rails at the minimum frequency shown in the following table except for Yard Track, Inactive Track or, in the case of new rail, if within 6 months of installation, it is ultrasonically inspected over its entire length and all defects are removed, the next continuous search for internal defects need not be made until the passage of 100 mgt or three years after the inspection, whichever occurs first.

Designated Minimum Rail Flaw Track Inspection Frequency Table

Class of Track	< 5 MGT	5 – 15 MGT	15 – 35 MGT	>35 MGT
Class 1	N/A	N/A	N/A	N/A
Class 2	Once every 2 years	Annually	Annually	Twice annually
Class 3	Annually	Annually	Annually	Twice annually
Class 4 and 5	Annually	Twice annually	Three times annually	Four times annually

Figure SUB-PART F – 15 – Rail Flaw Track Inspection Frequency

b) In the case of Class 2 track where Passenger trains are operated, track must be inspected at least annually with a Rail Flaw detector

c) The maximum interval of days following the previous Rail Flaw Inspections is defined as follows:

   i. Annually: No more than 500 days between inspections.

   ii. Twice Annually: No more than 300 days between inspections.

   iii. Three Annually: No more than 250 days between inspections.

   iv. Four Annually: No more than 200 days between inspections.

d) For Class 2 track carrying 3 to 5 MGT annually, with less than 100 lbs rail weight and authorized car loading 263,000 lbs or greater, the rail must be tested at least annually with a rail flaw detector.

e) For Class 4 or 5 track, with 100 lbs rail weight and authorized car loading 286,000 lbs or greater, the rail must be tested twice annually with a rail flaw detector.

f) Rail in sidings and crossovers, where track speed is 25 mph or greater, the rail must be inspected annually.

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

h) Each defective rail must be marked and highly visible.

i) Missed Segment of Rail Flaw Inspection

   i. If the operator assigned to operate the rail defect detection equipment determines that, due to rail surface condition and or other reasons, a valid search for internal defects could not be made over a particular length of track, the test on that particular length of track cannot be considered as a search for internal defects under this section.

   ii. If a valid search for internal defects cannot be conducted for reasons described in i), the railway company must, before the expiration of time or tonnage limits

   iii. Conduct a valid search for internal defects, or

   iv. Reduce class of track to bring the track into compliance until such time as a valid search for internal defects can be made, or

   v. Remove the rail from service.

15.3 Rail Flaw Detection – District Manager Responsibilities

a) The District Manager is responsible for the Rail Flaw Detection testing conducted on his territory, including preparation for the test, and the marking, protection, removal, handling and reporting of defective rail.

15.4 Rail Flaw Detection –Test Preparation

a) Each District must make arrangements to have enough replacement rails available to replace defective rails as soon as they are identified. As a general rule, the supply of replacement rails should equal the number used during the previous test.

b) The Track Supervisor (Inspector) must ensure that rail lubricators are turned down in advance of testing to ensure test accuracy. Lubricators must be activated after testing has been completed.

15.5 Rail Flaw Detection – Operation

a) The Track Supervisor (Inspector) or representative must go with the rail flaw detector car as it travels over his territory and is responsible for the operation of the car while it operates as a track unit.

b) With respect to rail flaw detector car operation, the Track Supervisor (Inspector) must:

   i. Determine the time the test is to begin, in consultation with the Rail Traffic Controller and the rail testing contractor's supervisor;

   ii. Ensure that any track units following the rail flaw detector car remain at least 500 feet behind the detector car, and that the detector car operator keeps a careful lookout for backup movements;

   iii. After consulting with the RTC's office, arrange a tie up location and advise the MRTC of the next day's work limits.

15.6 Rail Flaw Detection – Handling Defects Found by Test

a) For defects found by the Rail Flaw Detector car, the Track Supervisor (Inspector) must:

   i. Arrange to have defective rails inspected immediately following the rail flaw detector car's test. The inspection must determine the appropriate action to be taken;

   ii. Arrange to have all detected defects (those detected by rail flaw detection equipment or by visual inspection) marked immediately for removal from the track;

   iii. Have equipment and personnel ready to replace defective rails as soon as possible after the rail flaw detector car has completed its operations;

   iv. Protect rail defects until removed from the track, as outlined in Sub-Part D – Section 6.4 Defects and Protection Codes.

b) Give top priority to changing out rail defects that have cracked out and transverse defects.

c) Protect defective rails in track according to the instructions in Item Sub-Part D – Section 6.4 Defects and Protection Codes.

d) Rail removed from track that is defective or that is otherwise unfit for relay in track, and cannot be improved by treatment, must be classified and marked as scrap. It must be stored for removal in a location that is apart from the racks where maintenance and relay rail plugs are stored.

e) Rail must be placed in clearly defined piles according to grade of rail and length of rail.

f) All noted rail defects 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.

15.7 Rail Flaw Detection – Reporting

a) The operator of the Rail Flaw Detection car must submit weekly reports to the Superintendent, Maintenance of Way summarizing test miles and location, number and description of defects.

b) The contractor on the Rail Flaw Detection car must submit daily reports to the District Manager / Track Supervisor (Inspector) summarizing test miles and location, number and description of defects.

c) The Track Supervisor (Inspector) must supplement the Rail Flaw Detection car daily reports of detected rail failures with information on the protection provided and remedial action taken, including the location and the extent of slow orders and an accounting of the number of defective rails remaining in the track. These reports must be updated until all defective rails have been replaced.

d) The Track Supervisor (Inspector) must report to the District Manager and maintain a written record of all defective rails detected and the date of their removal for at least two years.

e) Document the information in the applicable record for all service rail failures that are found by any means other than the Rail Flaw Detection Car.

15.8 Rail Flaw Detection – Handling Defective Rail

15.8.1 Removal of Defective Rail

a) Any rail showing a crack, split or other defect which may result in the rail breaking or being unsafe for the passage of trains at normal speed must be removed from track.

15.8.2 Replacement of Defective Rail

a) The full length of the rail (33-36-39’) must be removed when replacing a defective rail if the following apply:

   i. Mackie or control-cooled rails are being removed from the track because of:

      - Vertical split heads outside of the joint area.
      - Transverse fissures or transverse defects accompanied by gross distortion of the rail section (for example, heavy flow or evidence of rail shelling).

b) Defective rails must be marked in accordance with our Rail Wear Limits and Rail Management Design Zones.

c) Rails removed from the track because of other defects must also be plainly marked using permanent white paint.

15.8.3 Protection of Defective Rail

a) All noted rail defects detected visually or by using rail flaw detector cars, including those 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) Refer to Sub-Part D – Section 6.4 Defects and Protection Codes.

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Appendix A. Rail Wear Limits and Rail Management Design Zones

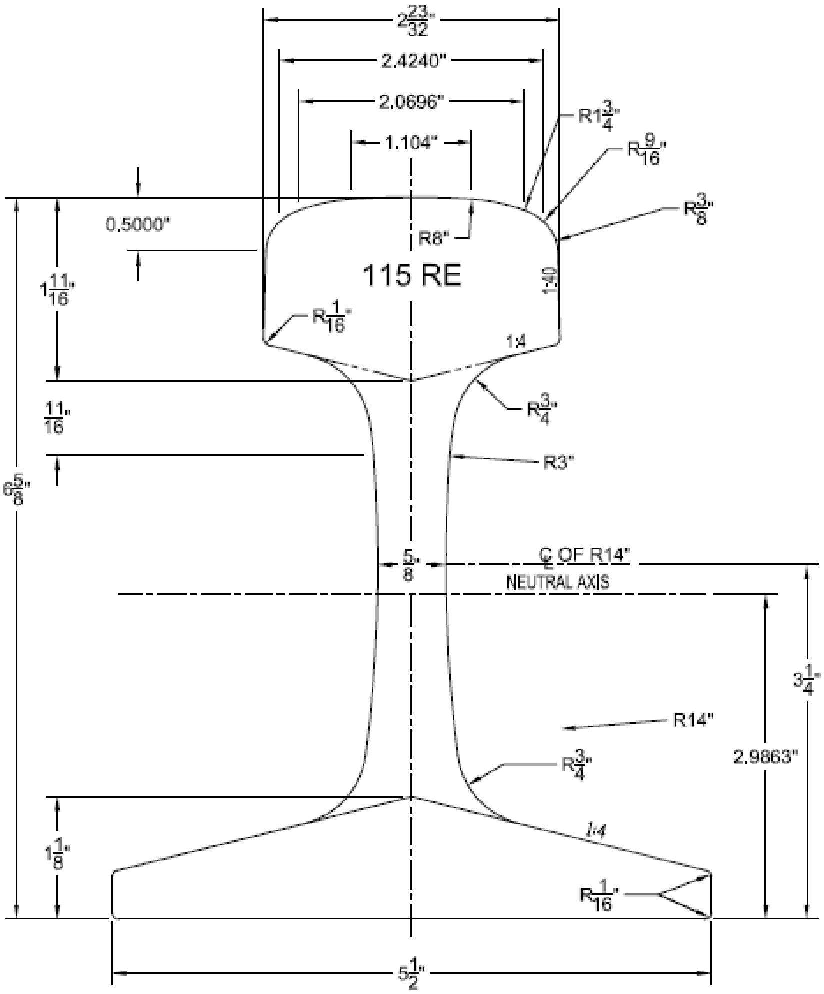

Figure Appendix A – 1 – RE Rail Section Design

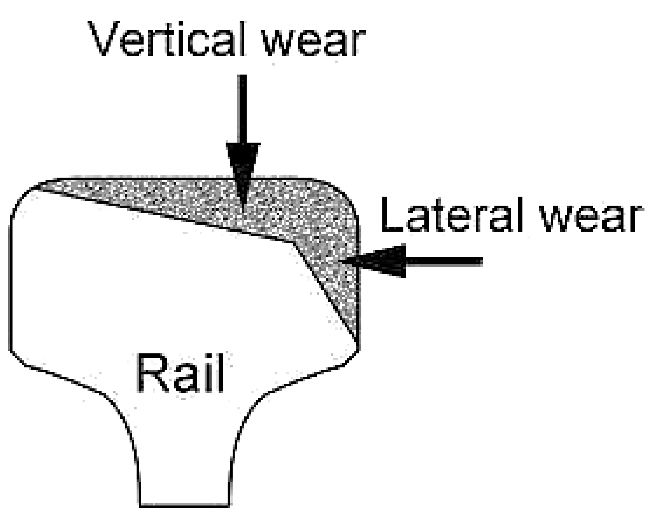

Figure Appendix A – 2 – Vertical and Lateral (Gauge Face) Wear

RAIL WEAR LIMITS &
RAIL MANAGEMENT DECISION ZONES

Wear Diagram for XXX Rail Section

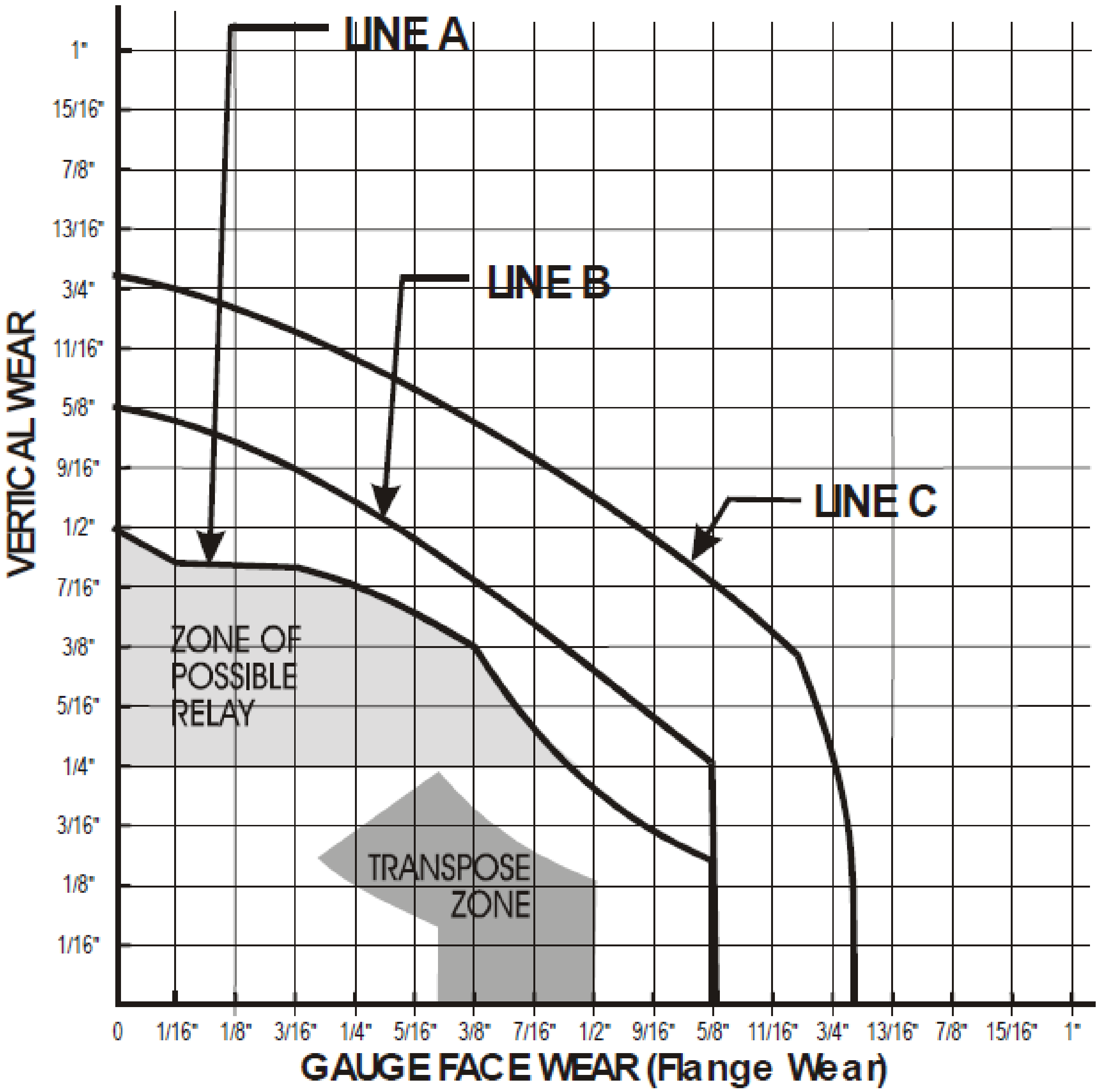

Figure Appendix A – 3 – Rail Wear Limits and Decision Zones

LINE A

a) LINE A shows previous maximum rail wear limits. LINE A also shows the wear measurements at which a fully tread worn wheel will just begin to contact a new joint bar. Jointed rail should be planned for renewal at this point unless the joint condition is good, joints are welded up, or high clearance joint bars are applied on the gauge side of worn rail.

b) LINE A limits for planning rail should also be applied in CWR where there is evidence of fatigue. In this case, rail is considered to be fatigued when, among rail of the same type and the same age in the same curve:

   a) There has been **one** of the following defects in the last 12 months;

OR

b) **Two** of the following defects in the last 24 months;

- Compound fissure
- Transverse fissure
- Detail fracture from shell
- Transverse defect
- Piped rail
- Head web separation
- Vertical split head
- Horizontal split head outside of joint
- Detail fracture from head check

<u>LINE B</u>

a) LINE B shows extended rail wear limits. When wearing rail to LINE B, **high clearance joint bars** should be used.

b) LINE B also shows the wear measurements at which continuous welded rail should be removed from track, as long as the CWR has maintained:

   i. Good rail surface and

   ii. Good rail-wheel contact geometry by rail grinding.

<u>LINE C</u>

IMPORTANT: LINE C shows new maximum rail wear limits.

a) LINE C shows rail wear measurements at which rail must be removed from track. When rail wear exceeds these limits, train speed must be restricted to a speed as near as possible to equilibrium speed until rail can be changed out. (See Sub-Part C – Section 12 - Curves) If rail change-out cannot be done in a timely manner (e.g., 30 days) then a further speed restriction of 10 mph must be applied.

For example, assume the following conditions exist:

i. Jointed track with poor joint support

ii. Heavy joint bar contact in jointed track or in CWR

iii. Evidence of rail fatigue

iv. Broad or eccentric rail contact

To obtain regular rail life for these conditions, plan renewal at LINE A and plan a slow order at LINE B.

To obtain extended rail life for these conditions, either production grind and weld, or grind and apply high clearance joint bars. Then, plan renewal at LINE B and plan a slow order at LINE C.

Zone of Possible Relay

a) The Zone of Possible Relay shows a zone of wear at which point it may be economical to release rail for relay provided there is a requirement for relay rail of this type.

b) If the rail does not yet have wear measurements within this zone, do not consider it for replacement in order to free up relay rail. The decision about when to release rail for relay purposes depends upon how the relay rail is used. When choosing donor sites for specific relay rail, here are some factors to consider:

   i. If relay rail is required for spot replacements (for example, when replacing rail defects), the rail should have the kind of rail wear conditions suitable for the territory in which it will be used.

   ii. If the relay requirement is for continuous welded rail, the donor site should have continuous welded rail with sufficient rail life remaining to be useable in the new location, OR it should be jointed rail with adequate rail life after cropping and welding.

   iii. If jointed rail is required for relay out-of-face, the donor rail should be assessed on the basis of wear on the rail joint fishing surfaces and rail end batter. It should also be assessed on the amount of rail wear remaining in the new location.

c) The District Manager is responsible for properly identifying the need for relay rail. If stocks of relay rail are not available, the Director, Rail Infrastructure is also responsible for recommending the most economical rail replacement program to generate relay rail.

Transpose Zone

The Transpose Zone is where rail life may be extended by placing the worn gauge face of the rail to the field side using one of the following methods:

a) Switch high and low rails at a particular curve.

b) Move the high rail to the low rail and install a new high rail.

c) Move the gauge face worn rail to a new location where it can be installed with the worn face to the field side.

Rail Wear Limits of Transposed Rail

a) When determining the rail wear measurements of a rail previously transposed from the high rail to the low rail (using the Rail Wear Limits and Rail Management Design Zone graphs), include both the field side gauge face wear and the vertical wear.

b) For example, if there is a rail on the low side of a curve that had previously been on the high side of the curve, the following must be done when measuring rail wear:

   i. Take both the vertical wear and the flange wear on the field side into account when deciding whether to keep using rails that fall within the rail wear limits.

   ii. IMPORTANT: In order to achieve extended rail life by transposing, transpose only when the rail wear measurements fall within the transpose zone as outlined in the Rail Management Design Zone graphs. (Transposing beyond this zone will do little to extend the life of the rail, if you take into account the flange and vertical wear on the low side rails that were previously on the high side.) Please note that transposed rail will have an increased rate of wear and extra attention must be paid to transposed rail locations to monitor this accelerated rail wear.

Special Requirements

a) New rail wear limits do not replace the requirement to maintain gauge. It may be necessary to transpose or replace rail before wear limits are reached. However, every effort should first be made to correct other conditions contributing to the wide gauge condition.

b) In 100 lb. RE-HF territory, where rail may already be worn beyond the limits of joint bar contact and joint bars are showing corresponding wear, bars worn less than existing joint bars must not be installed. If new bars are installed, they must be high-clearance bars.

c) In 115 lb. RE territory, when continuous welded rail is worn beyond joint bar contact limits, a special high – clearance joint bar approved by the Director, Rail Infrastructure must be used. This joint bar is used on the gauge side of any new joint installed in the track (for example, in the replacement of a rail defect with a temporary jointed repair rail).

Rail Wear Limits for Rail with only Vertical Wear	
90 lbs	**85 lbs or less**
1/4" *(6 mm)*	**3/16"** *(5 mm)*

Both Vertical and Gauge Face (lateral) Wear ***Combined wear measurements shall not exceed***	
90 lbs	**85 lbs or less**
7/16" *(11 mm)*	**5/16"** *(8 mm)*

Figure Appendix A – 4 – Rail Wear Limits (90 lb / 85 lb)

RAIL WEAR LIMITS &
RAIL MANAGEMENT DECISION ZONES

Rail Section 100 lb. RE - HF

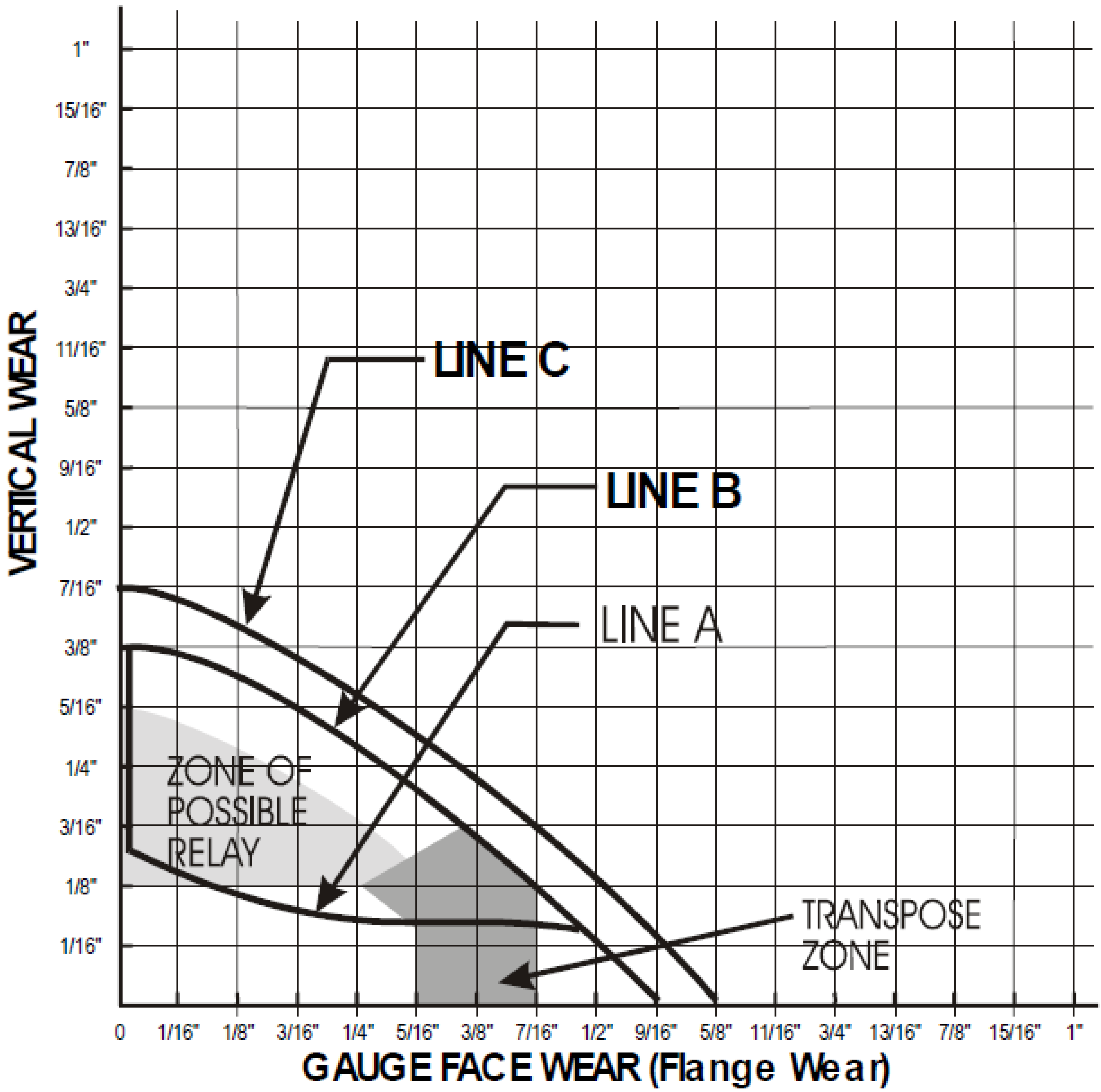

Figure Appendix A – 5 – Rail Wear Limits and Decision Zones 100 lb RE-HF

RAIL WEAR LIMITS &
RAIL MANAGEMENT DECISION ZONES

Rail Section 115 lb. RE

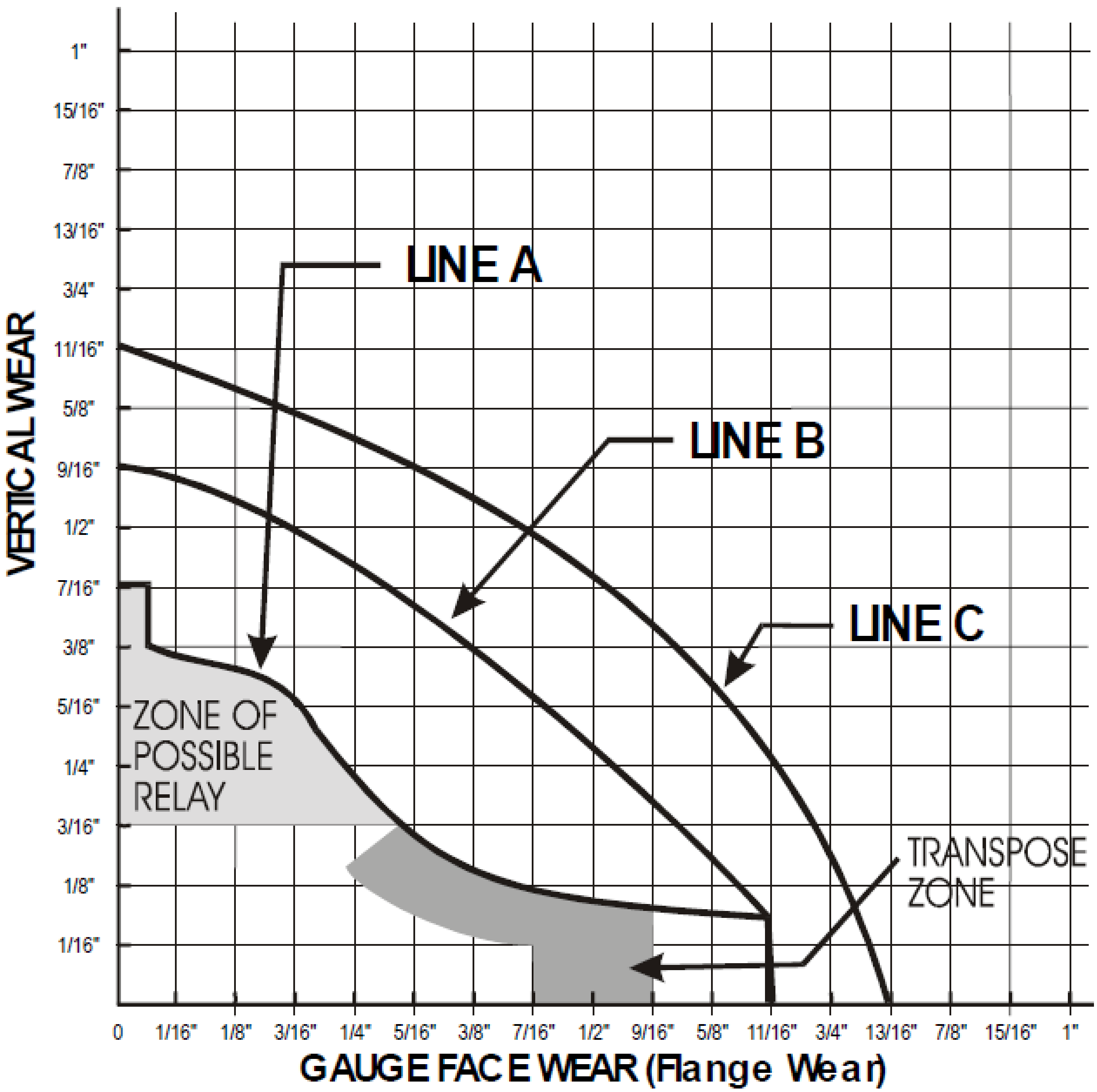

Figure Appendix A – 6 – Rail Wear Limits and Decision Zones 115 lb RE

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Appendix B. Destressing / Restressing Rail – Recommended Methods

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

1. Continuous welded rail may drift into tension or compression, so that it is stress free at some temperature outside the preferred rail laying temperature range, as a result of such activities as track surfacing, tie renewals, ballast cleaning, track lining, and curve rail renewal. Even if the track is not worked on, the rail can shift and go out of destress as a result of rail breaks, emergency brake applications, worn or defective anchors, poor quality or insufficient ballast, Permanent Slow Order locations, or soft subgrade. On vertical curves and gradients, rail is generally seen to move slowly downhill, resulting in an excessively low stress-free temperature at the bottom and an excessively high stress-free temperature at the top.
2. Any locations where rail is added below the PRLTR, the rail should be destressed prior to a rail temperature increase greater than 40°F or 22°C above the RLT.

Destressing CWR

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

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

When it is evident that the stress-free temperature of a section of rail has decreased to a level that a track buckle may occur, the stress-free temperature should be adjusted back to the Preferred Rail Laying Temperature.

The method of destressing involves removing rail anchors, cutting the rail and removing rail to achieve the correct rail laying temperature.

1. Prior to cutting the rail, the following MUST be completed:
    a. Rail anchors may have to be tightened for at least 200 feet *(61,000 mm)* on each side of where the rail is to be cut.
    b. All ties must be fully box anchored at least 200 feet *(61,000 mm)* beyond the rail being destressed prior to making the cut.
    c. In concrete tie territory, chording clips and risers must be distributed, tie pads and insulators if required.
    d. Reference marks must be made with a paint stick on the field side web of the rail at a minimum of 5 ft. *(1,524 mm)* away from both sides of the joint or planned rail cut.
    e. Starting at the reference marks, match marks MUST be made with a paint stick on the gauge side base of the rail extending onto the tie plates or concrete ties on unanchored ties intervals throughout the length to be destressed about every 100 ft. *(30,000 mm)*.
2. The rail shall be cut and may need to be trimmed or placed in a position that will permit the rail ends to bypass each other.
3. The rail anchors/rail clips shall be removed for the length of rail being destressed to allow for the free movement of rail.
4. The rail must be raised from the tie plates or tie pads on all tie types and placed on risers or elevating rollers.

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

5. Unless authorized, on all tie types, risers must be placed every 12 to 15 ties to ensure base of rail is free.

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

7. Following the completion of Items 1 through 6, the rail now in the raised position on risers, or fully power vibrated, is stress free at the current rail temperature as it is totally unrestricted.

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

8. Knowing the length of rail being destressed, the PRLT and the present rail temperature, the calculations can now be made as to the adjustment requirement per [Appendix C](#).

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

10. If this rail is the last 200 feet of CWR before jointed rail, it must also be destressed. Make the adjustment and check the match marks to ensure that proper movement has been achieved.

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

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

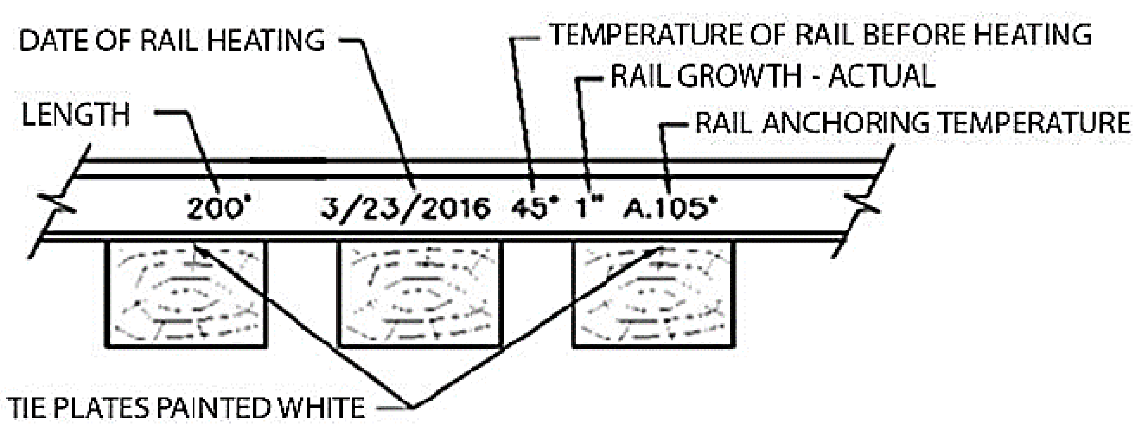

Figure Appendix B – 1 – Rail Markings for Destressing

13. Record the new laying temperature and the amount the rail the was removed within the track maintenance in the applicable records.

14. If there was no maintenance record created, document the information in the applicable records. Providing a copy to the Track Supervisor (Inspector) and the Director, Rail Infrastructure.

Restressing CWR Strings – Recommended Method

Rail should be restressed when the ambient temperature is at or below the preferred laying temperature. This ensures the rail will contract when joint bars are removed, or the rail is cut.

IMPORTANT: If the rail was laid below the preferred laying temperature, restress the rail before there is any possibility the rail could reach 40 F degrees above the actual rail laying temperature.

To restress strings laid below the preferred laying temperature, use the following steps:

Setting Up

1. Place a closure rail at the cut-in location.
2. Prior to making a cut, tighten anchors for 195 feet on the rails next to the section being adjusted. Install additional anchors if required.
3. Mark the rail on either side of the cut location to show the amount of rail movement and measure the distance between the marks very accurately. Make marks where they will not be erased during the adjustment.
4. Make match marks at quarter points on the section of rail to be de-stressed on the field side of the rail.

Restressing the rail

5. Remove joint bars between the strings to be adjusted or cut the rail as necessary. Offset rail ends, if required.
6. Remove anchors on the rail being de-stressed. Start at the cut to assist rail movement.
7. Ensure rail is in a neutral position by observing the field side match marks. Additional vibration of the rail may be required to obtain the necessary movement.

   *Rail can be vibrated with mechanical devices or by striking the tie plates with an 8- or 10-pound Babbitt hammer.

Determining the amount to be heated

8. After the rail has taken a “neutral” position, measure any gap at the rail end.
9. Use the difference between the actual rail temperature and the preferred laying temperature to determine the amount the rail may expand. Make the calculation using the table in Appendix C Rail Movement for Different Temperature Differentials.

   Note: If the measured gap is more than 1 inch larger than the calculated required expansion, a closure rail will be needed to make up the difference. For wide gap welding 2-3/4 inch applies.
10. Make quarter point match marks at the same locations as the field side match marks only this time on the gauge side of the rail, to measure the movement of the rail when expanded.

Heating the Rail and Closing up

11. Use a rail heater, if available. The sun or ambient temperature can be used to heat the rail, if practicable.

    NOTE: A rail tensor may be used in tangent track. Do not use a rail tensor next to a permanent track structure such as a turnout or bridge.

12. If the rail temperature is below the preferred laying temperature, move the rail the required distance at each of the marks.
13. Adjust the speed to heat the rail consistently. Vibrate the rail to move it through the tie plates.
14. Re-apply rail anchors once the correct movement at each match mark has been obtained. Applying anchors directly behind the rail heater (when used) will assist in vibrating the rail.
15. Install the closure rail, or heat the gap closed, as applicable. If the adjoining string requires adjusting, use the same procedure, working towards the common joint.
16. Record the new laying temperature and the amount the rail was expanded (the difference between the marks measured in Step 3 before and after de-stressing) on the rail and document the information in the applicable records.
17. If there was no maintenance record created, document the information in the applicable record. Providing a copy to the Track Supervisor (Inspector) and the Director, Rail Infrastructure.

Appendix C. Rail Movement for Different Temperature Differentials

a) The following figures show CWR expansion segments and the amount of rail movement for any temperature differential. CWR strings are generally 1440 to 1520 feet in length. They are made by welding 36-foot, 39-foot and 78-foot rail sections. The appropriate table must be used to determine proper expansion segments as outlined in paragraph c.

Continuous Welded Rail Expansion Segments (Tables)

Temperature Differential	Distance in Each Direction Anchors Removed		
	100’	150’	200’
5°F	1/8"	1/4"	7/16"
10°F	1/4"	9/16"	13/16"
15°F	7/16"	13/16"	1-1/4"
20°F	9/16"	1-1/8"	1-11/16"
25°F	11/16"	1-3/8"	2-1/8"
30°F	13/16"	1-11/16"	2-1/2"
35°F	1"	1-15/16"	2-15/16"
40°F	1-1/8"	2-1/4"	3-3/8"
45°F	1-1/4"	2-1/2"	3-13/16"
50°F	1-3/8"	2-13/16"	4-3/16"
55°F	1-9/16"	3-1/16"	4-5/8"
60°F	1-11/16"	3-3/8"	5-1/16"
65°F	1-13/16"	3-5/8"	5-1/2"
70°F	1- 15/16"	3-15/16"	5- 7/8"
Lengths in Feet	**360**	**720**	**1080**

Figure Appendix C – 1 – CWR Expansion – Distance Anchors Removed

Number of 36' Rails

Temperature Differential	10	20	30	40
5°F	1/8"	1/4"	7/16"	9/16"
10°F	1/4"	9/16"	13/16"	1-1/8"
15°F	7/16"	13/16"	1-1/4"	1-11/16"
20°F	9/16"	1-1/8"	1-11/16"	2-1/4"
25°F	11/16"	1-3/8"	2-1/8"	2-13/16"
30°F	13/16"	1-11/16"	2-1/2"	3-3/8
35°F	1"	1-15/16"	2-15/16"	3-15/16"
40°F	1-1/8"	2-1/4"	3-3/8"	4-1/2"
45°F	1-1/4"	2-1/2"	3-13/16"	5-1/16"
50°F	1-3/8"	2-13/16"	4-3/16"	5-5/8"
55°F	1-9/16"	3-1/16"	4-5/8"	6-3/16"
60°F	1-11/16"	3-3/8"	5-1/16"	6-3/4"
65°F	1-13/16"	3-5/8"	5-1/2"	7-5/16"
70°F	1- 15/16"	3-15/16"	5- 7/8"	7-7/8"
Lengths in Feet	**360**	**720**	**1080**	**1440**

Figure Appendix C – 2 – CWR Expansion – 36' Rails

Number of 39' Rails

Temperature Differential	**9**	**18**	**27**	**37**
5°F	1/8"	1/4"	7/16"	9/16"
10°F	1/4"	9/16"	13/16"	1-1/8"
15°F	7/16"	13/16"	1-1/4"	1-11/16"
20°F	9/16"	1-1/16"	1-5/8"	2-1/4"
25°F	11/16"	1-3/8"	2-1/16"	2-13/16"
30°F	13/16"	1-5/8"	2-7/16"	3-3/8"
35°F	15/16"	1-15/16"	2-7/8"	3-15/16"
40°F	1-1/16"	2-3/16"	3-1/4"	4-1/2"
45°F	1-1/4"	2-7/16"	3-11/16"	5-1/16"
50°F	1-3/8"	2-3/4"	4-1/8"	5-5/8"
55°F	1-1/2"	3"	4-1/2"	6-3/16"
60°F	1-5/8"	3-1/4"	4-15/16"	6-3/4"
65°F	1-3/4"	3-9/16"	5-5/16"	7-5/16"
70°F	1- 15/16"	3-13/16"	5- 3/4"	7-7/8"
Lengths in Feet	**350**	**700**	**1050**	**1440**

Figure Appendix C – 3 – CWR Expansion – 39' Rails

Number of 80' Rails

Temperature Differential	4.5	9	13.5	18
5°F	1/8"	1/4"	7/16"	9/16"
10°F	1/4"	9/16"	13/16"	1-1/8"
15°F	7/16"	13/16"	1-1/4"	1-11/16"
20°F	9/16"	1-1/8"	1-11/16"	2-1/4"
25°F	11/16"	1-3/8"	2-1/8"	2-13/16"
30°F	13/16"	1-11/16"	2-1/2"	3-3/8"
35°F	1"	1-15/16"	2-15/16"	3-15/16"
40°F	1-1/8"	2-1/4"	3-3/8"	4-1/2"
45°F	1-1/4"	2-1/2"	3-13/16"	5-1/16"
50°F	1-3/8"	2-13/16"	4-3/16"	5-5/8"
55°F	1-9/16"	3-1/16"	4-5/8"	6-3/16"
60°F	1-11/16"	3-3/8"	5-1/16"	6-3/4"
65°F	1-13/16"	3-5/8"	5-1/2"	7-5/16"
70°F	1-15/16"	3-15/16"	5-7/8"	7-7/8"
Length in Feet	**360**	**720**	**1080**	**1440**

Figure Appendix C – 4 – CWR Expansion – 80' Rails

b) The formula for calculating rail expansion is as follows: AL = L(inches) x s T x e

Where

AL = rail expansion or contraction in inches

L = rail length in inches

AT = temperature differential in h F

and

e = coefficient of rail thermal expansion

c) For example, to find the expansion for 9 – 39-foot rails with a temperature difference of 5 F degrees, the formula would be: AL = 9 x 39' x 12" x 5 degrees x .0000065

This equals .140", which equates to 1/8" expansion.

TEMP. DIFF. °F from PRLT	CWR MOVEMENT CHART – INCHES												TEMP. DIFF. °F from PRLT
	100	125	150	175	200	225	250	275	300	325	350	375	
5	--	--	--	--	--	--	--	--	--	--	--	--	**5**
10	--	--	--	--	--	--	1/4	1/4	1/4	1/4	1/4	1/4	**10**
15	--	--	--	1/4	1/4	1/4	1/4	3/8	3/8	3/8	1/2	1/2	**15**
20	--	1/4	1/4	1/4	3/8	3/8	3/8	1/2	1/2	1/2	1/2	5/8	**20**
25	1/4	1/4	1/4	3/8	3/8	1/2	1/2	1/2	5/8	5/8	3/4	3/4	**25**
30	1/4	1/4	3/8	3/8	1/2	1/2	5/8	5/8	3/4	3/4	7/8	7/8	**30**
35	1/4	3/8	3/8	1/2	1/2	5/8	3/4	3/4	7/8	7/8	1	1	**35**
40	1/4	3/8	1/2	1/2	5/8	3/4	3/4	7/8	1	1	1-1/8	1-1/4	**40**
45	3/8	1/2	1/2	5/8	3/4	3/4	7/8	1	1-1/8	1-1/8	1-1/4	1-3/8	**45**
50	3/8	1/2	5/8	5/8	3/4	7/8	1	1-1/8	1-1/4	1-1/4	1-3/8	1-1/2	**50**
55	1/2	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-3/8	1-1/2	1-5/8	**55**
60	1/2	5/8	3/4	3/4	1	1-1/8	1-1/4	1-3/8	1-1/2	1-1/2	1-5/8	1-7/8	**60**
65	1/2	5/8	3/4	7/8	1	1-1/4	1-1/4	1-1/2	1-1/2	1-3/4	1-7/8	2	**65**
70	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2	1-5/8	1-7/8	2	2-1/8	**70**

MOVEMENT FORMULA – RAIL LENGTH (FEET) X TEMP. DIFF. °F FROM PRLT X 0.00008
PRLTR IS 85°F + 15°F = 100°F; EFFECTIVE JANUARY 1, 2026 PRLTR IS 90°F + 15°F = 105°F

TEMP. DIFF. °F from PRLT	CWR MOVEMENT CHART – INCHES												TEMP. DIFF. °F from PRLT
	400	500	600	700	800	900	1000	1100	1200	1300	1400	1600	
5	1/8	1/4	1/4	1/4	3/8	3/8	3/8	1/2	1/2	1/2	5/8	5/8	**5**
10	3/8	3/8	1/2	5/8	5/8	3/4	3/4	7/8	1	1	1-1/8	1-1/4	**10**
15	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2	1-5/8	1-5/8	1-7/8	**15**
20	5/8	3/4	1	1-1/8	1-1/4	1-1/2	1-5/8	1-3/4	1-7/8	2-1/8	2-1/4	2-5/8	**20**
25	3/4	1	1-1/4	1-3/8	1-5/8	1-3/4	2	2-1/4	2-3/8	2-5/8	2-7/8	3-1/4	**25**
30	1	1-1/4	1-1/2	1-3/4	1-7/8	2-1/8	2-3/8	2-5/8	2-7/8	3-1/8	3-3/8	3-7/8	**30**
35	1-1/8	1-3/8	1-3/4	2	2-1/4	2-1/2	2-7/8	3-1/8	3-3/8	3-5/8	4	4-1/2	**35**
40	1-1/4	1-5/8	1-7/8	2-1/4	2-5/8	2-7/8	3-1/4	3-1/2	3-7/8	4-1/8	4-1/2	5-1/8	**40**
45	1-1/2	1-3/4	2-1/8	2-1/2	2-7/8	3-1/4	3-5/8	4	4-3/8	4-3/4	5	5-3/4	**45**
50	1-5/8	2	2-3/8	2-7/8	3-1/4	3-5/8	4	4-3/8	4-7/8	5-1/4	5-5/8	6-1/2	**50**
55	1-3/4	2-1/4	2-5/8	3-1/8	3-1/2	4	4-3/8	4-7/8	5-1/4	5-3/4	6-1/4	7	**55**
60	1-7/8	2-3/8	2-7/8	3-3/8	3-7/8	4-3/8	4-7/8	5-1/4	5-3/4	6-1/4	6-3/4	7-5/8	**60**
65	2-1/8	2-5/8	3-1/8	3-5/8	4-1/8	4-3/4	5-1/4	5-3/4	6-1/4	6-3/4	7-1/4	8-3/8	**65**
70	2-1/4	2-3/4	3-3/8	3-7/8	4-1/2	5	5-5/8	6-1/4	6-3/4	7-1/4	7-7/8	9	**70**

MOVEMENT FORMULA – RAIL LENGTH (FEET) X TEMP. DIFF. °F FROM PRLT X 0.00008
PRLTR IS 85°F + 15°F = 100°F; EFFECTIVE JANUARY 1, 2026 PRLTR IS 90°F + 15°F = 105°F

Figure Appendix C – 5 – CWR Movement Charts

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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 an upcoming figure 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:

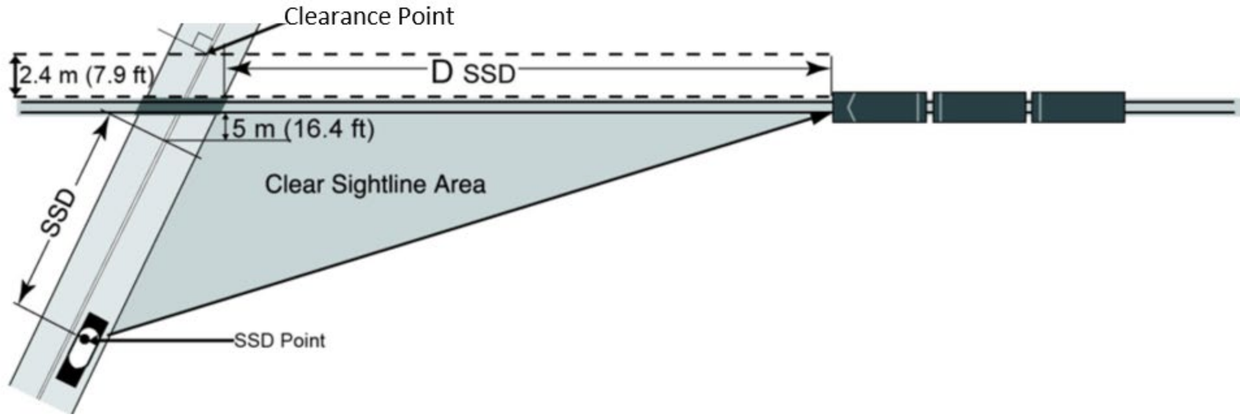
- Are aware of all factors affecting sightlines and ensure that any changes to these are relayed to either party immediately.

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 – SSD (0% Road Approach Gradient)		**Rail Traffic – D_{SSD}** (10 second T_{SSD})	
Maximum Vehicle Speed (km/h)	**Minimum Distance SSD metres** ***(feet)***	**Maximum Train Speed (MPH)**	**Minimum Distance D_{SSD} metres** ***(feet)***
Stop or Pedestrian	5 *(17)*	Stop	30 *(99)*
10 km/h	8 *(27)*	10 m/h	45 *(148)*
20 km/h	20 *(66)*	20 m/h	90 *(296)*
30 km/h	30 *(99)*	30 m/h	135 *(443)*
40 km/h	45 *(148)*	40 m/h	180 *(591)*
50 km/h	65 *(214)*	50 m/h	225 *(739)*
60 km/h	85 *(279)*	60 m/h	270 *(886)*
70 km/h	110 *(361)*	70 m/h	315 *(1034)*
80 km/h	140 *(460)*	80 m/h	360 *(1182)*
90 km/h	170 *(558)*	90 m/h	405 *(1329)*
100 km/h	210 *(689)*	100 m/h	450 *(1477)*
110 km/h	250 *(821)*		

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

To Establish Required Clear View Area

1. Use maximum allowable train and vehicle speeds.
2. View from 1.05m above road surface to 1.2 m above top of lowest rail.
3. Where road gradients and / or T_{SSD} differs from above, refer to Transport Canada's Grade Crossing Standards
4. 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.
5. SSD values provided as reference for when SSD is not provided by Road Authority.

ALWAYS REFER TO TRANSPORT CANADA'S GRADE CROSSING STANDARDS

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Appendix E. Temporary Speed Restrictions for Track Work

Temporary Speed Restrictions for Track Work				
Type of Work	**Temperature**	**TSO in CWR <u>without</u> Dynamic Stabilizer**	**TSO in CWR <u>with</u> Dynamic Stabilizer**	**TSO in Jointed Rail**
Rail Laying (Continuous (out-of-face))	Any	1 train at 10 mph then inspect, if ok, then, 1 train at 25 mph then inspect, if ok, then track speed	N/A	1 train at 25 mph then inspect, if ok, then track speed
Spot Tie Renewal Spot Surfacing Shoulder Cleaning	At or above PRLT *(85°F or greater)* *(Effective 2026-01-01 - 90°F or greater)*	2 trains at 25 mph then inspect, if ok, then track speed	N/A	1 train at 25 mph then inspect, if ok, then track speed
	Below PRLT *(less than 85°F)* *(Effective 2026-01-01 - less than 90°F)*	Inspect If ok, then track speed	N/A	Inspect If ok, then track speed
Mechanized Tie Renewal Continuous Surfacing *Turnout Replacement Ballast Cleaning / Undercutting Track Surfacing and Lining	At or above PRLT *(85°F or greater)* *(Effective 2026-01-01 - 90°F or greater)*	1 train at 10 mph, then inspect, if ok then, 10 trains at 25 mph, then inspect, if ok, then track speed	2 trains at 30 mph, then inspect, if ok then track speed.	1 train at 10 mph then inspect, if ok, 5 trains at 25 mph then inspect, if ok, then track speed
	Between PRLT and 40°F below the PRLT *(Between 45°F and 85°F)* *(Effective 2026-01-01 - between 50°F and 90°F)*	1 train at 10 mph, then inspect, if ok, then, 5 trains at 25 mph, then inspect, if ok, then track speed	Inspect, if ok then track speed.	1 train at 10 mph then inspect, if ok, 2 trains at 25 mph then inspect, if ok, then track speed
	40°F or more below the PRLT *(45°F or lower)* *(Effective 2026-01-01 - 50°F or lower)*	2 trains at 25 mph, then inspect If ok, then track speed	Inspect, if ok then track speed.	1 train at 25 mph then inspect, if ok, then track speed

Note 1: Train is defined as freight or a mixed train; Passenger trains are <u>not</u> to be counted for provisions of this table.
Note 2: Do not remove speed restrictions in the heat of the day.
Note 3: In the interpretation of Maximum Speed, the Timetable may dictate a more restrictive speed.
Note 4: Work performed to address an URGENT defect(s) must be inspected by Quality Assurance personnel, per Sub-Part C, Section 8 – URGENT Defects.
***Reminder:** If it is a newly constructed mainline, a Category 1 yard turnout, or a Special Track Work a 10 mph TSO applies until a **Detailed Turnout Inspection** has been completed, in addition to the required TSOs noted above.

Figure Appendix E – 1 – Temporary Speed Restrictions for Track Work

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Appendix F. Classes of Track

a) In the application of Track Safety Rules, the following Track Classifications apply;

Subdivision	From	To	Class
Temagami	0.0	138.5	3
Ramore	0.0	109.7	3
Kirkland Lake	0.0	60.0	3
Iroquois Falls	0.0	6.2	2
Devonshire	0.0	28.2	3
Island Falls	0.0	186.2	3
Kapuskasing	0.0	93.0	2
Kapuskasing	93.0	129.0	3
Agrium	0.0	17.0	3
Pagwa Spur	0.0	23.9	1

Figure Appendix F – 1 – Track Classes

****Always refer to your Timetable***

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Appendix G. Ontario's Industrial Operations Protocol on Fire Prevention and Suppression

a) Fire Suppression Equipment

If mechanical equipment is operating on the site, a serviceable fire extinguisher must be located on each piece of equipment or within 5 metres of it. The purpose of the fire extinguisher is to put out fires starting on the equipment itself.

Wildland fire suppression equipment may also be required on an operation. Unless deemed low risk, a backpack pump is required on or within 30 m of every piece of heavy machinery and at the location of any hot work. A serviceable pressurized water delivery system located on a machine can replace the requirement for a backpack pump. A backpack pump consists of a flexible or rigid container containing at least 18 litres of water with a short rubber hose and a single action hand pump to disperse the water. They must be immediately available to take quick action on a small fire while they can still be effective. Figure Appendix G – 1 identifies the number of backpack pumps that are required depending on the industrial operation or activity.

As the number of pieces of heavy machinery increases in the operation, additional fire suppression equipment may be required. Equipment caches, or units of fire equipment, must be stored in a central location within a 10 km radius of the operation(s) and available to be transported quickly to any worksite when a fire is detected. These equipment caches must consist of a minimum of a pumping unit (which includes intake and output hose, tools and gas) and at least 3 shovels and other fire suppression equipment that the industry may have in place. Figure Appendix G – 1 describes the fire suppression equipment required according to the operation. Staff must know how and where to access the equipment and how to use the equipment once at the worksite. The equipment must be checked on a regular basis to ensure that it is in working order.

Operation Type	Backpack Pump Requirements	Additional Suppression Equipment Requirements
10 or more pieces of heavy machinery being operated within a 10 km radius if no more than 5 are equipped with tire chains, metal tracks or skids.	1 per machine located on or within 30 metres of where the machine is being used, or 1 pressurized water delivery system per machine	1 fire equipment cache containing at least one pumping unit and 3 shovels
6 or more pieces of heavy machinery being operated within a 10 km radius equipped with tire chains, metal tracks or skids.	1 per machine located on or within 30 metres of where the machine is being used, or 1 pressurized water delivery system per machine	1 fire equipment cache containing at least one pumping unit and 3 shovels
Hot work	1 per hot work operation, located within 3 metres of the operation	None required
Rail cutting, welding or grinding, thermite welding, switch crossing grinding	1 per operation located within 3 metres of the operation	If fire intensity code is A, B or C, a water delivery system with a minimum of 90 gallons of water onsite
Rail production grinding	4 per grinding operation	A water delivery system with a minimum of 1000 gallons of water onsite

Figure Appendix G – 1 – Suppression Equipment Required by Operation

b) Fire Suppression Capabilities

Anyone working in a forest area that is expected to use fire suppression equipment must be trained to use that equipment. Operations that meet the "trained and capable" standard outlined below may qualify to work longer during higher fire danger periods and not have to modify their operations as often or as significantly, as they should be trained and capable to respond to any fires that start.

"Trained and Capable" operations must meet each of the following criteria:

1. **Prevention**: Implementation of an effective prevention program for the type of operation, as outlined in the fire plan.

2. **Suppression**: Fire suppression equipment onsite to meet the minimum requirements laid out in Table 1.

3. **Communication**: The ability to communicate and report fires immediately and to obtain updated information on the fire danger.

4. **Immediately** means two-way radio or telephone capabilities from the site to the company or local MNRF Fire Management Headquarters.

5. **Training**: A minimum 25% of all staff involved in industrial operations on the worksite must be trained and proficient to the MNRF SP105 standard if an equipment cache is not required or to the SP106 standard if an equipment cache is required.

- Industry will implement refresher training to ensure that their staff are proficient with the material covered within the SP105 and SP106 course.

Operations that do not meet all of the above criteria will be considered to be not trained and capable operations and their operations may be restricted more frequently as the fire danger increases.

c) Communications

Communication capabilities are essential to ensure an appropriate response to a wildfire, and to obtain the most current information for determining the requirement for operational modifications or mitigation efforts.

Ontario Northland staff must be able to contact the RTC office so they may contact the MNRF to report fires. This communications link must also function in both directions as MNRF staff may need to provide our personnel with updated hazard information or contact them to obtain additional information. While a direct link is preferred, in some cases, our field operations will have to communicate with MNRF through the RTC and vice versa. The fire plan clearly lays out the procedure along with pertinent phone numbers and contact names.

Our "Fire Plan" is updated and distributed across the system each year prior to the start of each fire season. It is also available through your SharePoint ('OneDrive').

d) Determining Modifications and Mitigations to Industrial Operations

When the worksites are snow free, our must be modified, or mitigation steps taken as fire danger increases to reduce the risk of igniting a wildland fire. The steps in determining when and how operations should be modified or mitigated by considering the fire hazard and risk of ignition from the operations include:

1. **Determine the Fire Risk Category (Appendix G (e))** of the operations being conducted.

2. **Consider Mitigation of Operations to Lower the Fire Risk Category**.

3. **Determine the Forest Fire Fuel Group** at the worksite.

4. **Determine the Fire Intensity Code** for the next day.

5. **Determine the Operational Modifications** for the next day.

The following provide details and background information regarding each of these steps.

A field guide to the industrial operations protocol is available from your supervisor and contains the tables and charts required for daily interpretation and application of the protocol in the field.

e) Determine the Fire Risk Category of the Operation

Operations are categorized into four levels of operational risk:

- Very High Fire Risk Operations
- High Fire Risk Operations
- Moderate Fire Risk Operations
- Low Fire Risk Operations

The fire risk categories are based on the potential for the operation to create a spark (e.g., presence of stones or bedrock when using heavy machinery equipped with metal parts that may come in contact with the stones), or other sources of ignition (e.g., hot work).

Operational modifications (i.e., restrictions on hours of work) are not required for low fire risk operations unless extreme fire danger or a wildland fire event requires forest closure or an Emergency Area Order restricting access to some areas of the forest.

Figures Appendix G – 2 and 3 outline the fire risk for common industrial operations on sites with surface stoniness of <15% and >15% respectively. If the operation in question is not included in Figures Appendix G – 1, 2 and 3, you are to contact the Manager, Standards Compliance and Training, your supervisor or you may contact the local Fire Management Supervisor (FMS) for advice in determining the fire risk category of that operation.

Any operation working exclusively on mineral soil, clay or gravel (e.g., on roads and landings, where there is no continuous fuel component) is classified as low risk.

However, in the case of hot work, there must be no forest fuel or other continuous flammable material within eleven metres of the hot work operation.

Operation - <15% Stoniness	Risk Category
▪ Hot work: welding, torch or saw cutting of metal and grinding, operations involving open flame ▪ Thermite welding ▪ Rail production grinding ▪ Switch crossing grinding ▪ Operation that uses heavy machinery equipped with metal parts that may come into contact with rocks or similar material in the normal course of operation and cause a spark, e.g., equipment with tire chains or metal tracks or skids such as rubber-tired skidders with chains, bulldozers or drill rigs; machines with rotary cutting heads; mechanized site preparation; mechanical tending with chain flails and mowers; hydro-axe ▪ Geophysical surveys using a power generator (e.g., induced polarization)	High Fire Risk Operations
▪ Blasting without mats ▪ Delimbing, slashing felled trees with heavy machinery ▪ Slash piling ▪ Using a portable sawmill ▪ Stripping of the forest floor and surface vegetation with heavy machinery ▪ Any drilling operation that does not use water as a coolant/flushing agent and where the area has not been cleared of the forest floor and surface vegetation.	Moderate Fire Risk Operations
▪ Building, spreading and shaping sub-grade with a backhoe or excavator ▪ Graveling/grading roads ▪ Bulldozer flattening of sub grade (mineral soil) ▪ Stream work: water crossing installation/ repairs, bridge work, stream rehabilitation ▪ Portable chipping ▪ Loading wood or gravel and hauling ▪ Using chainsaws or brush saws ▪ Blasting with mats ▪ Using all-terrain vehicles (wheels or rubber tracked) ▪ Using heavy machinery with rubber tires (no chains) ▪ Manual industrial operations (e.g., tree planting and tending, claim staking, line locating, surveying and manual stripping) ▪ Pitting and trenching with mechanical equipment, including the use of a channel saw, where the forest floor and surface vegetation has been removed for at least 3 metres from the site. ▪ Any drilling operation that uses water as a coolant/flushing agent or is carried out where the area has been cleared of the forest floor and surface vegetation The following railway operations: ▪ Surfacing, tie installation, under-cutting, gauging, spiking, gophering	Low Fire Risk Operations

Figure Appendix G – 2 – Fire Risk Categories / Surface Stoniness Less Than 15%

Operation - >15% Stoniness	Risk Category
▪ Operation that uses heavy machinery equipped with metal parts that may come into contact with rocks or similar material in the normal course of operation and cause a spark, e.g., equipment with tire chains or metal tracks or skids such as rubber-tired skidders with chains, bulldozers or drill rigs; machines with rotary cutting heads; mechanized site preparation; mechanical tending with chain flails and mowers; hydro-axe ▪ Stripping of the forest floor and surface vegetation with heavy machinery	Very High Fire Risk Operations
▪ Hot work: welding, torch or saw cutting of metal and grinding, operations involving open flame ▪ Thermite welding ▪ Rail production grinding ▪ Switch crossing grinding ▪ Blasting without mats ▪ Operations using a channel saw where the forest floor and surface vegetation has not been removed to a distance of at least 3 metres. ▪ Geophysical surveys using a power generator (e.g., induced polarization)	High Fire Risk Operations
▪ Delimbing or slashing with heavy machinery ▪ Portable sawmills ▪ Slash piling ▪ Building, spreading and shaping sub-grade with backhoe/excavator ▪ Operations using 3 or more brush saws ▪ Using heavy machinery with rubber tires (no chains) (e.g., forwarders, skidders) ▪ Drilling operations that do not use water as a coolant / flushing agent and where the area has not been cleared of the forest floor and surface vegetation	Moderate Fire Risk Operations
▪ Graveling/grading roads ▪ Bulldozer flattening of sub grade (mineral soil) ▪ Stream work: water crossing installation/ repairs, bridge work, stream rehabilitation ▪ Portable chipping ▪ Loading wood or gravel and hauling ▪ Operation using chain saws and/or no more than 2 brush saws ▪ Blasting with mats ▪ Using all-terrain vehicles (wheels or rubber tracked) ▪ Manual industrial operations (e.g., tree planting, claim staking, line locating, surveying, manual stripping) ▪ Pitting and trenching with mechanical equipment, including the use of a channel saw, where the forest floor and surface vegetation has been removed for at least 3 metres from the site. ▪ Any drilling operation that uses water as a coolant/flushing agent or where the area has been cleared of the forest floor and surface vegetation The following railway operations: ▪ Surfacing, tie installation, under-cutting, gauging, spiking, gophering	Low Fire Risk Operations

Figure Appendix G – 3 – Fire Risk Categories / Surface Stoniness Greater Than 15%

f) <u>Mitigation of Operations to Lower Fire Risk Category</u>
Certain measures can be taken to lower the fire risk of some operations. These will typically only be taken on operations where the worksite is very small as presoaking large areas is likely not cost effective.

During periods of elevated fire danger, some high or very high-risk operations, which occur on localized areas, can be conducted safely by mitigating the immediate worksite/work area to minimize the chance of causing a wildland fire. Mitigating the worksite can be done in a number of ways including removing flammable material in the area, modifying the flammable material so that it is no longer flammable (e.g., soaking with water/foam) or shielding the flammable material from sparks and other potential ignition sources. Another key part of mitigation is the organized patrolling of the area after the operation is complete while having immediate access to suppression equipment and a means of reporting any fires that are discovered.

The following mitigation activities will allow the fire risk category of operations other than hot work, rail production grinding and switch crossing grinding to be rated two fire risk categories lower (e.g., very high risk becomes moderate risk, high and moderate risk becomes low) before operational modifications are applied:

- Soak the operational area with water or a fire suppression foam mixture using backpack pumps or another water delivery system prior to commencing the operation.
- Keep the operational area in a wet condition during the operation.
- Assign at least one person to monitor the area during the operation to watch for possible fire ignitions and to take action on any fires that do ignite.
- After operations are complete, soak the operational area with water or a fire suppression foam mixture using backpack pumps or another water delivery system.
- Actively patrol the area for at least one hour after the operation has concluded. If a fire is discovered, notify RTC / MNRF and, if it safe to do so, extinguish any fires that are found.
- Ensure individuals monitoring the area or conducting patrols have the ability to immediately report a fire to RTC / MNRF and do so.

In addition to the measures described above, hot work, rail production grinding and switch crossing grinding also require the use of non-combustible shields designed to catch any and all material capable of igniting a fire. Taking all of these precautions will result in hot work, rail production grinding and switch crossing grinding being considered a moderate fire risk category operation.

It may be beneficial to plan to mitigate some operations because operations that are categorized as, or mitigated to, low risk do not require a fire prevention and preparedness plan, are not required to modify hours of work and do not require any additional fire suppression equipment. However, we must ensure that operations that require mitigation to categorize them as low risk fire operations must be mitigated or the requirements for our fire prevention and preparedness plan, fire suppression equipment and operational modifications apply.

g) Determine the Forest Fire Fuel Group

Fire danger is a general term used to describe the potential for wildland fires to start and spread. It is in part determined by the physical characteristics of the wildland fuels. The classification of wildland areas into general "forest fire fuel groups" is based on site characteristics and provides an initial indication of the potential fire behaviour, should a fire ignite.

Five forest fuel groups (Figure Appendix G – 4) have been developed using information from the 16 benchmark fuel types defined within the Canadian Forest Fire Behaviour Prediction (CFFBP) System. These fuel groups are used to classify the work area that will be operated on each day/shift at the forest stand or site level. The fuel group is determined by observing the nature of the stand/site, such as the amount and condition of conifer/deciduous vegetation, presence of understory vegetation, ladder fuels, etc. Site-specific forest fire fuel groups are determined using the forest fire fuel group decision keys found in your field guide or in Appendix C in the [Industrial Operations Protocol on the Ontario MNRF website].

Fuel Group	Hazard Level	Description of Vegetation
1	Very Low	Deciduous species and live grass-dominated stands
2	Low	Deciduous dominated mixed woods (<35% conifer), spruce-lichen woodlands, mature red and white pine, conifer on peat/organic soils
3	Moderate	Mixed woods (35-64% conifer), mature jack pine and self-thinned and pruned spruce
4	High	Mature upland boreal spruce without conifer understory, conifer plantations and mixed wood stands with >64% conifer
5	Very High	Mature upland boreal spruce with conifer understory, natural immature conifer stands, mixed wood stands with dead balsam fir, cured grass and slash-dominated sites

Figure Appendix G – 4 – Forest Fire Fuel Group Descriptions

If the work area is made up of more than one fuel group, use the highest fuel group that represents at least 20% of the work area. (e.g., work area is made up of 25% fuel group 2, 50% fuel group 3 and 25% fuel group 4 – use forest fire fuel group 4 to determine modifications). Alternatively, the modifications can be determined for each fuel group and applied to each fuel group area as the operation progresses through them.

Seasonal Conditions Adjustment to Fuel Group

Seasonal conditions, spring (leaf-off) and summer (leaf-on), also play a role in determining the appropriate fuel group to use (e.g. determining the fuel group to be a higher or lower hazard). Use the latest MNRF "*Industrial Fire Intensity Code Report*" available on the Ontario government internet at http://www.ontario.ca/environment-and-energy/fire-intensity-codes , to determine if the weather station representing the worksite area is in leaf off (spring) or leaf on (summer) conditions, or contact the local Fire Management Headquarters.

Site specific keys (found in your field guide or in Appendix C in the [Industrial Operations Protocol on the Ontario MNRF website](#)) provides a number of decision keys to determine the appropriate forest fire fuel group to use. They provide for applicable adjustments (+1/-1) to raise or lower the forest fire fuel group based on seasonal conditions and understory plants to determine the final fuel group.

h) Determine the Fire Intensity Code

Another important factor in determining fire danger is weather, which in combination with wildland fuel type determines the ease of ignition, rate of spread, and difficulty of control of a wildland fire. This protocol uses the Fire Intensity Code (FIC) as the key indicator of rate of spread and difficulty of control and therefore overall danger if a wildland fire should start. Fire intensity is directly related to suppression difficulty and the need to prevent and extinguish fires as soon as possible.

The fire intensity codes range from A (highest), through to E (lowest).

Fire Intensity Code	Level of Fire Danger	Fire Type (fire characteristics) (Typical suppression tools and tactics)
A	Extreme Fire Danger	Continuous crown fire, medium to long range spotting, major fire runs possible • Indirect attack and burn-out operations
B	Very High Fire Danger	Intermittent and continuous crowning • Indirect attack and burn-out operations
C	High Fire Danger	Intermittent crown fire with spotting • Pumps on flanks, air tankers/ bucketing on head
D	Moderate Fire Danger	Surface fire with torching • Pumps and hose with air support (bucketing or tankers)
E	Low Fire Danger	Smouldering and creeping • Hand tools and backpack pumps

Figure Appendix G – 5 – Fire Intensity Code Relation to Potential Head Fire Intensity and Suppression Capability

The available report shows each MNRF weather station, whether the area is considered in leaf on or leaf off conditions and the calculated fire intensity code for each fuel group. The MNRF will normally publish the Fire Intensity Code reports by 4 pm EDT by the following methods:

- **Internet**: http://www.ontario.ca/environment-and-energy/fire-intensity-codes
- **Telephone**: Fire Management Headquarters in each MNRF district will provide a recorded telephone message containing the Fire Intensity Codes by fuel group and weather station. The following link will provide contact information for the Fire Management Headquarters across the fire region. http://www.ontario.ca/page/fire-management-offices

These codes are distributed across the system during the fire season, in addition, the fire indices contact the weather station applicable to the mileage operations are taking place as it relates to the fuel group. It is the responsibility of staff to know the fire intensity codes for the weather stations used by each worksite daily. If the fire intensity code report is not available, the local Fire Management Headquarters must be contacted to obtain the fire intensity codes.

i) Determining Operational Modifications

Fire Risk Category	Fire Intensity Code	Work Modifications **Not** Trained **and / or** **Not** Capable	Work Modifications Trained **and** Capable
Very High-Risk Operation	A	SD	SD
	B	SD	RS
	C	SD	SS
	D	P	P
	E	P	P
High Risk Operation	A	SD	RS
	B	SD	SS
	C	SS	P
	D	P	P
	E	P	P
Moderate Risk Operation	A	SD	SS
	B	SS	SS
	C	P	P
	D	P	P
	E	P	P
Low Risk Operation	A, B, C, D & E	P	P

Figure Appendix G – 6 – Fire Intensity Codes and Work Modifications per Risk

P = Prevention (Normal Operations)
Wildfire prevention is a part of normal operations and at a minimum, the requirements identified in the Forest Fires Prevention Act and Outdoor Fires Regulation must be followed. These should be identified in the operation's fire plan if one is required.

SS = Short Shift
Operations are not permitted between 1200 and 1900 hrs local daylight savings time. Prevention measures still apply and a dedicated patrol* of the area must be carried out for one hour after operations shut down. Workers conducting the dedicated patrol must immediately report fires that are detected.

RS = Restricted Shift
Operations are not permitted between 0800 and 2200 hrs local daylight savings time. Prevention measures still apply and a dedicated patrol* of the area must be carried out for one hour after operations shut down. Workers conducting the dedicated patrol must immediately report fires that are detected. Water sources close to operations should be identified prior to commencing any operations.

SD = Shutdown
Operations are not permitted starting at 0600 hrs local daylight savings time on the first day of shutdown. Operations will remain suspended until conditions change, and Prevention, Short Shift or Restricted Shift is indicated. Prevention measures still apply and a dedicated patrol* of the area must be carried out for one hour after operations cease. Workers conducting the dedicated patrol must immediately report fires that are detected. Once this initial patrol is complete, lower risk operations working in the vicinity can offer dedicated fire patrols during the shutdown period.

*Personnel assigned to patrol a worksite are expected to move as much as required to continually assess the entire worksite for fires. If a fire is discovered, they are required to first notify RTC / MNRF of the fire and its location and then, if it is safe to do so, try to extinguish the fire.

Appendix H. Standard Signs

General Instructions

a) Track signs and posts must be installed and maintained in accordance with standard plans and special instructions.

b) All signs shall be located and erected in the manner that will afford the most advantageous view from an approaching train, vehicle or pedestrian.

c) Unless otherwise indicated in the description of location and erection;

   i. All signs shall be erected at right angles to the track which they govern.

   ii. All signs shall be erected 10 feet from the gauge side of the nearest rail to the right of the track as viewed from an approaching train. If site conditions do not permit location of sign as per above, sign may be located no closer than 10 feet nor farther than 25 feet from the gauge side of the nearest rail. In restricted side clearance areas, the signs shall be erected 6 feet from gauge side of the nearest rail.

d) All signs shall be at a minimum of 8 feet from top of rail to the centre line of the lowest sign of the post.

e) All signs shall be mounted on the standard "U" post for track signs, unless otherwise specified.

f) All post must penetrate the ground a minimum of 4 feet.

Block Signal 1 Mile Signs are to have letters in black on white background

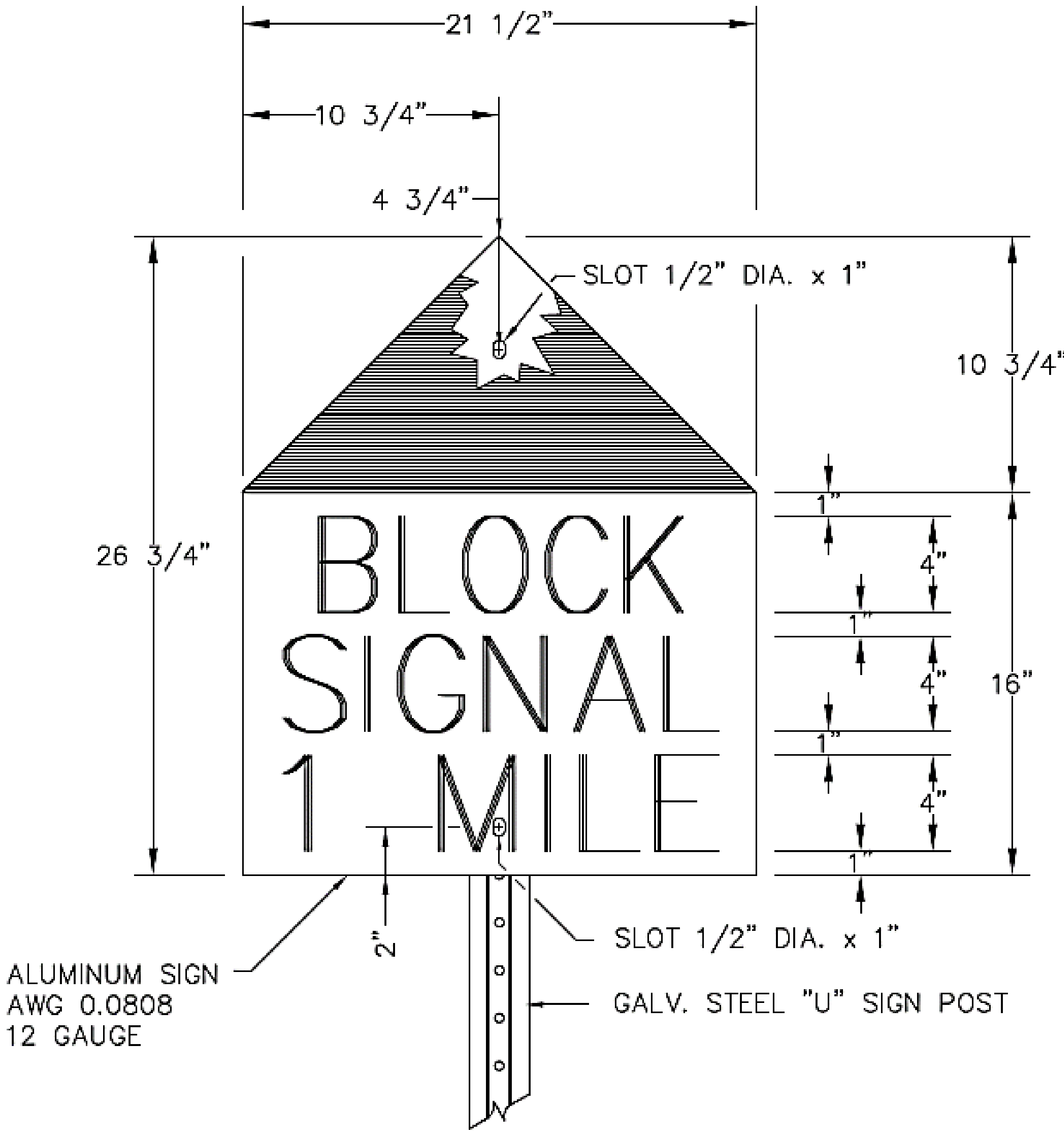
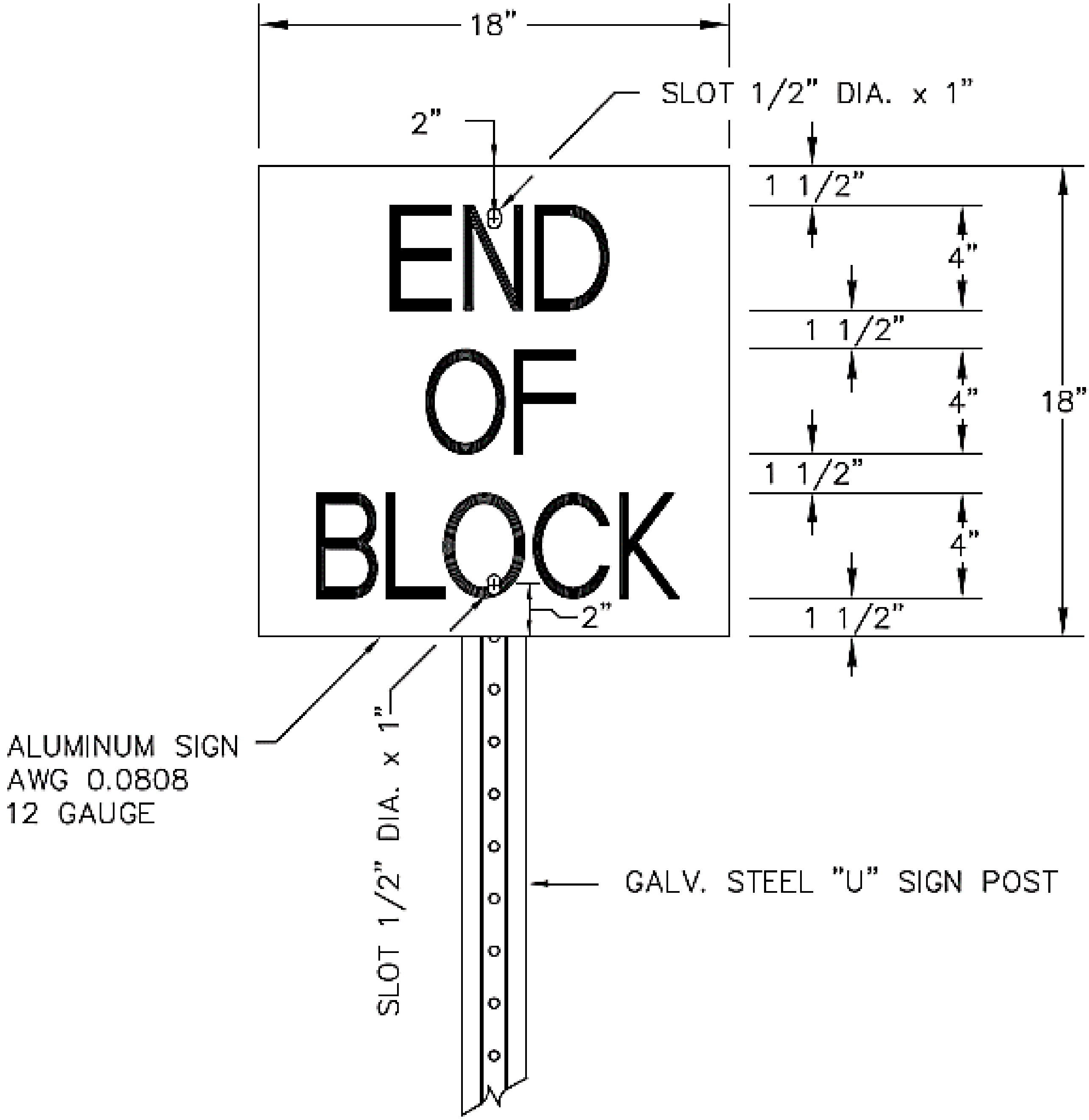
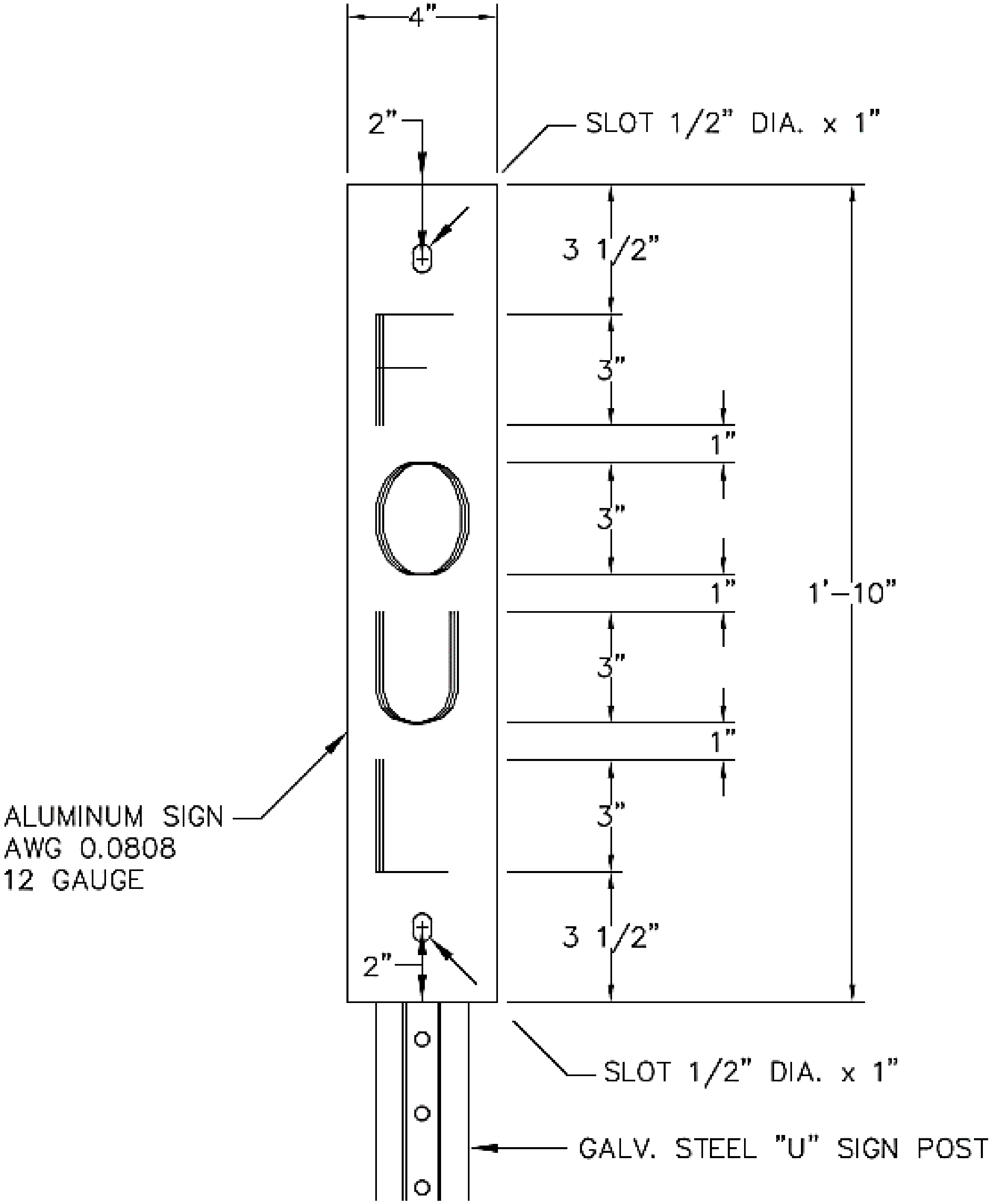


Figure Appendix H – 1 – Block Signal 1 Mile Signs



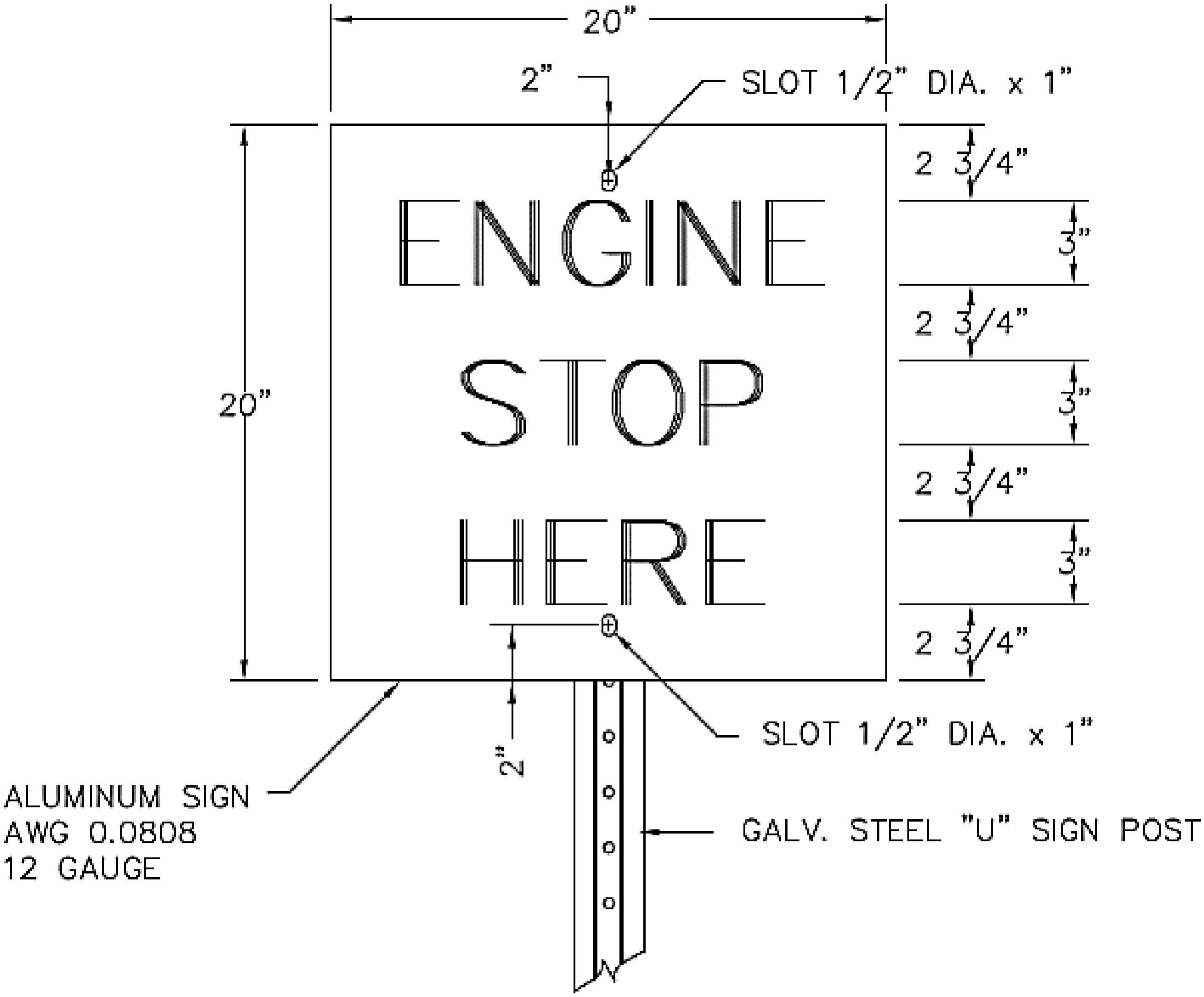
<u>End of Block Signs</u> are to have letters in black on white background

Figure Appendix H – 2 – End of Block Signs



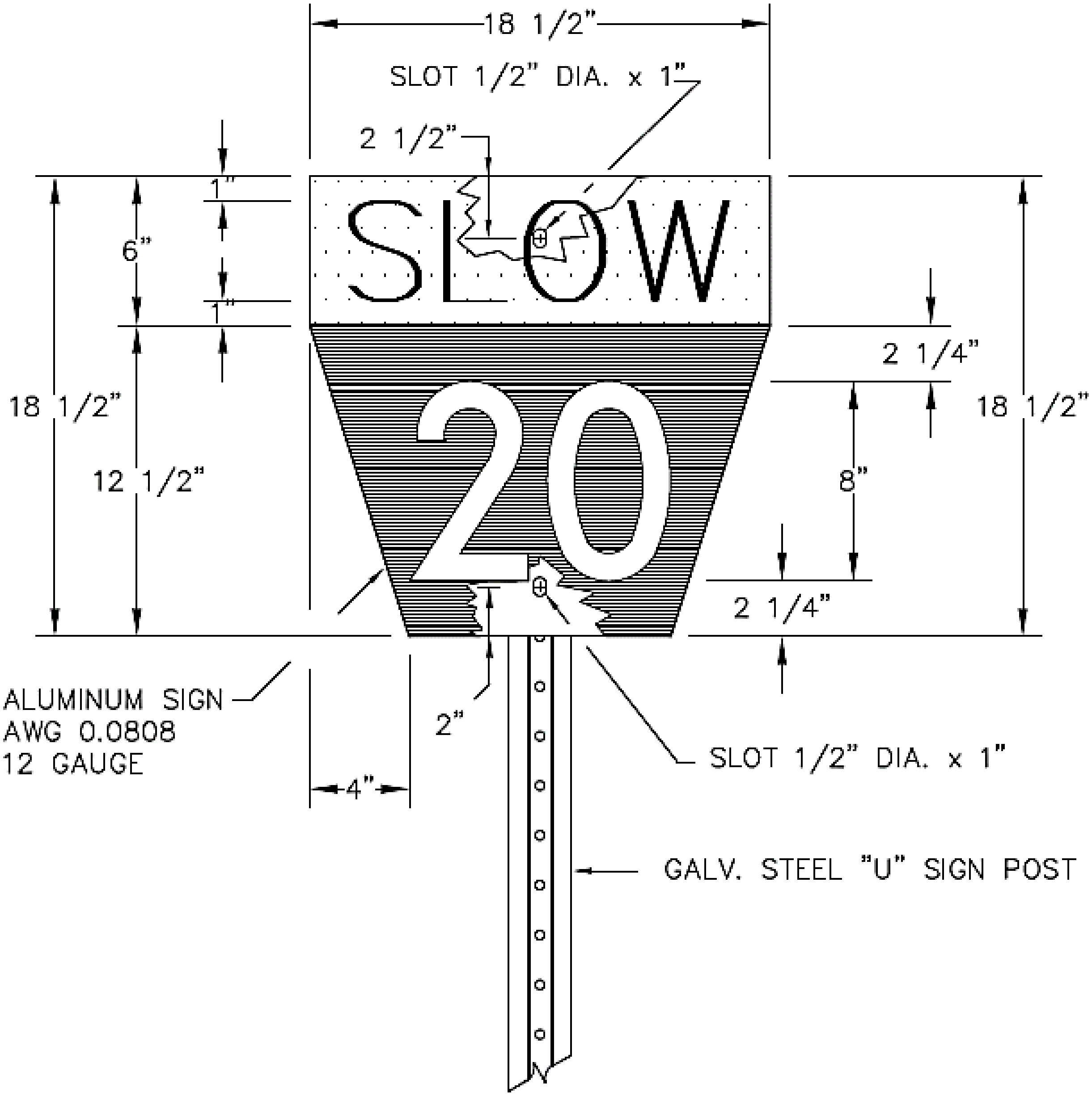
Foul Signs are to have letters in black on white background and located opposite the insulated joint and / or immediately beyond the clearance point of the siding.

Figure Appendix H – 3 – Foul Signs



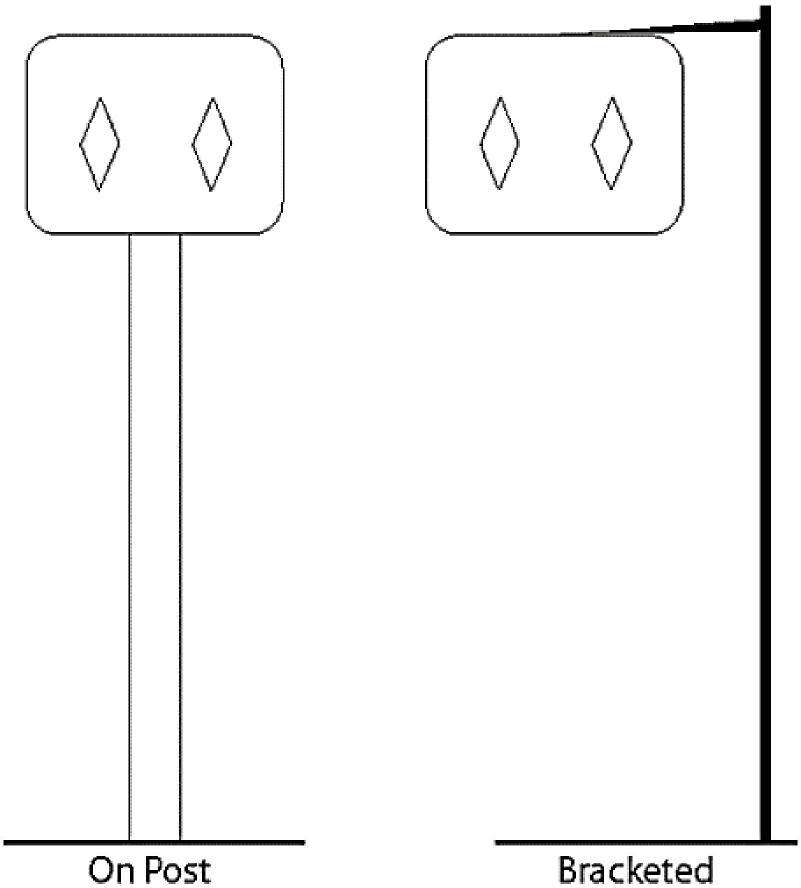
<u>Engine Stop Here Signs</u> are to have letters in black on white background and located on the center line of track behind the stop block or bumping post authorized by the Superintendent, Maintenance of Way

Figure Appendix H – 4 – Engine Stop Here Signs



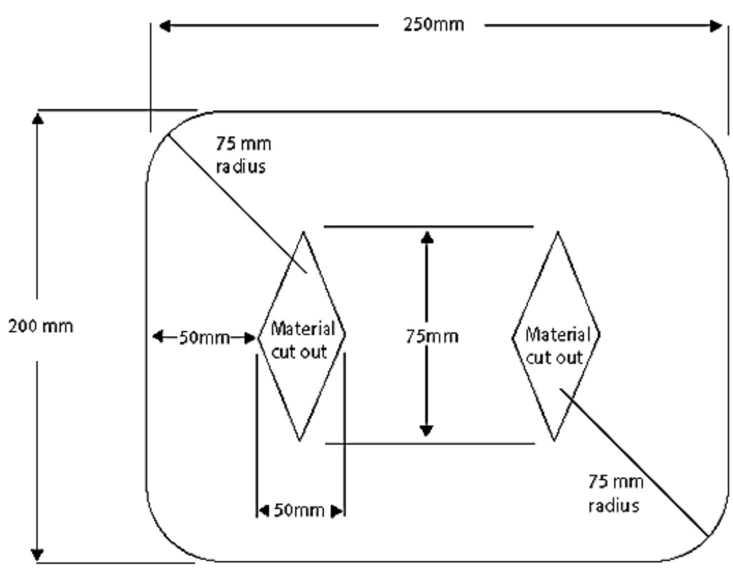
__**Slow Order Signs**__ are to have letters in black on yellow background and numbers will be white on black background

Figure Appendix H – 5 – Slow Order Signs



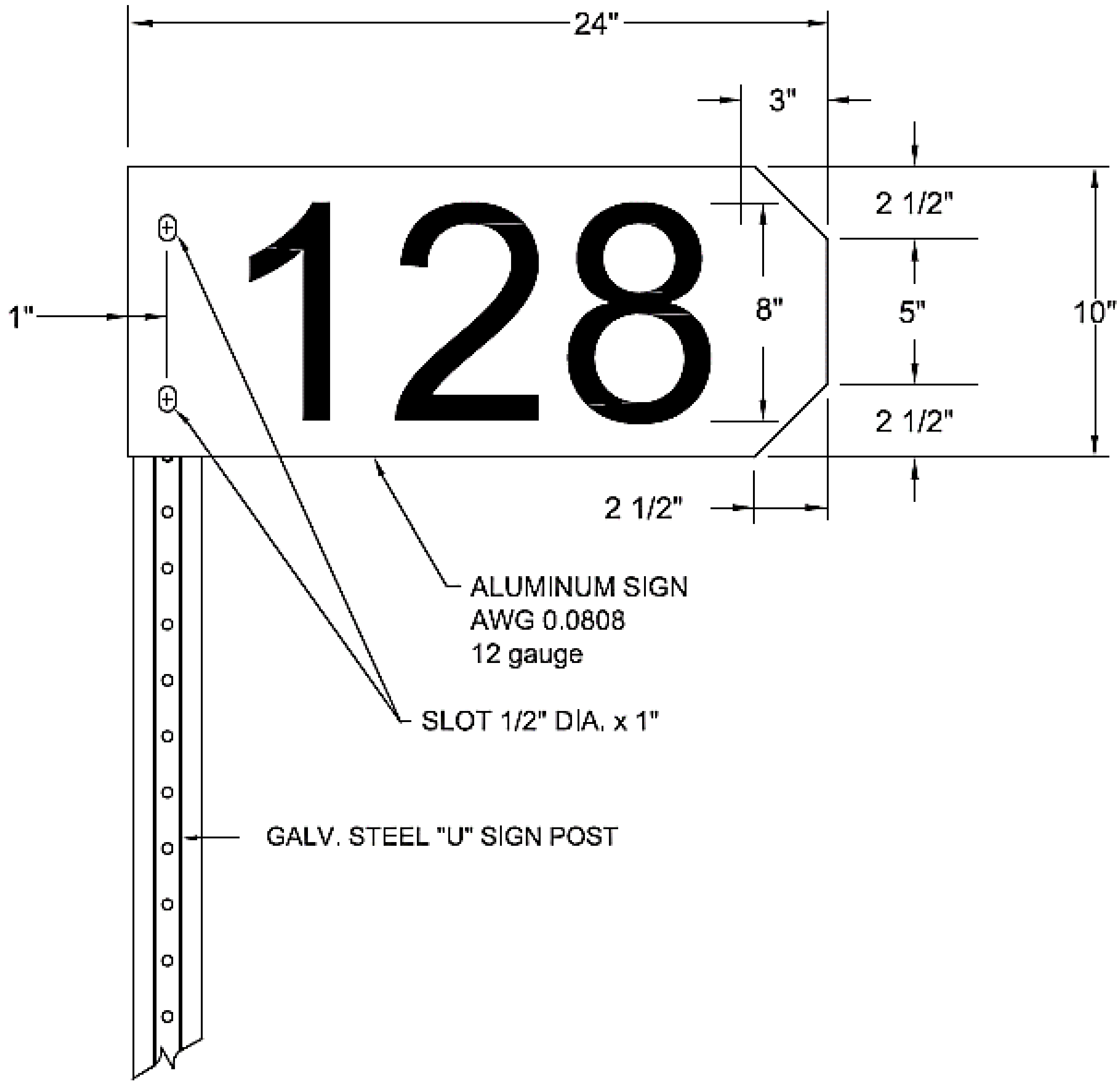
<u>Restricted Clearance Signs</u> are to be located as directed by the Superintendent Maintenance of Way. Where space does not permit installation of a conventional post, a bracket may be used to mount the sign on an adjacent building or structure.

At locations that have less than standard clearances and approved by the Director, Rail Infrastructure a *"Restricted Clearance Sign"* is to be erected.



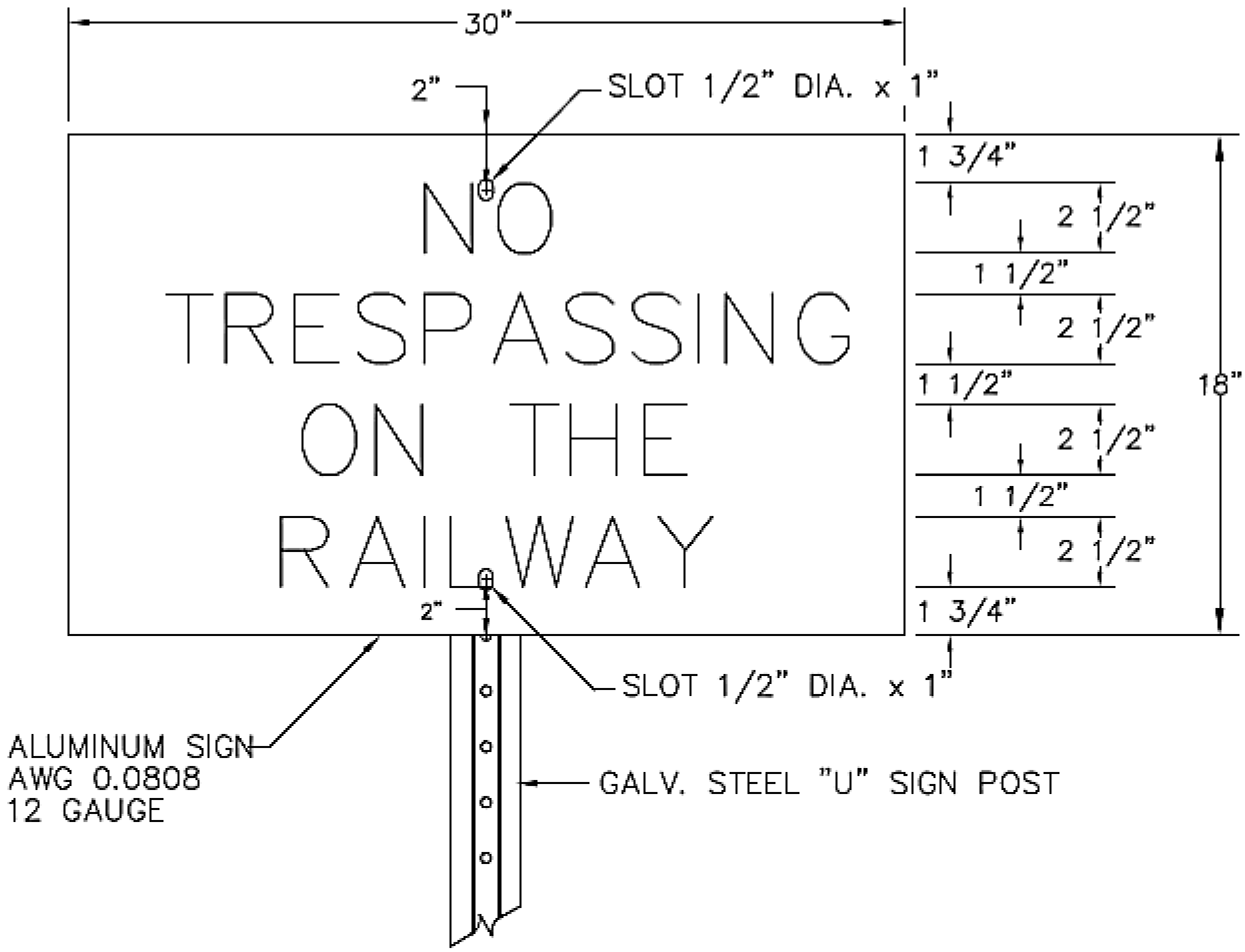
- Reflecting Material Specifications: 62-GP-11M
- Reflectivity: Level 1
- Sheeting Material: Reflective yellow sheeting to cover the entire surface

Figure Appendix H – 6 – Standard Restricted Clearance Signs



Mile Board Signs are to have letters in black on white background, both sides and are to be located opposite the mile point they represent. Signposts are to be erected at a minimum distance of 20 feet from centre line of track.

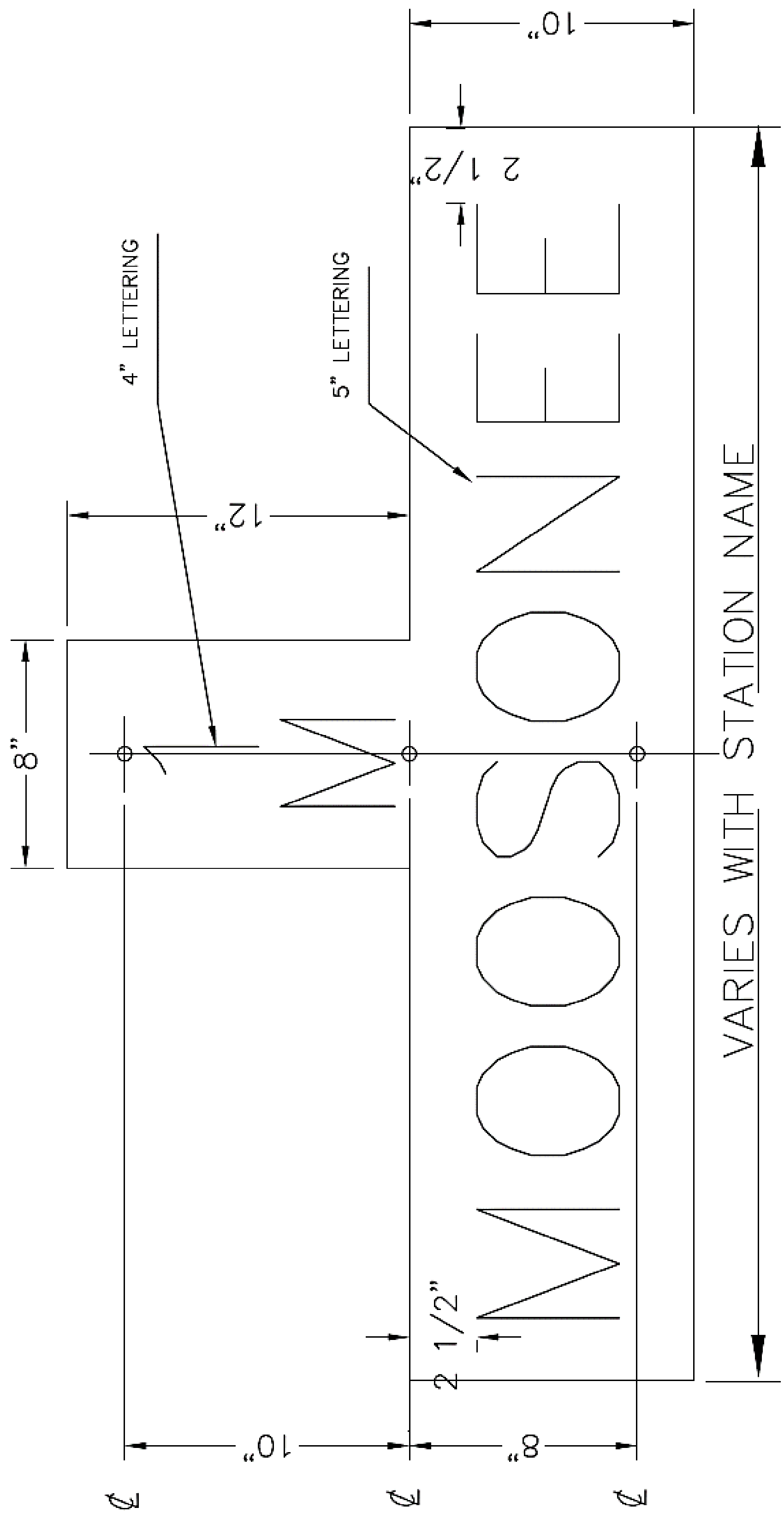
Figure Appendix H – 7 – Mile Board Signs



No Trespassing on the Railway Signs are to have letters in black on white background and erected as authorized by the Superintendent, Maintenance of Way. When erected at grade crossings, signs shall be located 25' from the gauge side of the nearest rail and 5' from the road right of way limits. At other locations, signs shall be erected a minimum of 25' from the gauge side of the nearest rail in a location that gives the best view to approaching trespassers and does not interfere with existing signs. Signs shall be erected on standard "U" post for track signs.

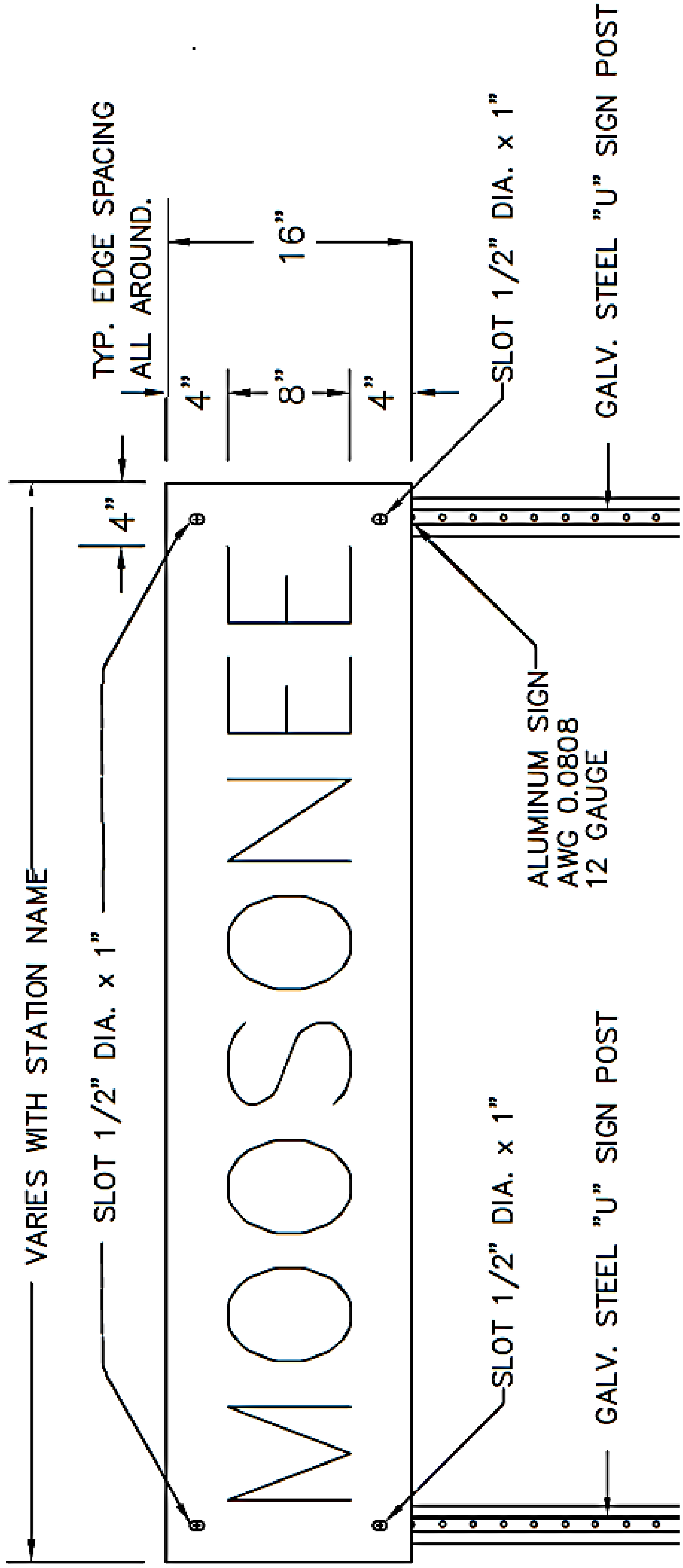
"NO TRESPASSING ON THE RAILWAY PROPERTY" wording is also acceptable.

Figure Appendix H – 8 – No Trespassing on the Railway Signs



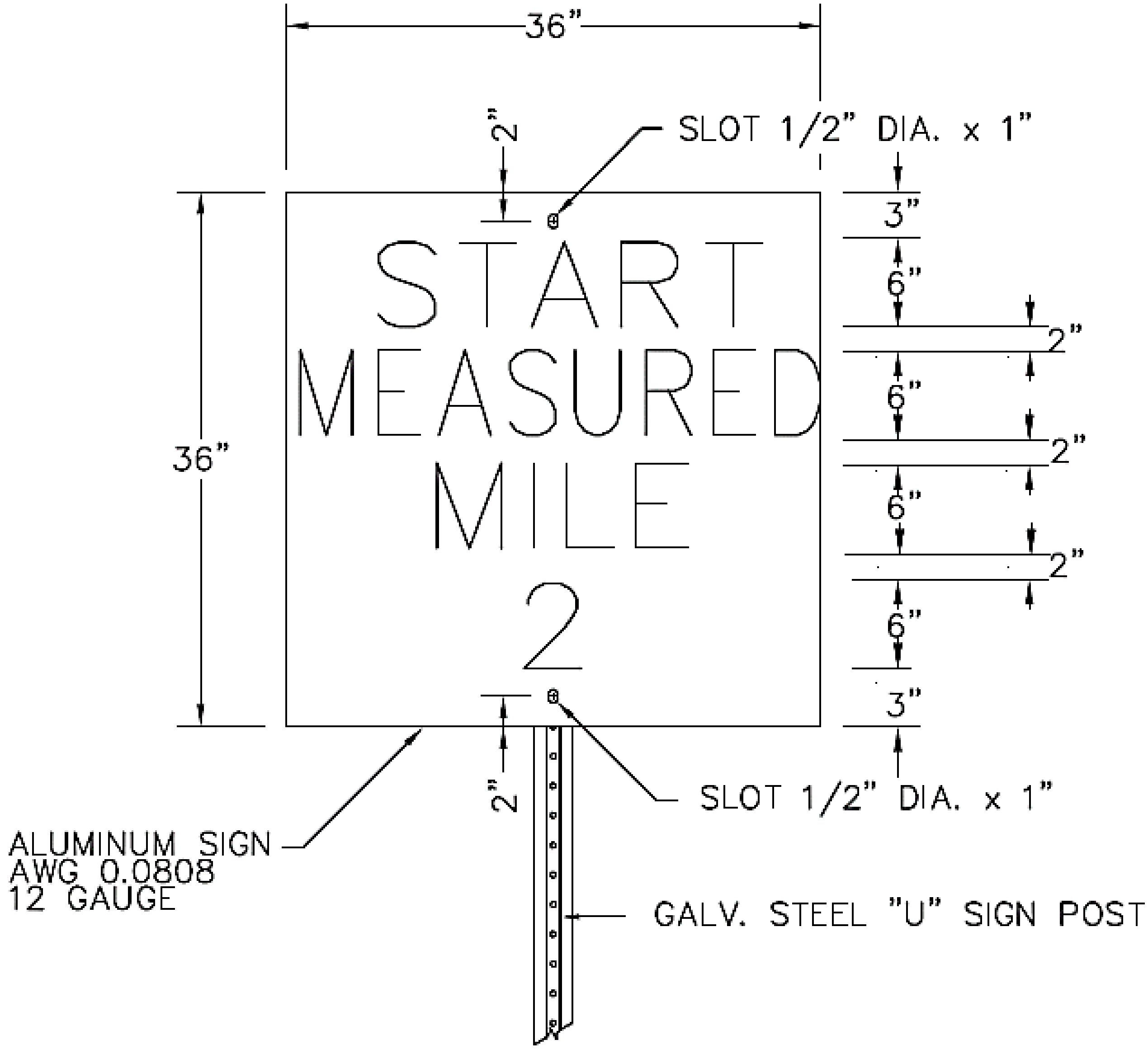
<u>1 Mile Station Signs</u> are to have black lettering on a white background on a corrugated metal post (C/W ½" diameter holes at 2" O/C)

Figure Appendix H – 9 – 1 Mile Station Signs



Station Signs are to have black lettering on a white background. Installed at the station location or center of siding.

Figure Appendix H – 10 – Station Signs



<u>Start Measured Mile Signs</u> are to have black lettering on a white background.

Figure Appendix H – 11 – Start Measured Mile Signs

<u>High Water Detector Signs</u> are to have black lettering on a white background.

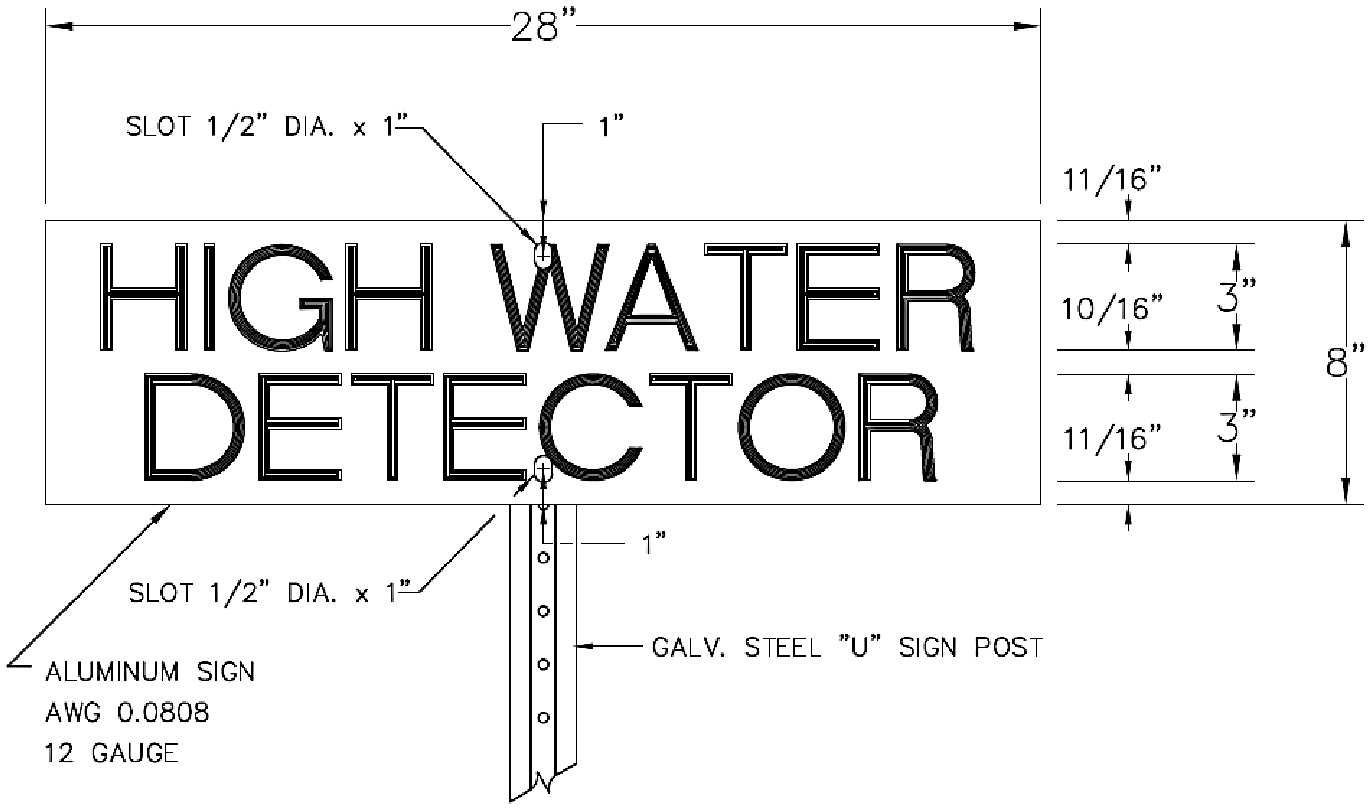


Figure Appendix H – 12 – High Water Detector Signs

Battery Well Signs are to have black lettering on a yellow background. These indicate the location of the buried enclosure that houses primary cells for track circuits.

Width – 8”
Height – 30”
Lettering – 2” Height

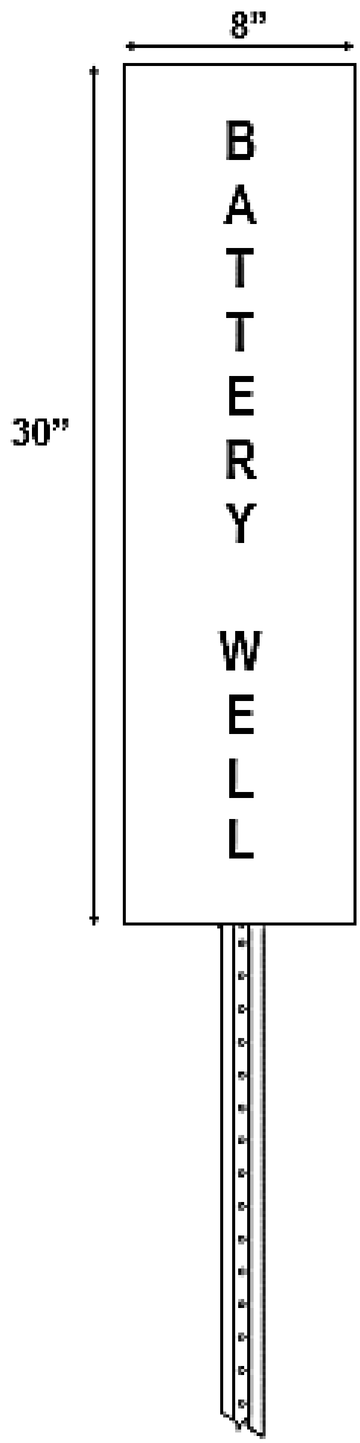


Figure Appendix H – 13 – Battery Well Sign

<u>Circuit Start Signs</u> indicates start of track circuit controlling Automatic Warning Devices or Interlocking Signal

All signs shall be black letters on white background. Dimensions: 8” wide x 30” high. Letters are 1-3/4” tall, bold type.

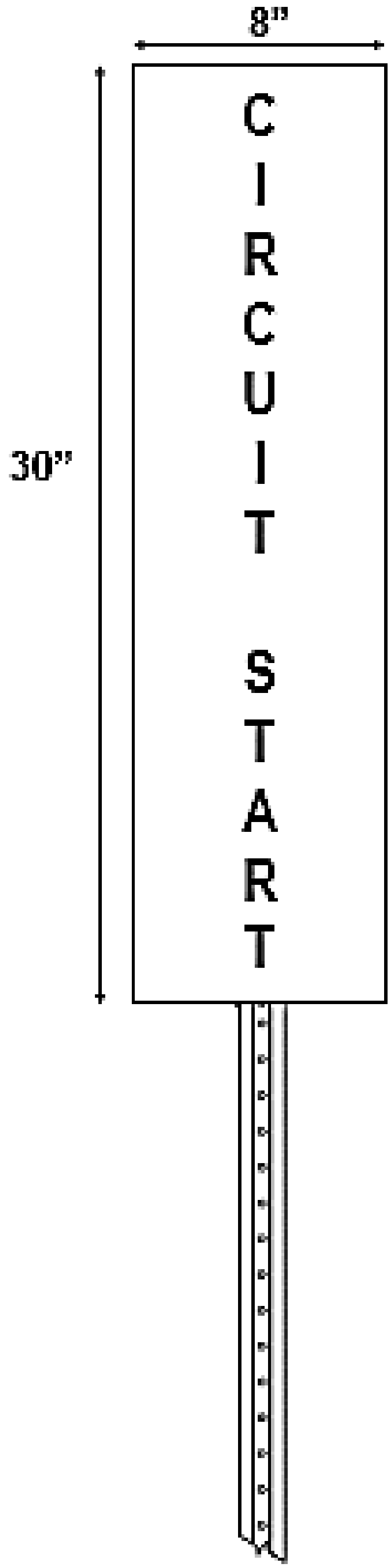


Figure Appendix H – 14 – Circuit Start Sign

Whistle and Bell Signs are to be located 1/4 mile (1,320') in advance of all public crossing at grade; and blind curves only as directed by the Directors of Transportation and Infrastructure (with a copy to the VP Rail). Signs to be placed to the engineman's side of track of an approaching train, a minimum of 9 feet from the gauge side of the nearest rail. Letters will be black on white background.

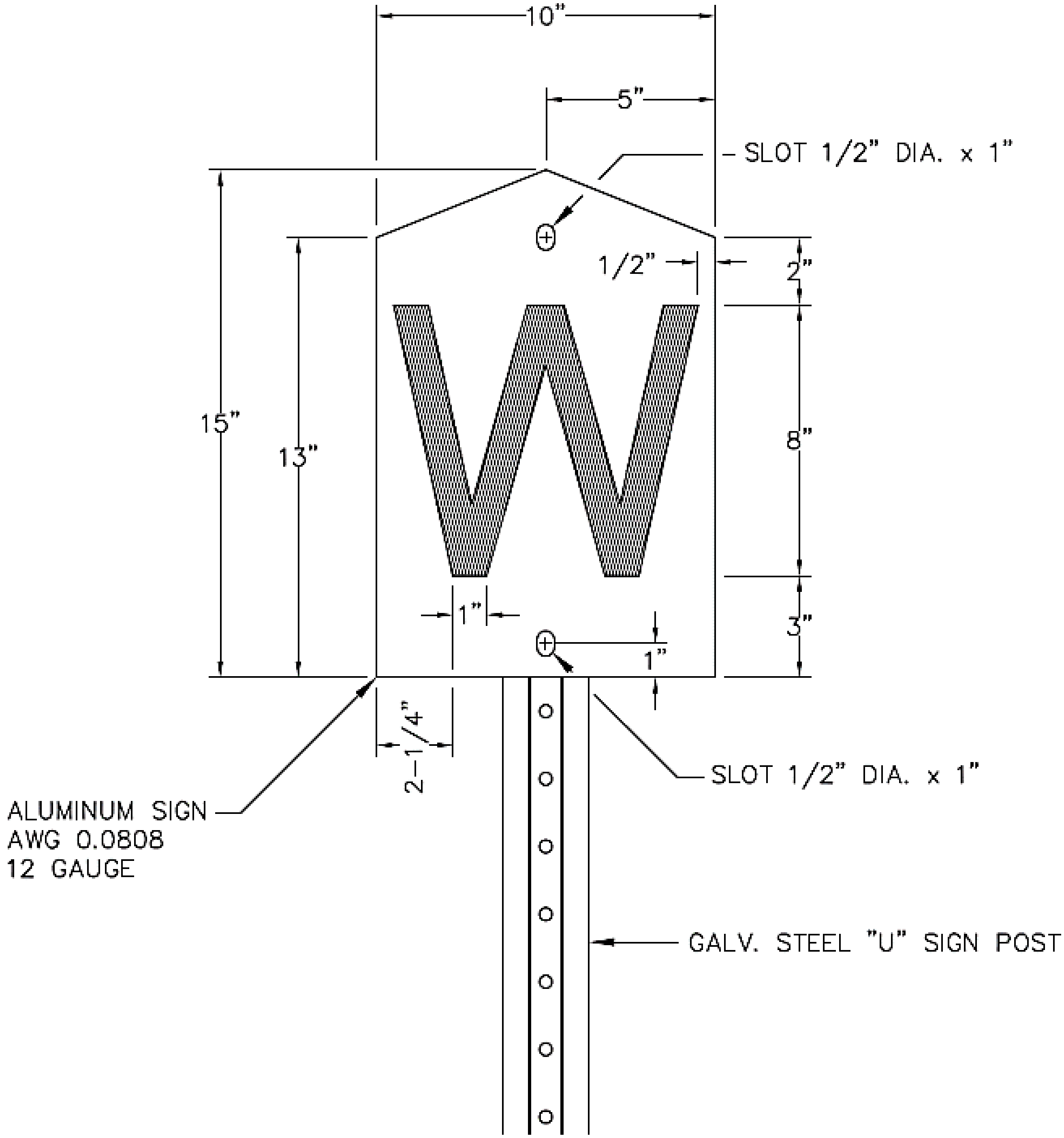


Figure Appendix H – 15 – Whistle and Bell Sign

Wing Blade Signs are to be mounted 75' minimum in advance of obstacles (crossings, turnouts, signal apparatus, bridges.) 9 feet from gauge side of rail, requiring the pulling in of the wings of plows. Wing Blade Signs are to be mounted with the arrow pointing towards the center of track. When a number of obstructions are within 300 to 400 feet of each other, to eliminate erecting a number of sign posts, install one wing blade sign at the first post location and the number of obstructions below (similar to the # of track signs at crossings). Wing signs are designed for left or right hand mounting. Sign contour will be black on a white background.

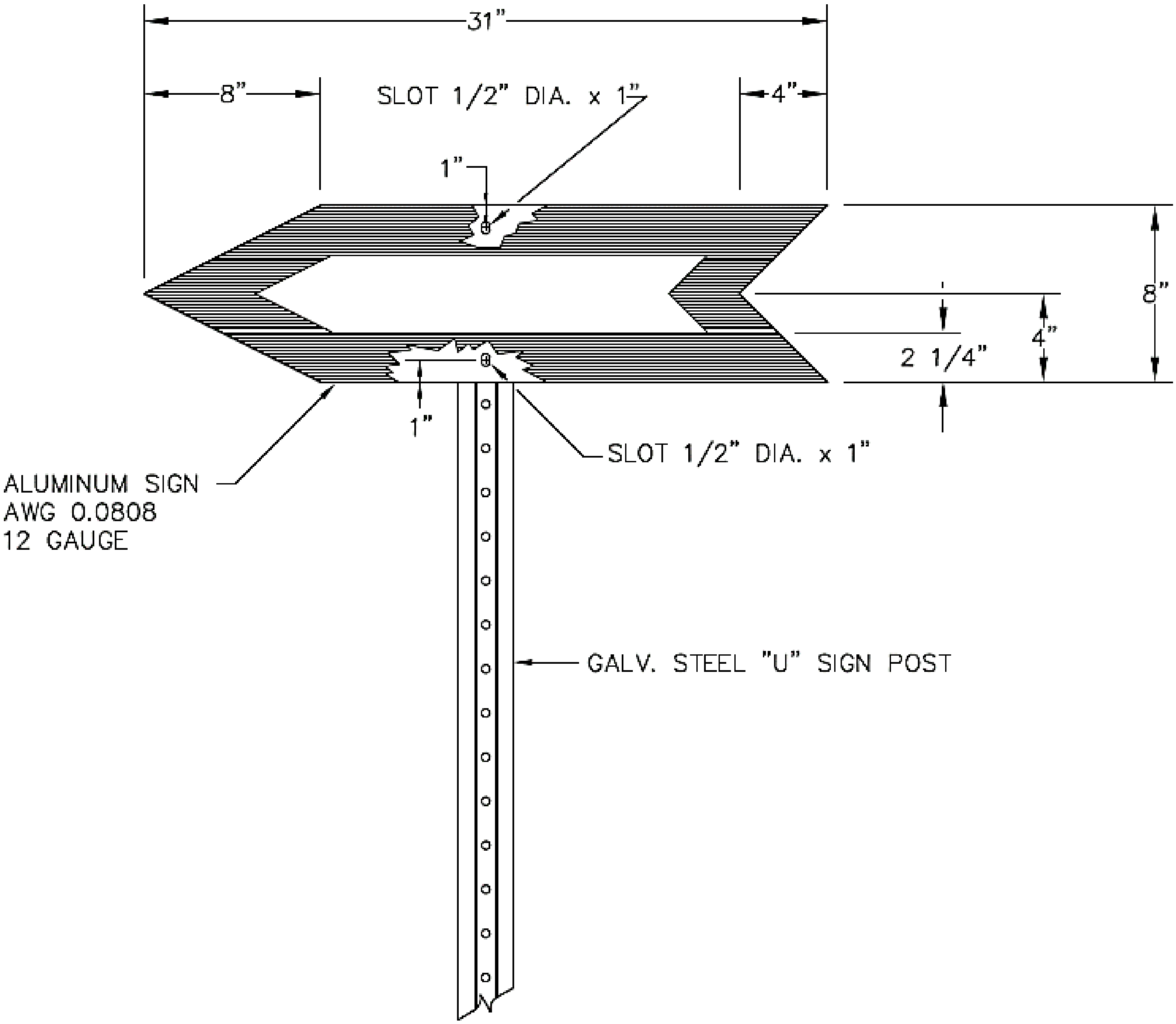
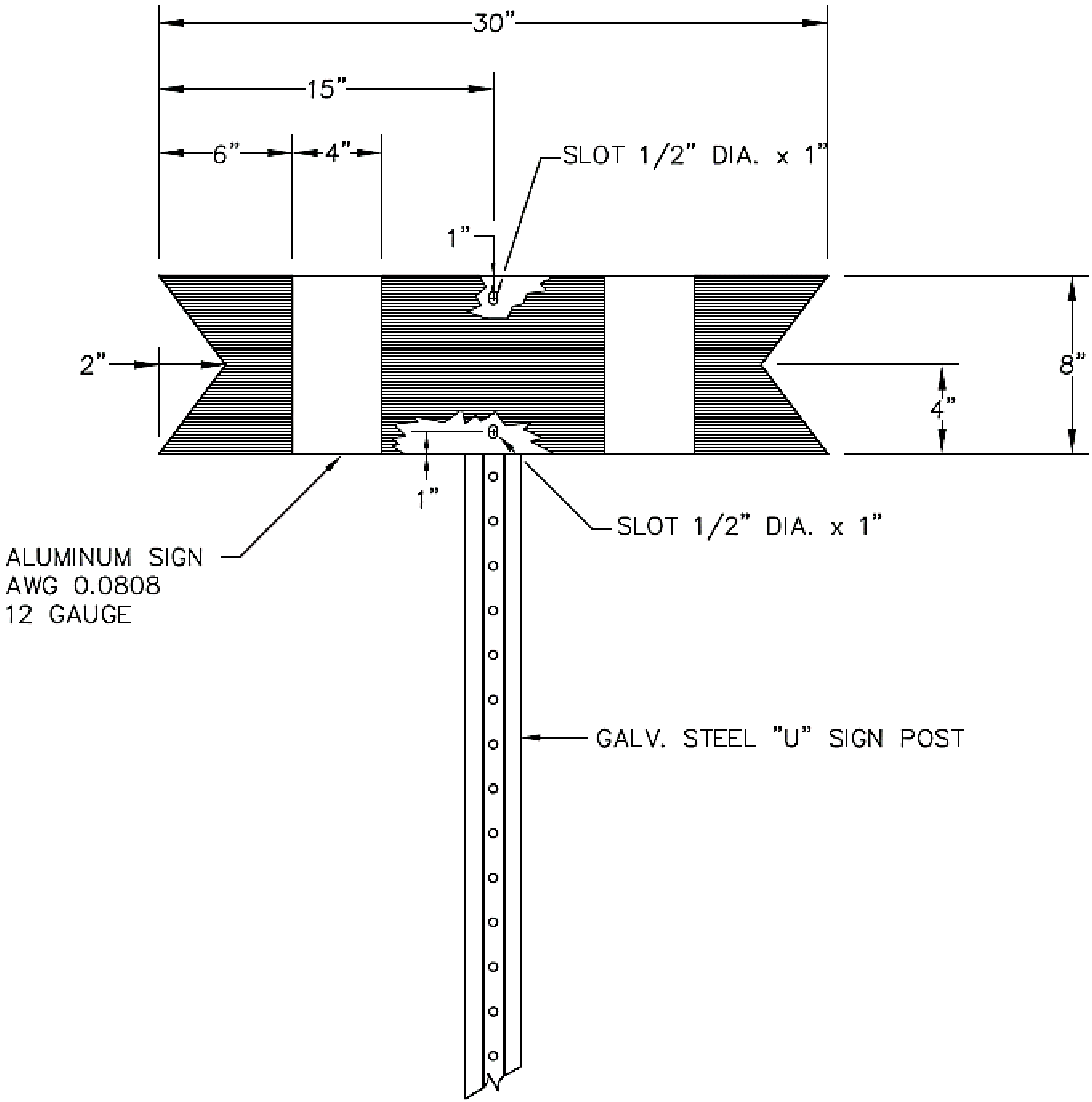


Figure Appendix H – 16 –Wing Blade Signs



Flanger Marker Signs are to be mounted 75' minimum in advance of obstacles (crossings, turnouts, signal apparatus, bridges.) 9 feet from gauge side of rail, requiring raising of flanger blades and nose. When a number of obstructions are within 300 to 400 feet of each other, to eliminate erecting a number of sign posts, install one snow plow / flanger sign at the first post location and the number of obstructions below (similar to the # of track signs at crossings). Sign face will be black with white vertical bars.

Figure Appendix H – 17 – Flanger Marker Signs

Derail Marker Signs are to be located at all hand thrown derails except where the derail is equipped with a target stand. Signs to have two blades front and back of post. Erect sign a distance of 6 feet minimum and 9 feet maximum from gauge side of rail containing the derail. Signs shall be fastened to post such that the sign points way from the track. Letters will be black on white background.

Note: In areas of extreme snow conditions, derail marker signs should be raised accordingly.

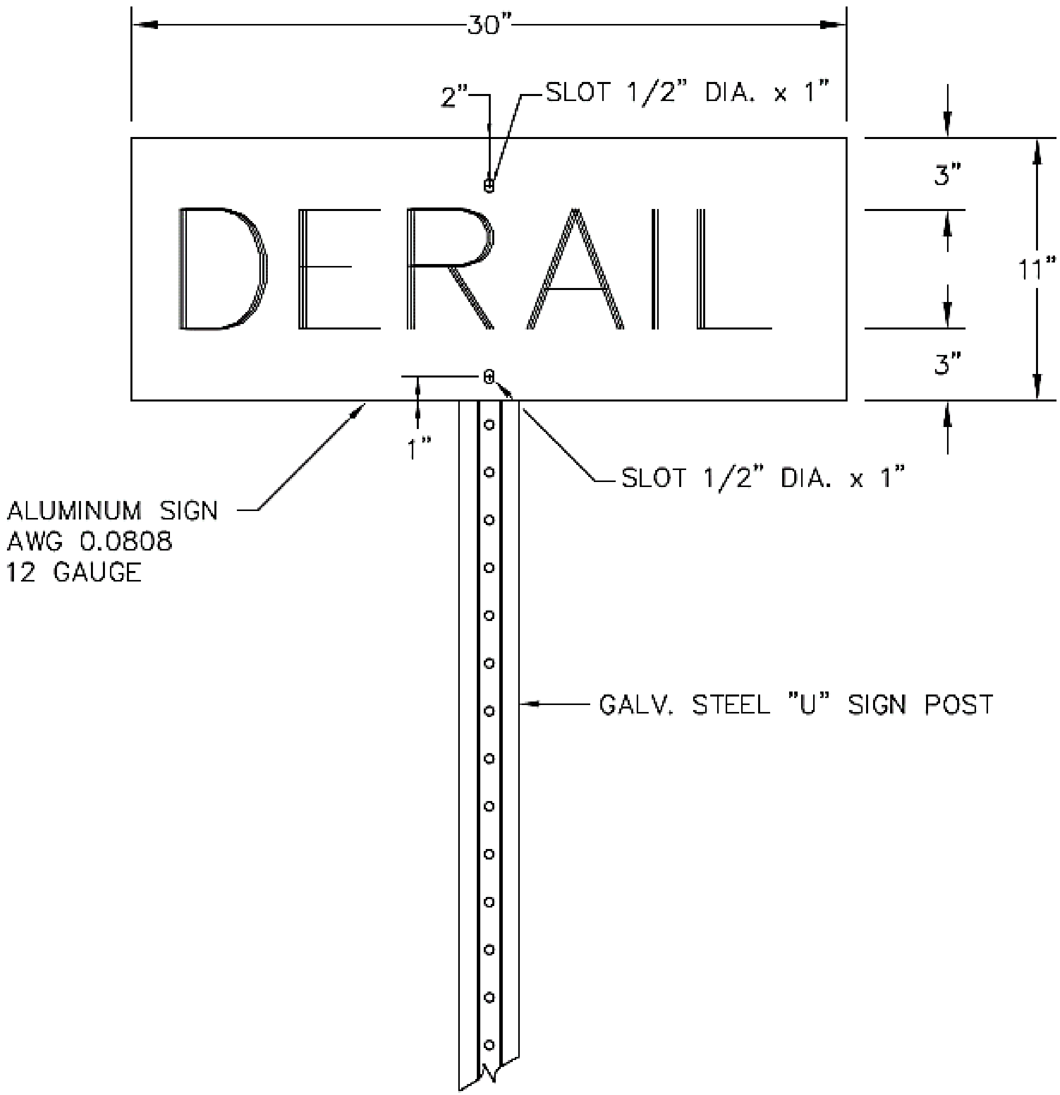


Figure Appendix H – 18 – Derail Marker Sign

Cautionary Limit Signs are to be located at the yard limit point as directed by the Director, Transportation. Letters will be black on yellow background.

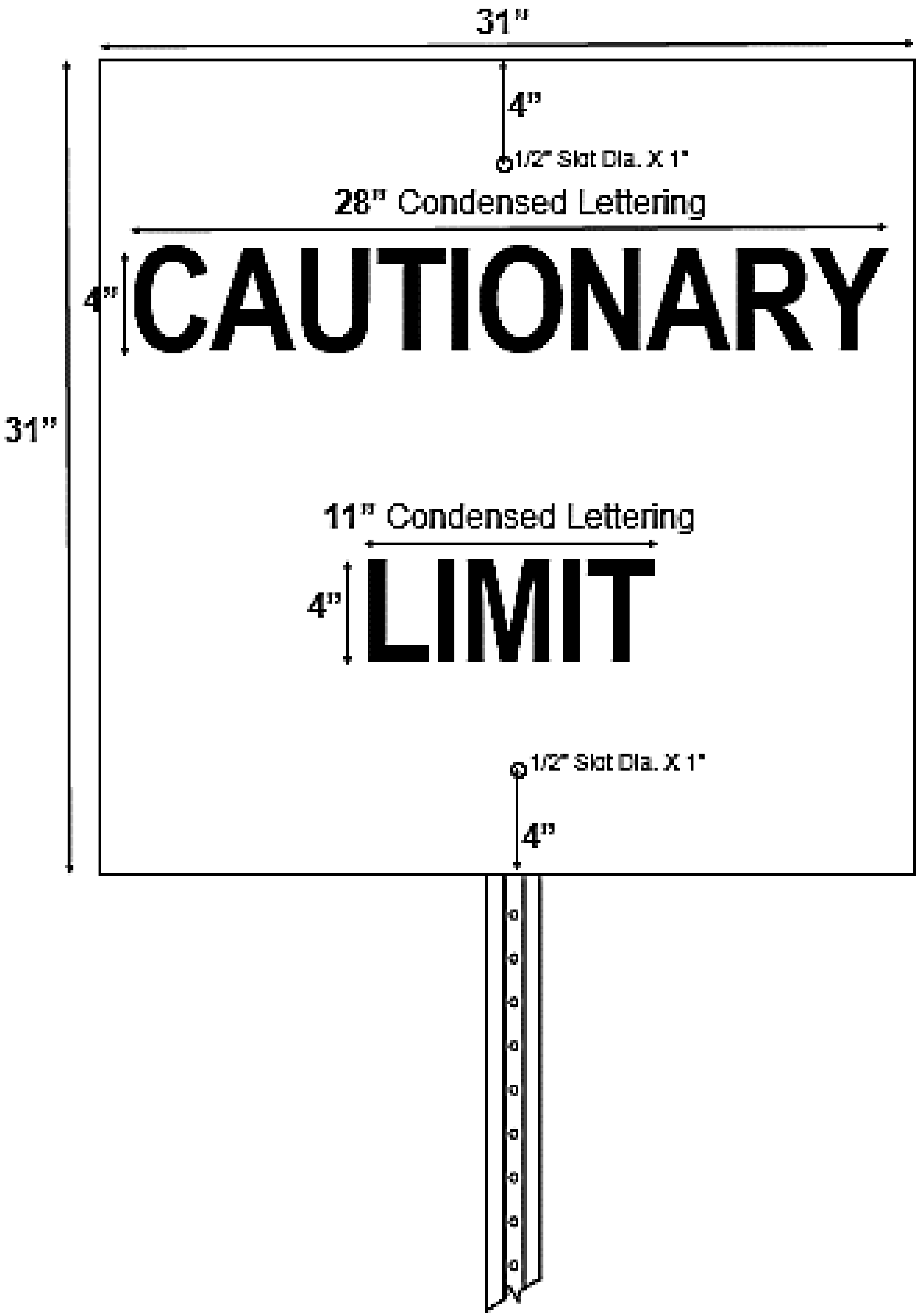


Figure Appendix H – 19 – Cautionary Limit Signs

Cautionary Limit 1 Mile Signs are to be located 1 Mile in advance of a cautionary limit sign. Letters will be black on white background.

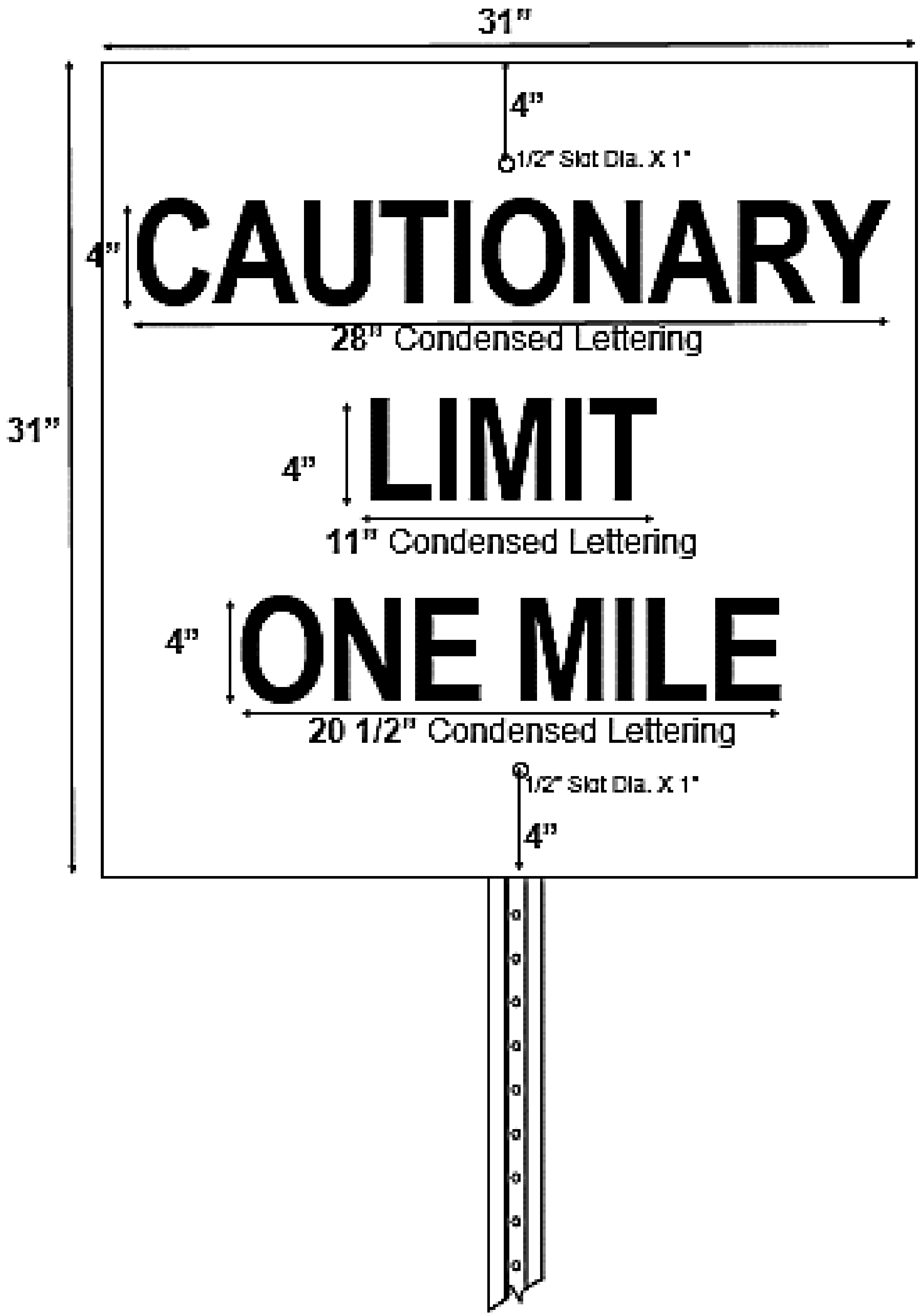
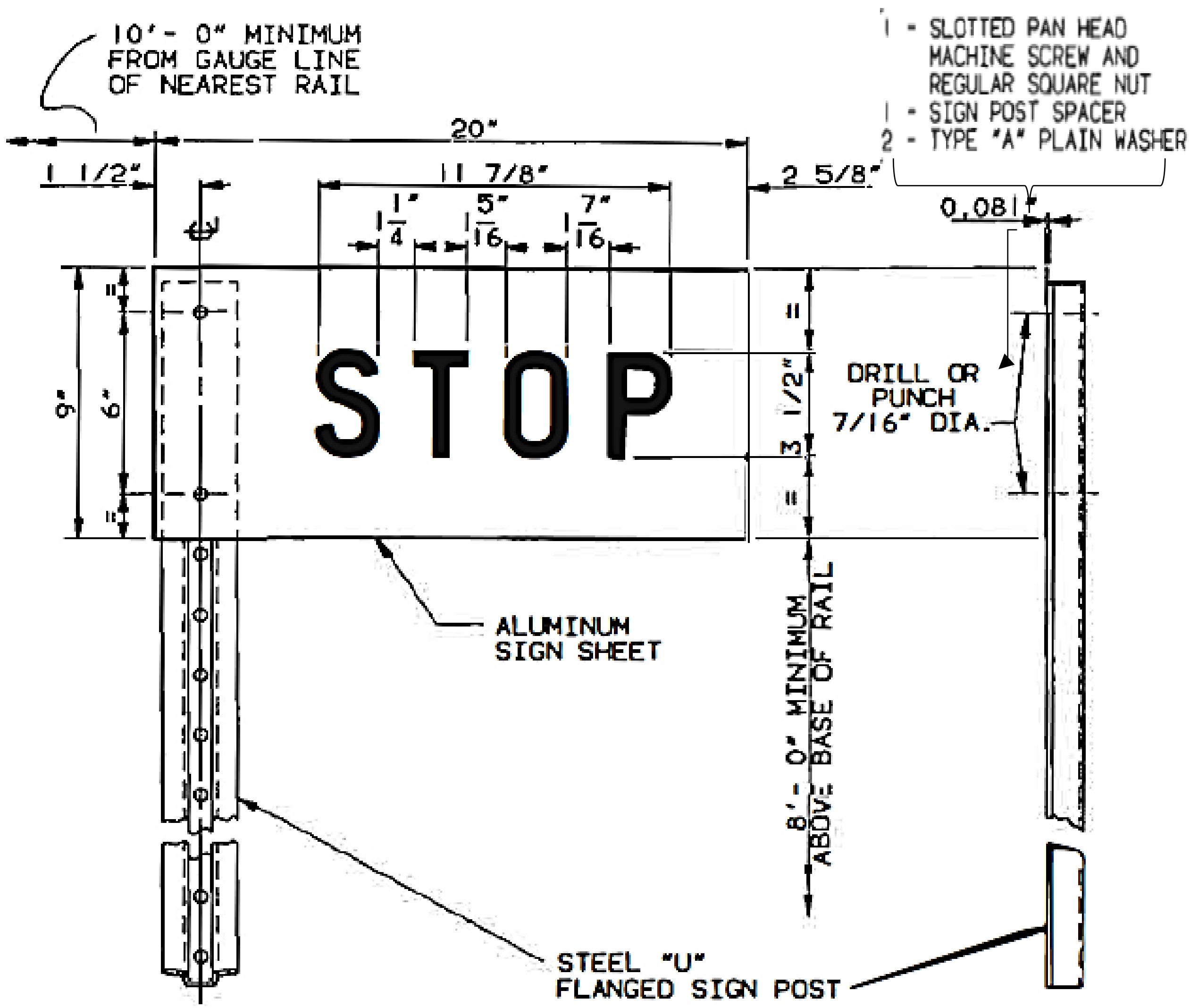


Figure Appendix H – 20 – Cautionary Limit 1 Mile Signs



STOP SIGN

SHEET: RED, HIGH INTENSITY SHEETING, ONE SIDE ONLY

LETTERS: BLACK, SCREENED INK OR PRECUT FILM (PRESSURE SENSITIVE), ONE SIDE ONLY

Stop Signs are to be located with the letters "STOP" as viewed from an approaching train to the side of the track, 500' from non-interlocking railway crossings at grade and at other locations where its use is required. Located on the right hand side, at angles to the track, in a manner that will afford the most advantageous view from an approaching train. If necessary, stop signs may be located to the left of the track. A minimum height of 8' 0" above the base of the rail to the bottom of the sign at a minimum distance of 10' 0" from the gauge line of the nearest rail to the inner edge of the sign. Shall be mounted on the standard steel "U" flanged sign post and penetrate the ground a minimum of 4'.

Figure Appendix H – 21 – Stop Sign

Private Crossing Signs are required as authorized by the Superintendent, Maintenance of Way on a farm or private crossing signs where a road or passage for use by vehicles and / or pedestrians, crosses a railway track at grade for the private and exclusive use by a particular person. Private Crossing signs are to be located on the right hand side of each approach, the sign post erected 14' from the gauge side of the nearest rail and 8' from the edge of the travelled portion of the roadway; the sign shall be not less than 5' nor more than 6' above the travelled portion, the said distance to be measured to the lowest part of the sign. The sign shall be located so as to be clearly visible to the approaching pedestrians and vehicles. The top half of the sign will always have a black background and white letters while the lower half of the sign will be the inverse. In Ontario, the English wording will figure at the top of the sign while in Quebec, the French wording will be at the top of the sign.

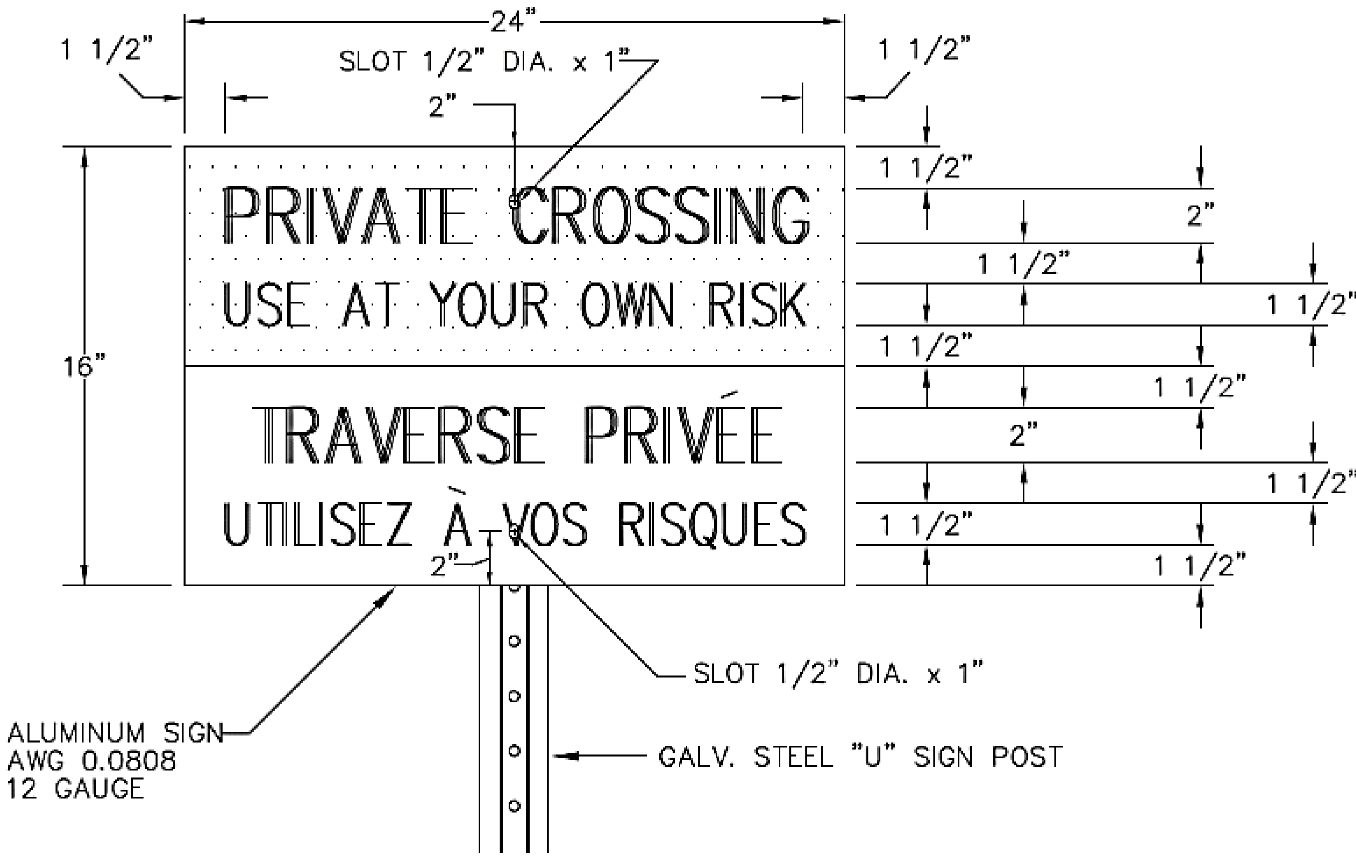


Figure Appendix H – 22 – Private Crossing Signs

Railway Crossing and Number of Tracks Signs are to be located between 0.3 m and 2.0 m from the face of the curb, or the outer edge of the road shoulder or, where there is no curb or shoulder, 2.0 m to 4.5 m from the edge of the travelled way; and must not be located closer than 3 m measured to the nearest rail.

A sign indicating the number of tracks at a grade crossing (Number of Tracks sign) must have a retroreflective coating that covers the entire front surface of the sign; have a digit and symbol that is transparent red inked silk-screened processed; and be installed on the supporting post of each railway crossing sign.

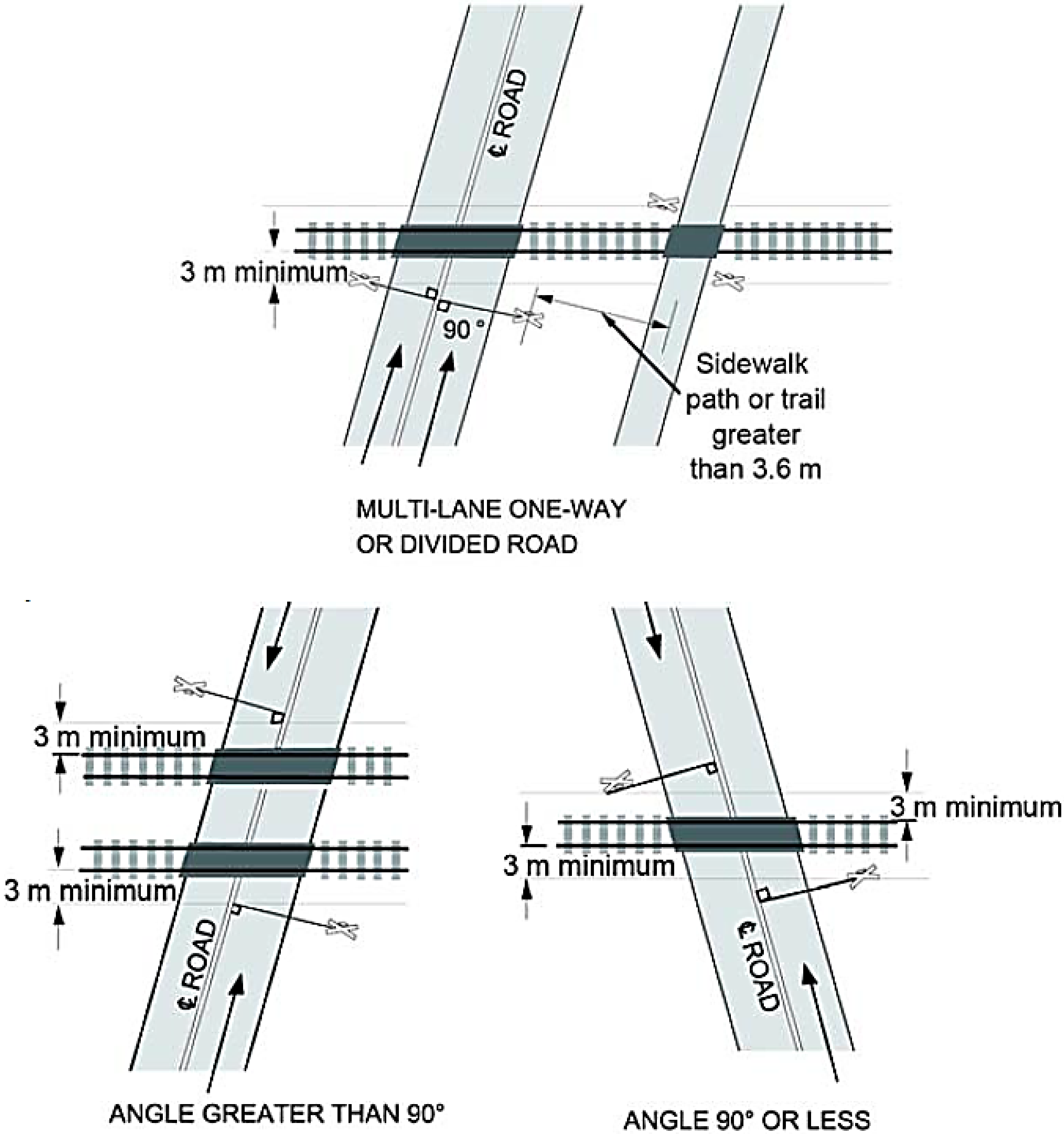


Figure Appendix H – 23 – Location of Railway Crossing Signs

Additional requirements include a 100 mm retroreflective strip must be applied on the back of each blade of the Railway Crossing Sign, for the full length of each blade; a 50 mm strip of silver white sheeting must be applied on the front and back of the supporting post, extending from no higher than 300 mm above the crown of the adjacent road surface to 70 mm above the centre of the Railway Crossing sign.

A sidewalk, path or trail with a centreline that is more than 3.6 m (12 ft.) from a Railway Crossing sign supporting post beside a road approach for vehicle traffic must have separate Railway Crossing signs.

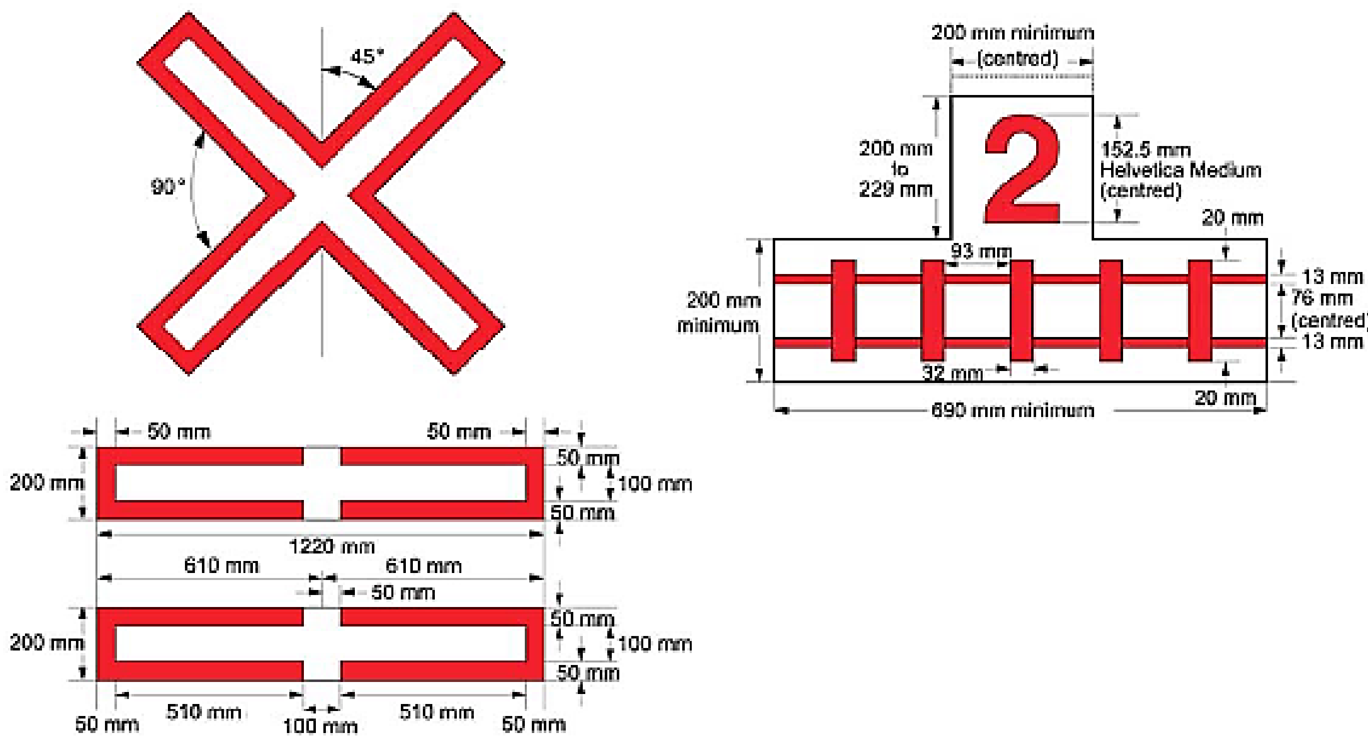


Figure Appendix H – 24 – Railway Crossing Sign and Number of Track Sign

Supporting Posts

The supporting post, on which is installed the Railway Crossing sign and the Number of Tracks sign, must, unless the Railway Crossing sign is installed on the mast of a warning system, the supporting posts must be of such construction that a 820 kg vehicle striking it at speeds 32 km/h or more, will not have a change in velocity greater than 4.57 m per second.

The intent is to ensure that the support post will break safely when struck by a vehicle from any direction, to prevent potential injuries that such an impact with an unyielding structure could cause. Breakaway sign supports are designed and constructed to break or yield when struck by a vehicle. This type of supporting post is made by drilling through the horizontal axis of the post at locations determined by its size. Structurally the post must be able to hold the weight of the sign.

Wood preservative should be in accordance with CAN/CSA-O80, Series-08, Use Category UC 4.1. All wooden posts should be stamped for wood preservative treatment using a mark authorized by the Canadian Work Preservers Bureau and be visible after installation and located at least 1.8 m from the bottom of the post. Cut ends and field drilled holes should receive 2 applications of 2% copper naphthenate wood preservative. Field-applied wood preservative that comes in contact with any metal components should be removed immediately.

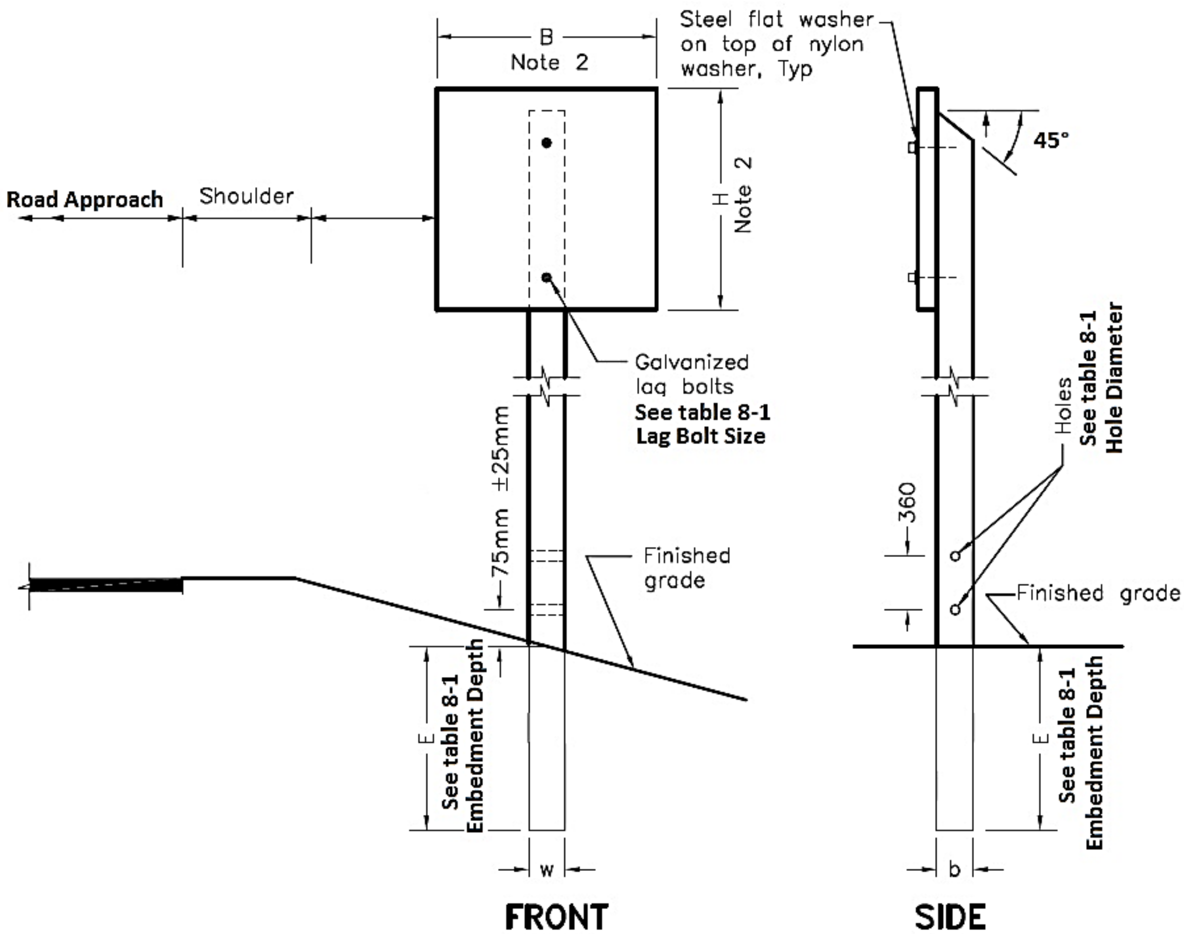


Figure Appendix H – 25 – Wooden Sign Post Breakaway Hole and Embedded Depth (TC Figure 8.1-2)

SIGN SUPPORT REQUIREMENTS							
EMPADMENT DEPTH	DRESSED POST SIZE AND HOLE DIAMATER			NOTE 2			GALVANIZED LAG BOLT SIZE
				MAX. SIGN DIMENTIONS		MAX. SIGN AREA	
E	w	b	HOLE DIA.	B cm	H cm	A M^2	INCH
920	89	89	S.O.	120	90	0,41	3/8 X 3
1000	89	140	38	120	120	0,90	3/8 X 3
1000	140	140	51	120	180	1,08	3/8 X 4
1200	140	184	76	120	180	1,80	3/8 X 4

Source: Ontario Provincial Standard Drawing 985.110

Figure Appendix H – 26 – Wooden Sign Support Post Requirements (TC Table 8.1)

Metal U-Flange Posts

Metal U-Flange posts should only be used for Railway Crossing signs on low-speed roadways with barrier-type curbs and posted speeds of under 70 km/h.

U-Flange posts can be made of cold-formed or hot-formed steel. However, all metal posts must be hot-dip galvanized after fabrication, in accordance with ASTM A123. Whether cold- or hot-formed steel is used, the tolerance for thickness should not be greater than ±0.38 mm and should be in conformance with the figures shown below.

Damaged or cut areas of hot-dip galvanized coatings on any galvanized components must be repaired in accordance with ASTM A780.

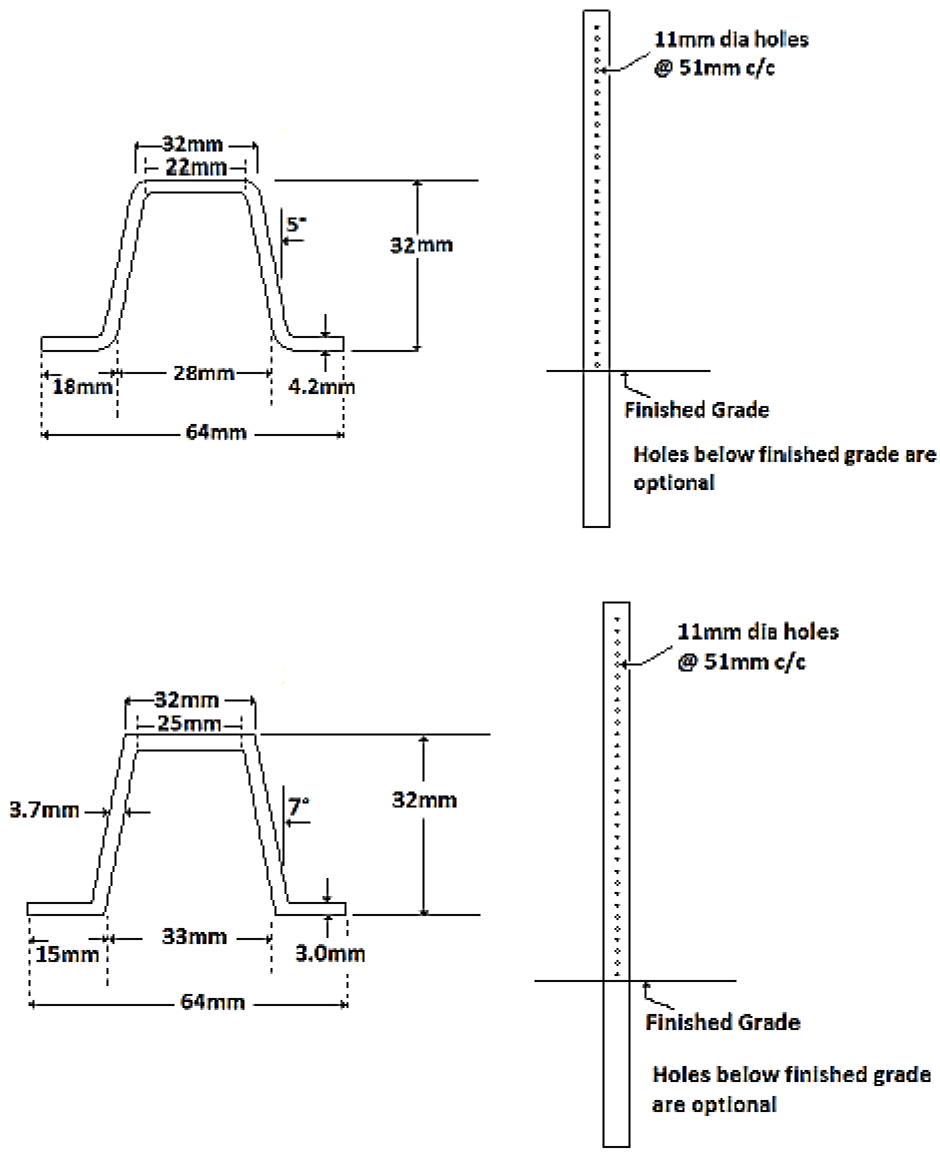


Figure Appendix H – 27 – Metal U-Flange Posts

Sign Hardware

All sign hardware must be hot dip galvanized in accordance with ASTM A153.

Posts must be plumbed within a tolerance of ±20 mm. The sign must be levelled on a multiple-post system within a tolerance of ±10 mm.

<u>Emergency Notification Sign (ENS)</u>

As of November 28, 2021, all railways are required to install Emergency Notification signs (ENSs) at all public grade crossings and it is considered a best practice to install ENSs at all grade crossings, including private grade crossings.

These signs provide all crossing users with the information needed to report/notify railway companies about emergencies or malfunctioning warning systems or any traffic control devices at grade crossings.

The ENS is to provide our emergency telephone number and the required information to positively identify the location of the grade crossing must be installed at all public grade crossings ((GCR sections 39, 63, 53(2) and 53(3))

- Parallel to the road, or
- On each side to the grade crossing, facing traffic approaching the grade crossing.

Best engineering practice is to install the ENS oriented to face the same direction as the other traffic control signs. (Perpendicular to the centre line of the road approach)

- The ENS must be clearly legible.
- The ENS should include the following information/characteristics at a minimum:
    - Ontario Northland's emergency telephone number established to receive reports about emergencies or malfunctions of the warning system and the traffic control devices within the crossing approaches.
    - The Crossing ID should preferably include a Mile Point and Subdivision name (Sub).
    - The wording should include the following at a minimum:
        - The word EMERGENCY (e.g. "REPORT EMERGENCY 1-800-555-5555")

ENS Size and Other Physical Characteristics

In order to be conspicuous, each ENS should:

- Measure 30.5 cm (12 inches) wide by 22.86 cm (9 inches) high at a minimum;
- Note: Proportional increases above the minimum sign dimensions to optimize the visibility of the ENS and/or to accommodate a bilingual message is permissible.
    - Be retroreflective; making it conspicuous to all crossing users by day and night.
    - Provide a minimum legible text (i.e., letters and numerals) with a character height not less than 2.54 cm (1 inch) for the sign information/message required above;
    - Have white text on a blue background with a white border; and
- Be a traffic control type sign manufactured using the specifications for retroreflective sheeting material for traffic control signs as required by Grade Crossings Standards (GCS) Article 8.1.8. Decals should not be used unless they are constructed with materials meeting Article 8.1.8 of the GCS and are mounted on a ridged sign backer plate mounted in a manner to be read horizontally.

Orientation of ENSs (Parallel or Perpendicular)

If the ENS is installed on the same mast/post as all the other railway signs, the ENSs should be placed, immediately below the Railway Crossing Sign, or where applicable, below the Number of Tracks Sign or Stop Sign, along the right side of each road/sidewalk/path or trail approach to the crossing.

For multi-lane road approaches, additional ENS should be considered.

If not installed on the same mast/post as all the other railway signs, the ENS should be located between 0.3 m and 2.0 m from the face of the curb or the outer edge of the road shoulder or, where there is no curb or shoulder, 2.0 m to 4.5 m from the edge of the travelled way while ensuring the sign does not obstruct other traffic control devices or warning system components.

While the ENS is permitted to be installed parallel to the road, in order to be conspicuous for all crossing users, the best engineering practice is to install the ENS orientated to face the same direction, as the other signs on the warning device mast/post (perpendicular to the centerline of the road approach). This orientation will provide visibility for all crossing users in a wide variety of situations. Minor variations may be justified in certain situations to optimize the visibility of the signs.

Bilingual Signs
Many jurisdictions in Canada may require that signs, such as these, provide its information in both official languages. While the language (English or French) is not specified in the GCR, or GCS, the use of bilingual signs may be required depending on the applicable jurisdiction.

For convenience, French, English and Bilingual (French/English), examples of ENSs are shown in the figure below.

Ontario Northland ENS have the following specifications:

- Sign Width – 17-3/4”
- Sign Height – 12”
- Letters / Numbers Height – 1”
- Ontario Northland Logo – 3/4" Height
- 14 gauge aluminum (minimum) plate with 1-1/2” radius rounded corners
- Retroreflective decals with white letters on blue background and white border
- Slot Locations – 2-1/4” from top edge and 1-1/2” from bottom edge

Figure Appendix H – 28 – Railway Crossing Emergency Notification Sign

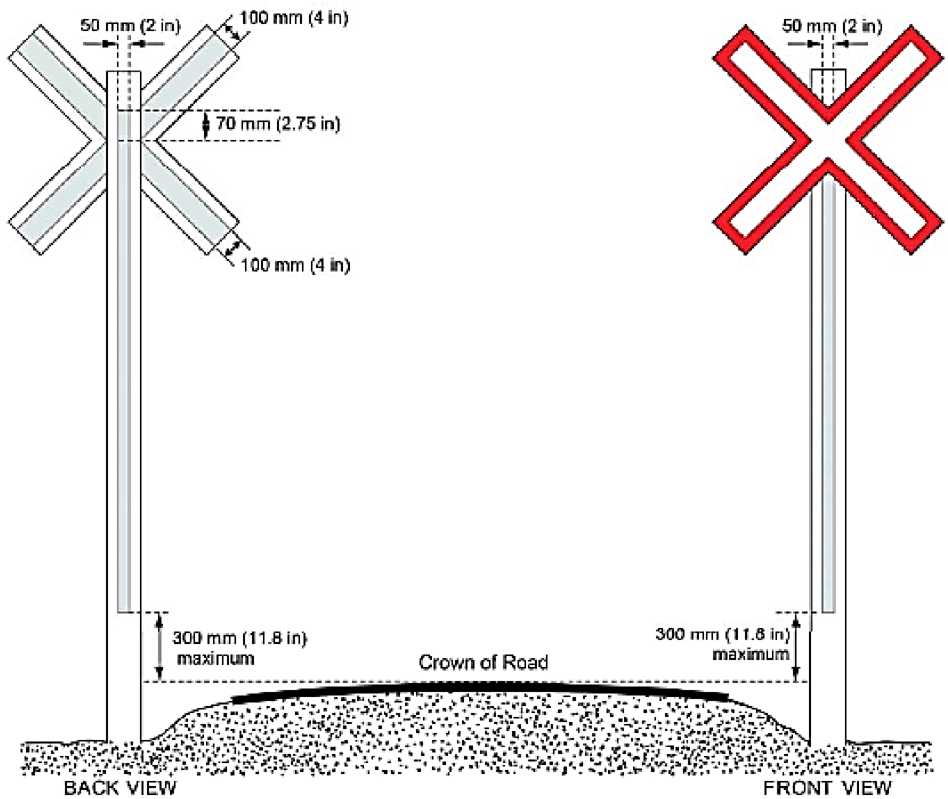


Figure Appendix H – 29 – Retroreflective Stripes on the Back of the Railway Crossing Sign and, on the Sign Supporting Post (public grade crossings without a grade crossing warning system)

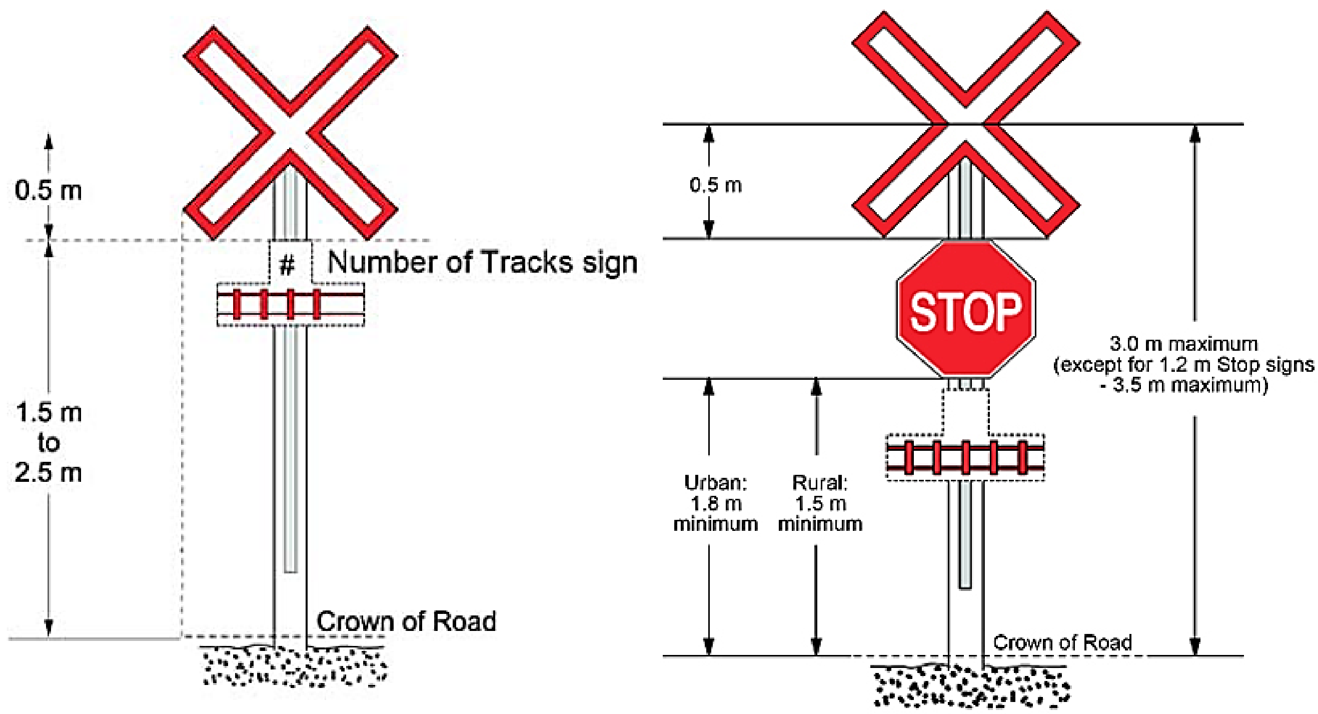


Figure Appendix H – 30 – Railway Crossing Sign and Number of Tracks Sign

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Appendix I.Rail Welding

1. General

The most common track welding functions are electric arc, thermite and flash butt. Standard arc welding processes such as shielded metal arc welding (SMAW), gas metal arc welding (GMAW) and flux-cored arc welding (FCAW) are used to weld manganese and carbon steel track components. Thermite and flash butt are used for joining continuous welded rail (CWR.) The flash butt method is used in the plant to create quarter-mile ribbon rails that are then transported by a specially constructed rail train to the location where they will be installed. Both flash butt (portable In-Track welding) and thermite (sometimes known as alumino-thermic) are then used in the field, to join the longer lengths of rail together into CWR. They are also used in maintenance welding for replacing defective rail and for light construction.

Electric welding refers to the standard arc welding processes used elsewhere, particularly SMAW (or "stick welding,") GMAW and FCAW, with or without additional gas shielding. These processes are used on frogs and crossing diamonds (both manganese and carbon steel), for carbon steel rail ends, switch points and wheel burns, and for joining carbon steel rails. Oxy-Acetylene Welding is now primarily limited to the build-up of rail ends that will later be thermite-welded.

Thermite welding is a process that joins rail ends by melting them with superheated liquid metal from a chemical reaction between finely divided aluminum and iron oxide. Filler metal is obtained from a combination of the liquid metal produced by the reaction and pre-alloyed shot in the mixture.

Flash butt welding is a resistance welding process that produces a weld at the closely fit surfaces of a butt joint by a flashing action, followed by the application of pressure after heating is substantially completed. Very high current densities at small contact points between the rail ends causes the flashing action, which forcibly expels the material from the joint as the rail ends are moved together slowly. A rapid upsetting of the two work pieces completes the weld.

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2. Rail Weld Repair Work Instructions

2.1 Rail Components and their Repair (Carbon Steels)

a) Material Identification
   - Standard Carbon Steel Rail – minimum hardness of 248 BHN
   - Premium Carbon Steel – nominal hardness exceeding 341 BHN

2.2 Repair of Battered Rail Ends (Carbon Steel Rails and Premium Carbon Steel Rails)

a) Carbon steel or Premium carbon steel rail may be repaired using arc welding processes (FCAW, SMAW, GMAW).

b) Visually inspect the rail to determine the repairability of the rail.

c) Purpose of welding rail ends
   i. Correct rail end batter
   ii. Repair chipped rail ends
   iii. Fit a good section of rail next to a worn section of rail

d) Do not weld rail end to,
   i. Correct drooped ends or surface bent rail
   ii. Compensate for worn joint bars, loose bolts or poor track fit up
   iii. Do not weld gauge face of rail

e) Determine proper electrode to be used for repair
   i. For example, Railbuild 540 (stick 3/16” diameter = 170 – 200 Amps, ¼” diameter = 210 – 230 Amps), Rail End 932, RailTuff

f) Arc welding is limited to jointed rails and insulated rails.

2.3 Determine Weld Length

a) If both rails are on the same plane and rail is battered or chipped, follow the below instructions:
   i. Build rail to a level matching existing beyond the batter or chip
   ii. Do not end weld directly over a bolt hole
   iii. Do not weld beyond the outer most bolt hole
   iv. To check true rail end batter, use a straightedge independently on each rail

**If rail is damaged beyond most outer bolt hole, the rail must be replaced.*

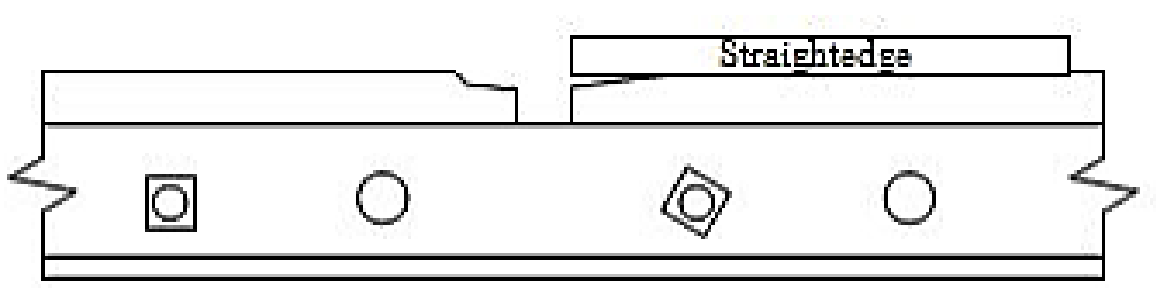


Figure Appendix I – 1 – Chipped or Battered Rail End

b) If one rail is on a lower plane than the abutting rail:
   i. Place a straight edge on the high rail and extend the end of the straight edge out above the low rail
   ii. Measure the distance between the straightedge and the low rail
   iii. Determine the length of weld on the low rail by dividing the measurement in Step Bii by 0.012”
      - Example 3/32” would require a weld length of approximately 8”

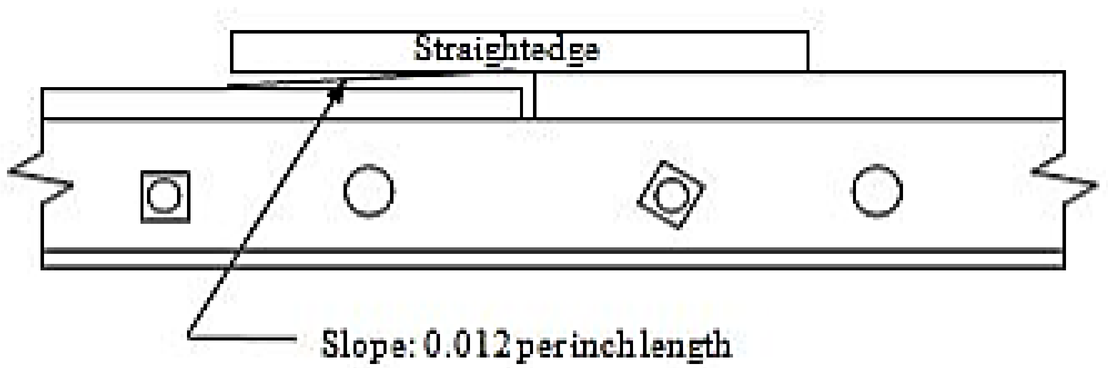


Figure Appendix I – 2 – Marking Joints for Length of Ramp

2.4 Inspection and Preparation

a) Repairing of rail ends by arc welding is limited to jointed rail and insulated joints
b) Welder should inspect joint prior to welding to make sure joint is fully bolted and all bolts are tight. Tighten and or replace bolts as needed before welding.
c) Rails to be welded must be cleaned free from dirt and grease

2.5 Remove Defective Material

a) Use a hand or angle grinder to remove all fatigued, spalled or otherwise defective material. Do not use carbon arc cutting or oxy-fuel cutting for this purpose.
b) Grinding may be done at lower temperatures than the pre-heat, and it is suggested as the grinding discs are more effective at removing material when within ambient temperature.
c) Avoid excessive pressure while grinding to minimize the heat build-up within the material.

2.6 Welding Procedure

2.6.1 Consumable Selection

a) Depending on the rail hardness (or alloy) and the process determined to be fit for the application, can help determine the proper consumable to be used.
b) Other factors to consider (not limited to);
   i. Ability to obtain suitable quality results,
   ii. Productivity of the process, as well as,
   iii. Operator's capability to perform for the given process and expected quality.

2.6.2 Preheat

a) Preheat the repair area a minimum of 3" (100 mm) longitudinally beyond the weld area in both directions.
b) Preheat non-alloyed rail to 700˚F (370˚C) and alloyed rail to 1000˚F (538˚C).
c) Maintain this temperature throughout the welding operation.
d) If train operations or other occurrences interrupt the welding operation, the rail must be re-heated to the minimum preheat temperature before welding.
e) Repairing rail in 32˚F (0˚C) temperature makes preheat more difficult and special attention should be made to insure the temperature of the rail does not fall below the specified temperature.

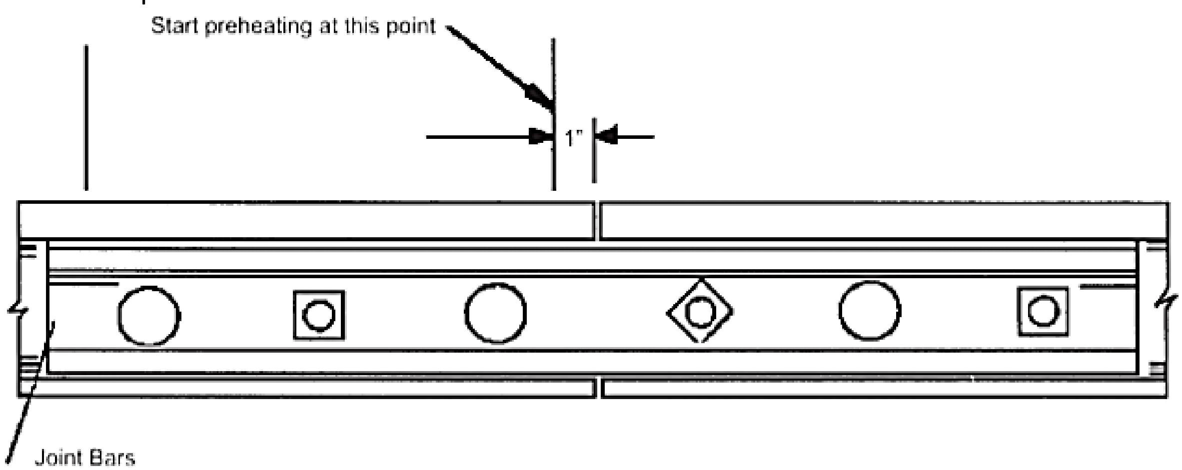


Figure Appendix I – 3 – Preheating

2.6.3 Applying the Weld

a) Apply the ground clamp to a rail anchor. Do not apply to or allow ground clamp to make contact with any part of the rail or the joint bar as this may lead to an electrical arc resulting in cracking.
   i. Make weld beads 5/8" – 3/4" wide.
      - See 2.6.3 xii below for weaving technique.
   ii. Weld hot to help with maintaining the preheat temperature.
   iii. Weld bead length may be as long as the repair area, if necessary.
   iv. Overlap weld beads 30% to 40%.
   v. Remove the slag with a chipping hammer and wire brush after applying each weld bead. Do not use a needle scaler.
   vi. All welds shall be deposited in parallel with the rail except in low chipped areas

vii. Apply the longest weld along the gauge side of the rail.

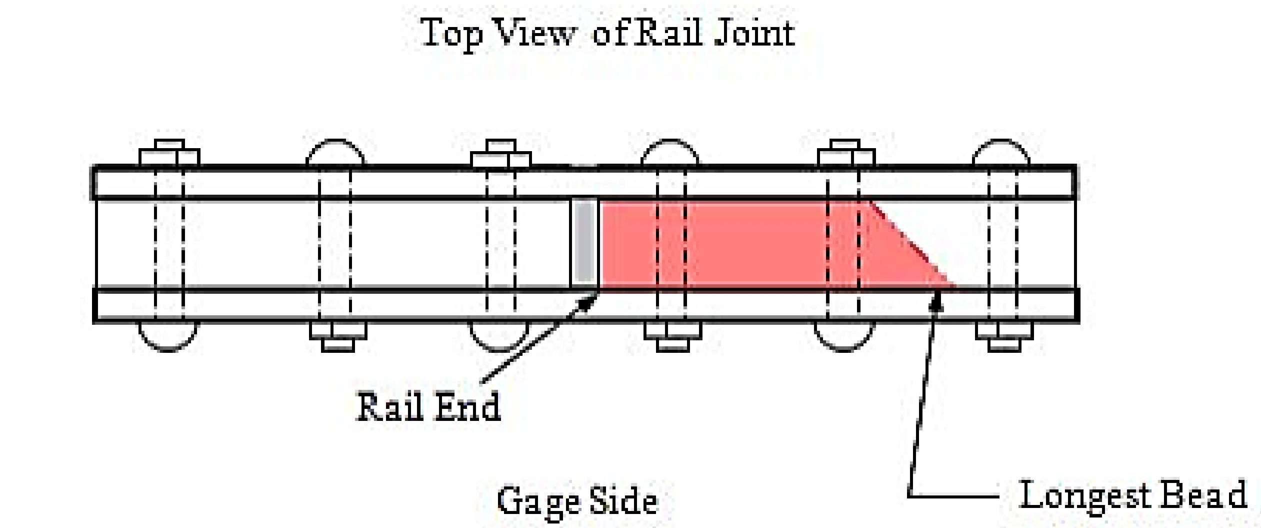
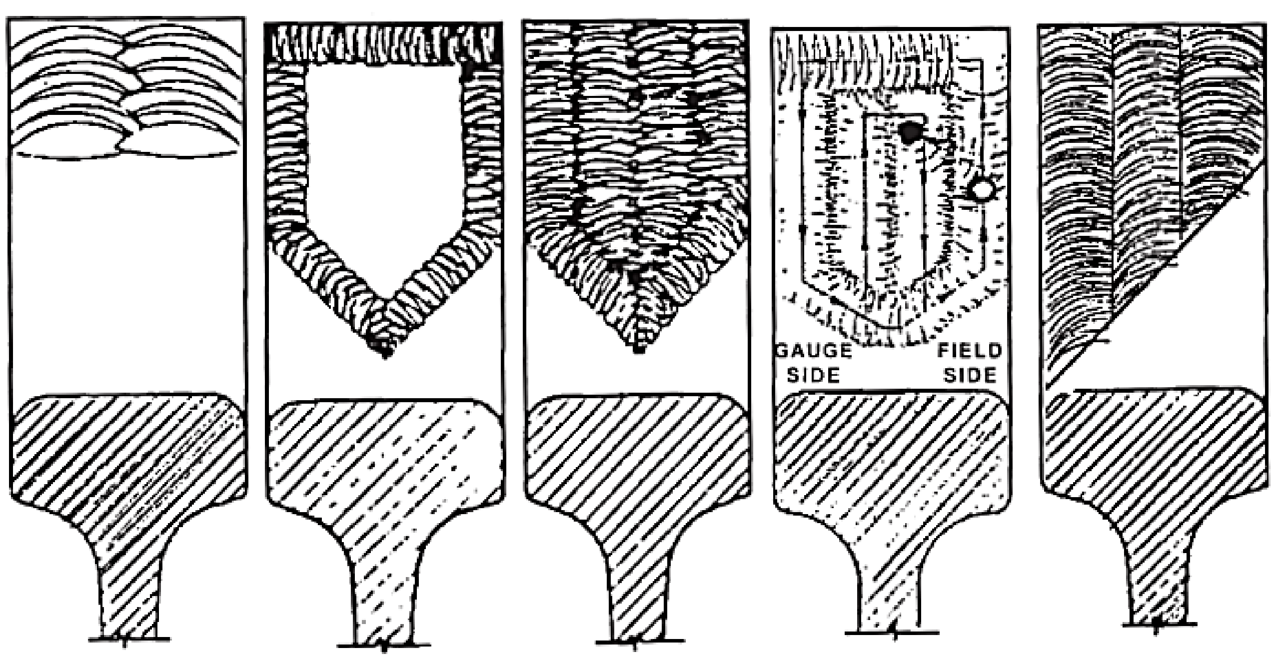


Figure Appendix I – 4 – Marking Joints for Length of Ramp

viii. Do not use carbon blocks on high carbon steel, use copper end jib to maintain a shoulder on the edge of the rail end.
ix. Arc strikes outside of the preheated area shall not be permitted.
x. Peen each weld bead 2 to 3 times per inch with a 2 lb. ball peen hammer
xi. Use appropriate bead pattern as shown within the recommended bead patterns below



Used for first pass on the lowest portion of ground rail end.

Figure Appendix I – 5 – Rail End Weld Bead Patterns – Good Practices

xii. Use a crater fill technique shown below. Reverse the travel angle and momentarily stop travel at the end of weld beads to fill in the crater.

xiii. Refer to the appropriate WPS: "RE-CS-SMAW" or "RE-AS-SMAW" or "RE-CS-FCAW" or "RE-AS-FCAW"

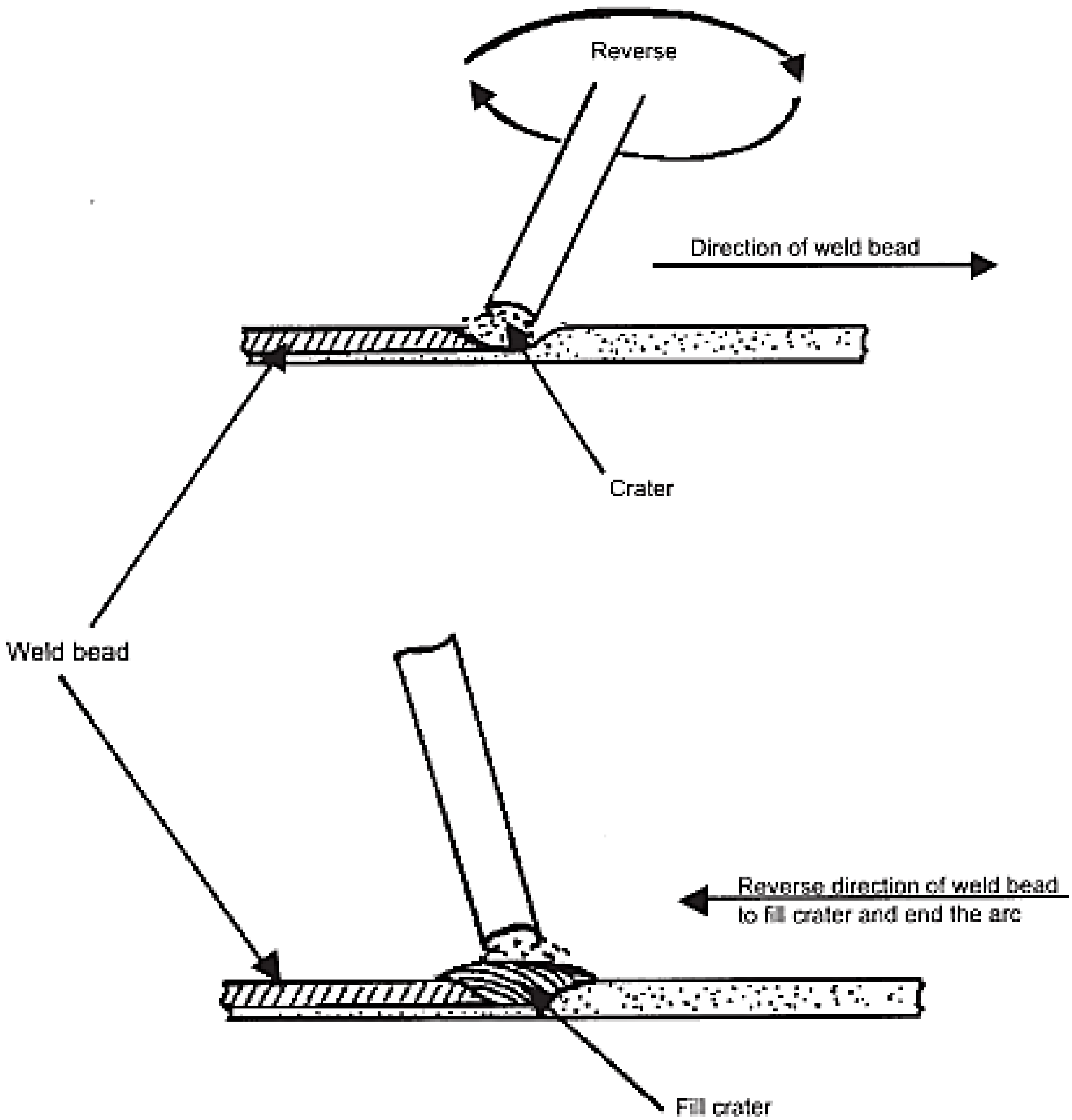


Figure Appendix I – 6 – Crater Fill Technique

2.6.4 Post-Weld Heat Treat Carbon Rail Ends

a) Post weld heat treatment is recommended using the temperatures shown in the below.
   i. If, at the end of the welding operation, the temperature is above the post weld heat treatment temperatures, post weld heat treatment is not required.

Type of Rail	Post Weld Heat Treat Temperature
Standard High Carbon Rail	1000°F (538°C)
Alloy Rail	1200°F (649°C)

Figure Appendix I – 7 – Post-Weld Heat

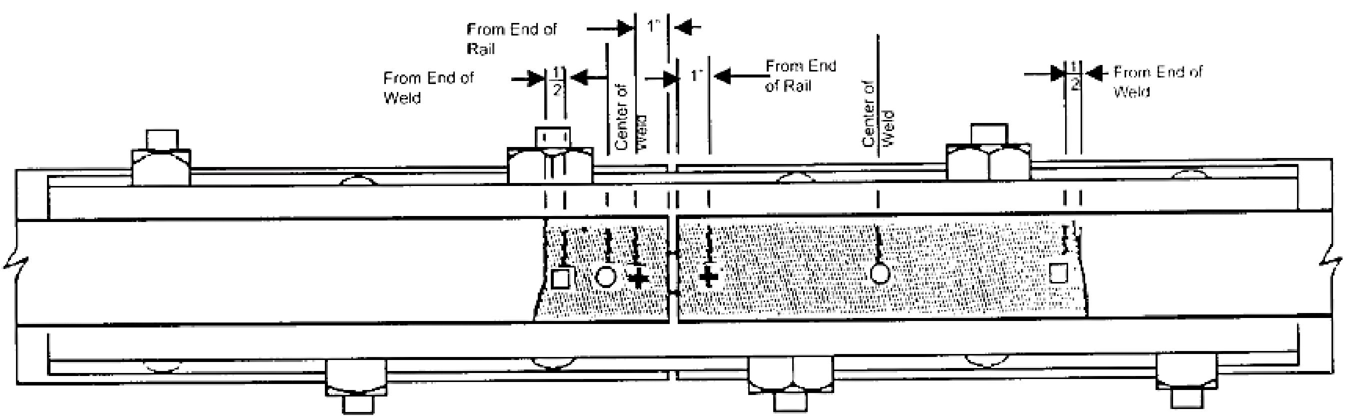
b) Wrap the repair area with 6" thick of insulation to allow for slow cooling until close to ambient temperature.

2.6.5 Post-weld Operations

a) Grinding and finishing operations should take place the same day as the welding.
b) Check Brinell Hardness and refer to the following;

Standard Strength Rail - 260 to 300 Brinell Hardness

1" (25 mm) From Rail End	Center of Weld	1/2" (13 mm) From End of Weld
+ 380 to 400	O 340 to 360	□ 300 to 320
+ 360 to 380	O 330 to 350	□ 300 to 320
+ 340 to 360	O 320 to 340	□ 270 to 300



View looking down at the rail

Figure Appendix I – 8 – Typical Satisfactory Brinell Hardness Patterns

2.6.6 Surface Grind Rail Ends

a) Grind the gauge and field side of the rail ends to match the existing profile of rail (remove overflow).
b) Grind the surface of the rail ends level – tolerance is 0.000" low to 0.010" high
c) If one rail is lower than the other, after welding, grind a uniform tapered surface from the high rail to the end of the weld repair on the low rail
d) If bond wires are damaged, notify Signals

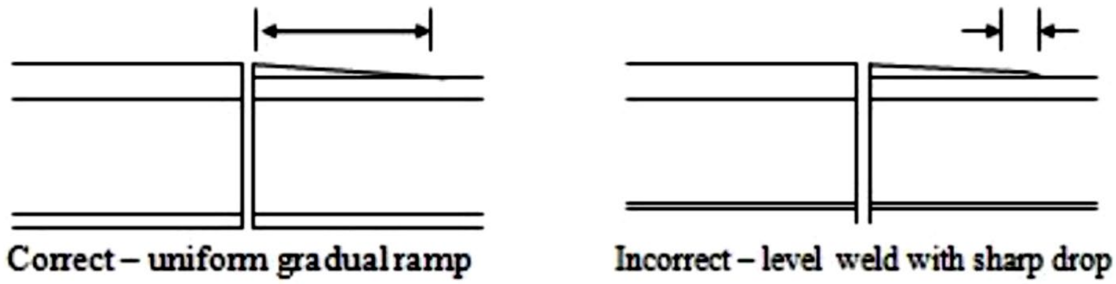


Figure Appendix I – 9 – Gradual Ramp Tolerance

3. Welding of Carbon Steel Switch Points

3.1 Switch Point Repair Restrictions

a) All of the repair work instructions on rail ends should be considered during the repair operation of a switch point.
b) Tighten any bolts that may be loose, ties under the heel block shall be tamped up if they are low.
c) Preheating and post heat should be applied to the base / web intersection so that distortion is minimized.
d) Use copper backing when welding switch points against stock rail to prevent arc strikes on the stock rail. Switch point must not be in the open position when welding, but must be closed against rail stock.
e) Trains and engines must not operate over switch points being repaired by welding until all pre-grinding, welding finish grinding and required adjustments are completed. Take the switch point out of service until all work is complete.
f) Heel end of switch points may be welding in all tracks according to procedures for rail end welding in Section 2 and WPSs based on welding process.

3.2 Identify Switch Point Type

a) Rail steel switch points are a full length one piece point and are magnetic
b) Manganese switch points are an insert that bolts to the longer carbon steel switch point section and are non-magnetic.

3.3 Switch Point Wear

a) If the switch point is worn down or chipped so that the top is more than 1/2”(13 mm) below the plane across the top of the stock rail, it is suggested that the switch point be repaired or replaced.

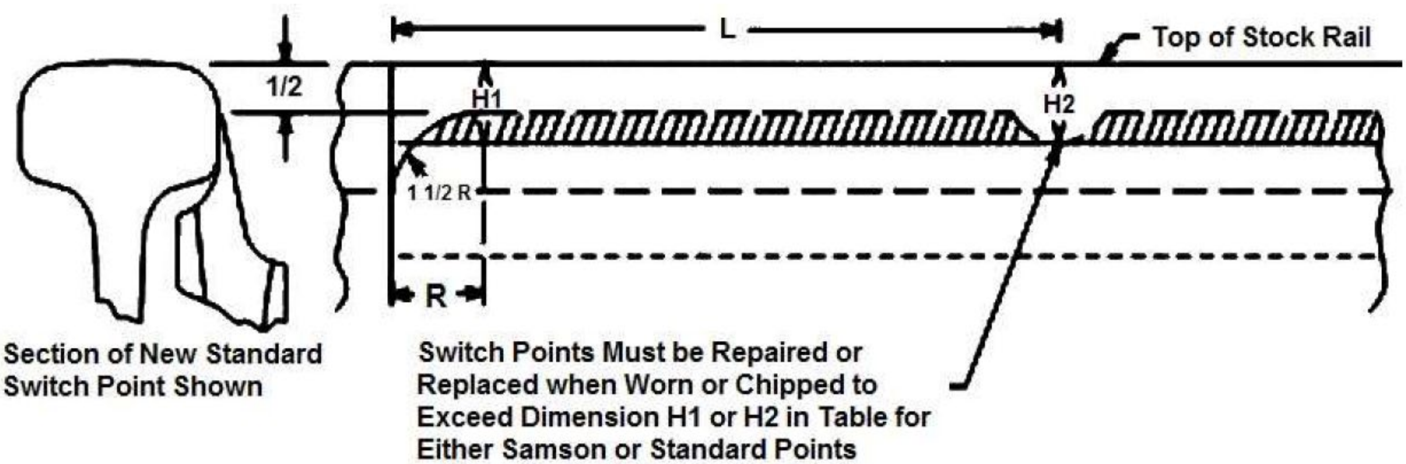


Figure Appendix I – 10 – Switch Point Wear

Length of Switch Point	Distance			
	R	H1	L	H2
Up to 19’ 6”	1-1/2”	7/8”	Over 10”	3/4"
19’6” or over	1-1/2”	7/8”	Over 16”	3/4"

Figure Appendix I – 11 – Switch Point Dimensions

b) If a switch point tip is chipped and has an unprotected vertical surface that is 3/16" (5 mm) or wider, 1/2" (13 mm) below the top of the stock rail, switch must be repaired or replaced as per the Manual of Track Requirements.

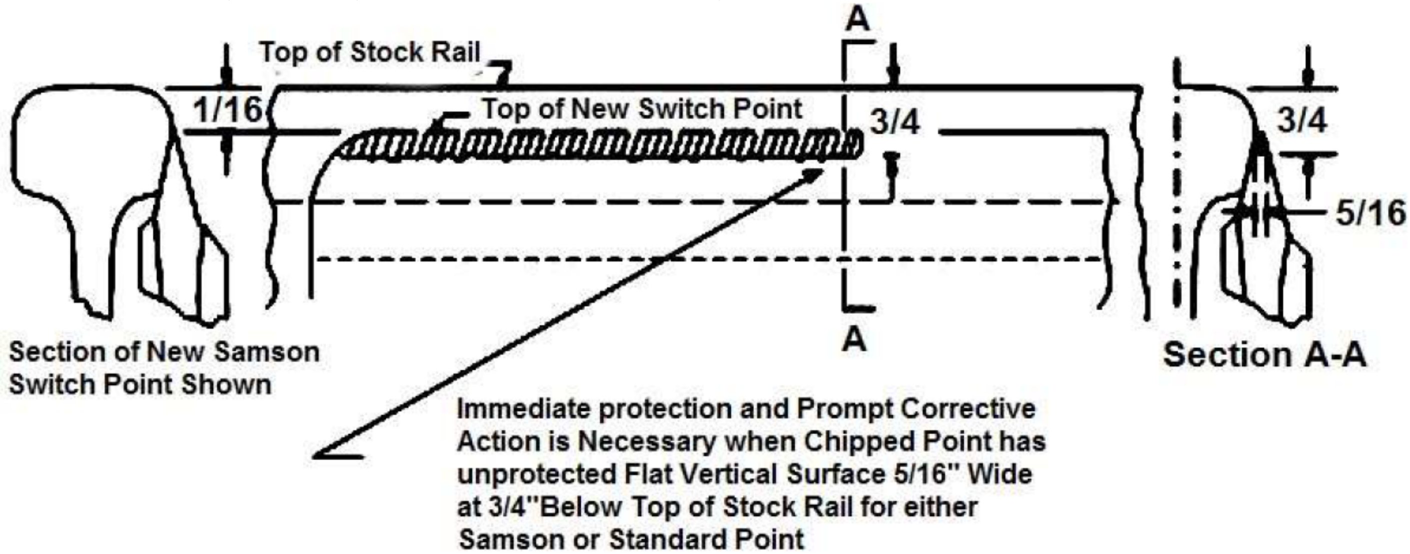


Figure Appendix I – 12 – Switch Point Wear

3.4 Remove Metal Flow from Stock Rail

a) Excessive metal flow will prevent the switch point from properly closing against the stock rail and should be removed where the switch point contacts the stock rail to provide a good fit. To remove the flow:
   - i. Remove all flowed metal from the gauge side of the stock rail before welding the switch point as follows:
     - i. Start 4" ahead of the switch point and grind back towards the heel where the switch point ends contact the stock rail
     - ii. Ensure no sharp projections remain after grinding
     - iii. When removing metal flow from stock rails, taper each end of the grind to a minimum of 4" in length as per Figure Appendix I – 11 – Areas of Taper
   - ii. Restore the gauge and field side corners on the stock rail to 5/16" to 9/16" radius

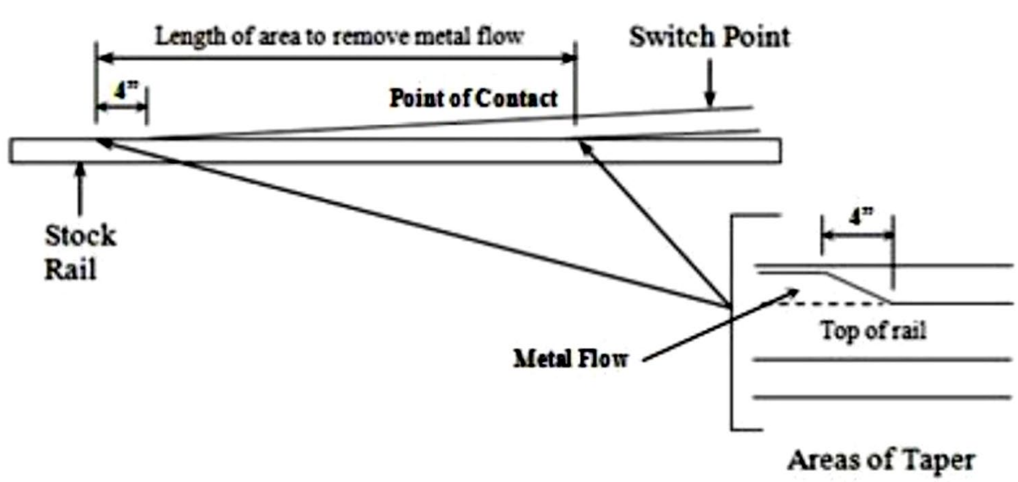


Figure Appendix I – 13 – Areas of Taper

3.5 Removal of Defective Material

a) Remove defective material from switch points by grinding only
b) Do not grind so aggressively as to cause a blueish oxide on the switch point surface
c) Do not use carbon arc cutting or oxy-fuel torch cutting for this purpose
d) When removing defective metal prior to welding repair, create a level surface by grinding the entire weld area flat
e) Maximum length of repair shall not exceed 16 inches
f) Slot the rail end at the heel of the switch point

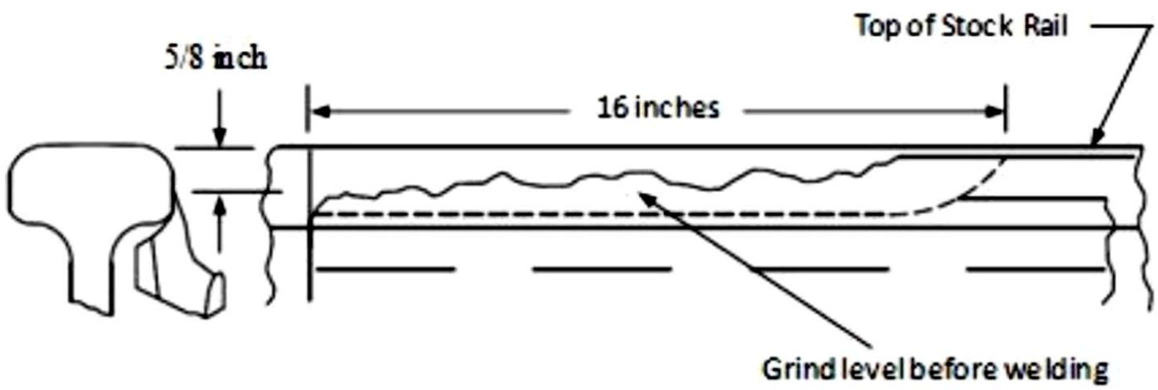


Figure Appendix I – 14 – Switch Point Repair

3.6 Welding Switch Points

a) On standard carbon rail steel switch points, preheat the entire weld area plus 3” past, to 700°F (358°C) and maintain this temperature throughout the welding repair
b) On manganese steel switch points inserts, do not preheat the steel
c) Do not allow the temperature of the parent steel to exceed 500°F. Use air to help cool the manganese steel
d) Use a temperature crayon to measure temperature 1/2" below deposited metal
e) Insert a 1/4” X 3” X 18” copper backing plate between the switch point and the stock rail before welding
f) Switch point must not be in the open position when welding but must be closed against stock rail
g) Use only approved welding electrodes listed in the “WPS RE-CS-SMAW” procedure
h) Begin welding at the tip of the switch point
i) Once the electric arc is established, move the electrode quickly away from the end of the switch point to avoid melting the tip
j) Remove all slag before depositing the next layer of weld metal
k) Do not use a needle scaler on carbon rail steel for this purpose (use a chipping hammer only)
l) Peen each bead and clean with a wire brush before applying the next weld layer
m) Refer to the appropriate WPS for detailed welding procedure

3.7 Grinding Switch Points

3.7.1 Top and End of Switch Point

a) The tip of the switch point must be 1/2" lower than the crown of the stock rail.
b) Ensure the top of the point tapers back so that the first 8” of the point will not carry any load

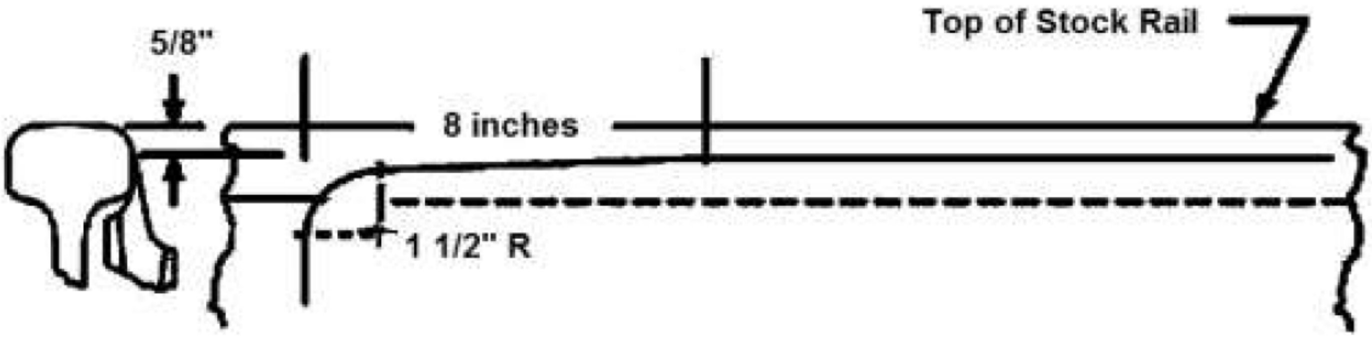


Figure Appendix I – 15 – Finishing Switch Point

3.7.2 Gauge and Stock Rail Side of Switch Point

a) Grind the gauge side corner to a 5/16” to 9/16” radius
b) Slightly bevel the top of the stock rail side, except the first 10” from the end of the point
c) Slot the rail end at the heel of the switch point

Check for proper fit between the switch point and stock rail after all welding and / or grinding operations are complete.

4. Rail Components and their Repair (Austenitic Manganese Steel)

4.1 Material Identification

Austenitic manganese steels are non-magnetic in the non-work hardened condition. After work hardening, the rail will become magnetic but to a lesser degree compared to regular carbon steel.

4.2 Repair of Austenitic Manganese Steel Frogs, Crossings and Switch Point Guards

Keep in consideration,

a) The welding and repair methods of austenitic manganese steel rails are much different than the methods used for carbon steel rail and components.
b) Unlike most steels that soften when tempered at a relatively low temperature, manganese steel becomes brittle and magnetic when heated above 500˚F (260˚C) and will fracture easily.
c) The outer portion of a manganese casting work-hardens to a depth of 1/8” – 1/4” while the inner area remains ductile.
d) Until fully work-hardened, manganese steel remains ductile, and it deforms from its original shape when stressed.
e) Austenitic manganese steel needs to have the hardened material completely removed and confirmed using hardness testing before any welding occurs.
f) Processes used to remove the hardened or defective material of austenitic manganese steels are much more effective than grinding which is the only option available for carbon steel rail. Carbon arc cutting can be used on austenitic manganese steel rails for repair of defective material.

4.3 Welding Process

a) The welding processes used can be either FCAW or SMAW.

4.4 Filler Metals

a) Consumables should contain between 12% and 14% manganese, see WPS: “FC-M-SMAW” or “FC-M-FCAW”
b) Austenitic manganese steels shall not be welded on using carbon steel or mild steel electrodes.
c) Overlay may be completed using a consumable which is relatively high in yield strength, while repair of a crack may be completed using a consumable which more closely matches the yield strength of the rail being repaired.

4.5 Preparation and Inspection of Austenitic Manganese Steels

a) Grease rust and dirt shall be removed before repairing.
b) Entire casting should be inspected for cracking using liquid penetrant inspection.
c) While manganese steel in track-work undergoes work hardening:
    i. Do not weld minor low spots.
    ii. Avoid all welding repairs unless the track component is deeply cracked or has broken or missing parts.
    iii. When possible, confine other repairs to grinding only.
    iv. As the steel loses its ductility and becomes hardened, critical areas of flange-ways will show metal flow. Do the following:
        - Check clearances using frog gauges when appropriate
        - Correct any deviation as follows:

- Grind off excess metal to restore the proper dimensions and contours.
- While grinding, make sure not to use excessive force to limit heat build-up in the metal.
    * To grind properly, allow the grinding wheel to cut without applying excessive pressure, which can produce heat buildup. Temperature should not exceed 500°F

v. Mark worn areas or defective metal to be removed using a straightedge and soap stone.
vi. Using carbon arc cutting (CAC) to remove work-hardened and defective metal
vii. Remove 1/4” of metal to get below the work-hardened zone
viii. Lightly grind the CAC areas to a clean level surface to remove the surface layer once the area has cooled to less than 500°F.

4.6 Horizontal Crack Removal

Use CAC to remove horizontal cracks

a) Remove all horizontal cracks and taper area at the ends to accommodate grinding wheels
b) To properly remove defective metal, remove metal at each end of the crack and work back toward damaged metal and crack. Cutting from both ends of a horizontal crack may allow for the removal of a single piece of metal

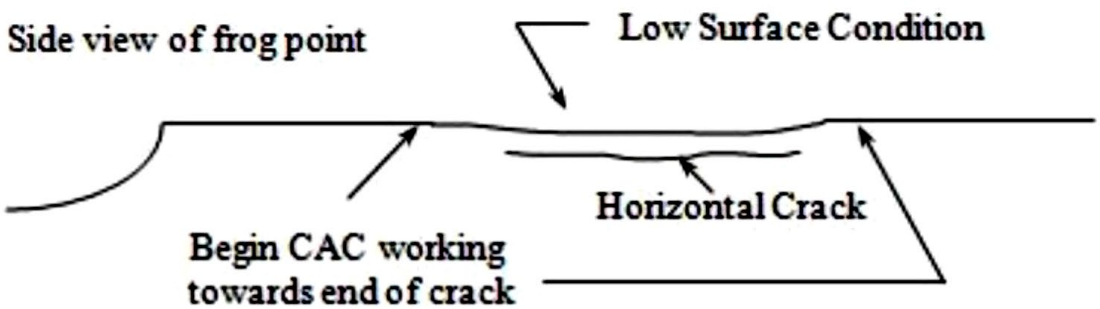


Figure Appendix I – 16 – Repair Area (Side of Point View)

4.7 Vertical Crack Removal

Use CAC to remove material at a vertical crack

a) Identify the crack
b) Remove entire vertical crack if possible, without burning through the frog casting
c) For cracks in frog flangeway including longitudinal cracks in the bottom of the flangeway, do not exceed 1/2” depth in metal removal
d) On frog wing rails and frog point, remove metal in the shape of a “U” groove type pattern to allow for electrode access
e) Grind repair area to a clean surface

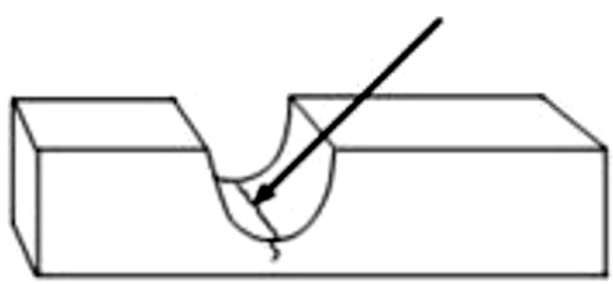


Figure Appendix I – 17 – “U” Groove Pattern

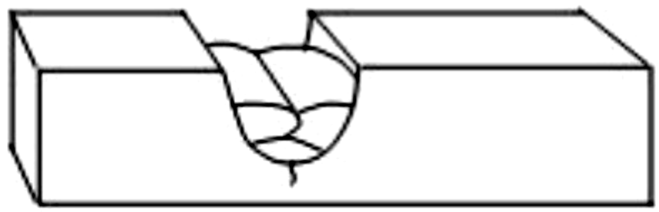


Figure Appendix I - 18 – SS Bead Passes

f) Use an approved stainless steel electrode (SMAW) designed to seal vertical cracks that cannot be fully removed
g) Complete the buildup using approved manganese welding products
h) Base metal temperature shall not exceed 500˚F (260˚C) at a point 1” (25 m) from the area being gouged.
i) Metal oxides shall be removed from gouged surface by grinding before welding can be started.

4.8 Applying the Weld

a) If surface moisture is present or if rail is below 32˚F (0˚C), heat manganese casting before welding repair begins, to dry the casting to no more than 100˚F (38˚C).
b) Weld the lowest areas first to create a level plane.

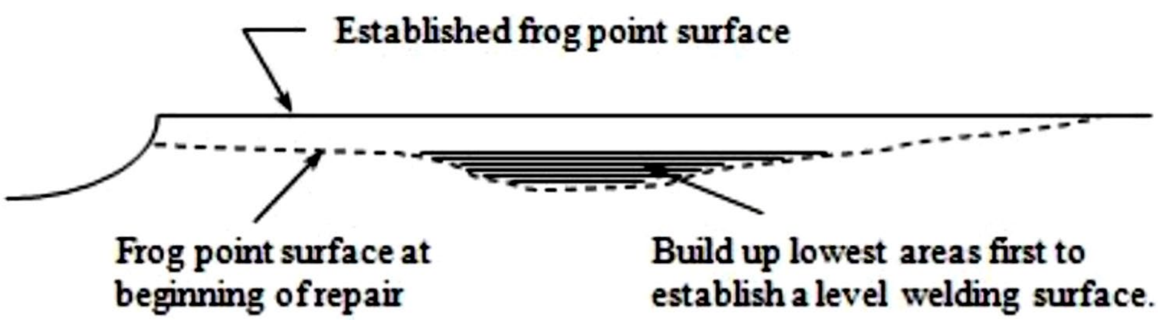


Figure Appendix I – 19 – Weld Area (side of point view)

c) Weld bead width should be between 1/2” and 5/8”. Length of the weld for stick electrodes shall be no greater than 9” (229 mm), and 12” (305 mm) for wire welding. If the weld bead is wider or longer than this, the material being repaired will heat up quickly. If the weld bead exceeds the specified width the travel speed shall be increased
d) Inter-pass temperature shall not exceed 500˚F (260˚C)
e) Use compressed air cooling to avoid overheating.
f) Weaving should be avoided and stringer welds shall be applied.
g) It is suggested to employ skip welding technique to distribute the heat and to avoid reaching the maximum inter-pass temperature.

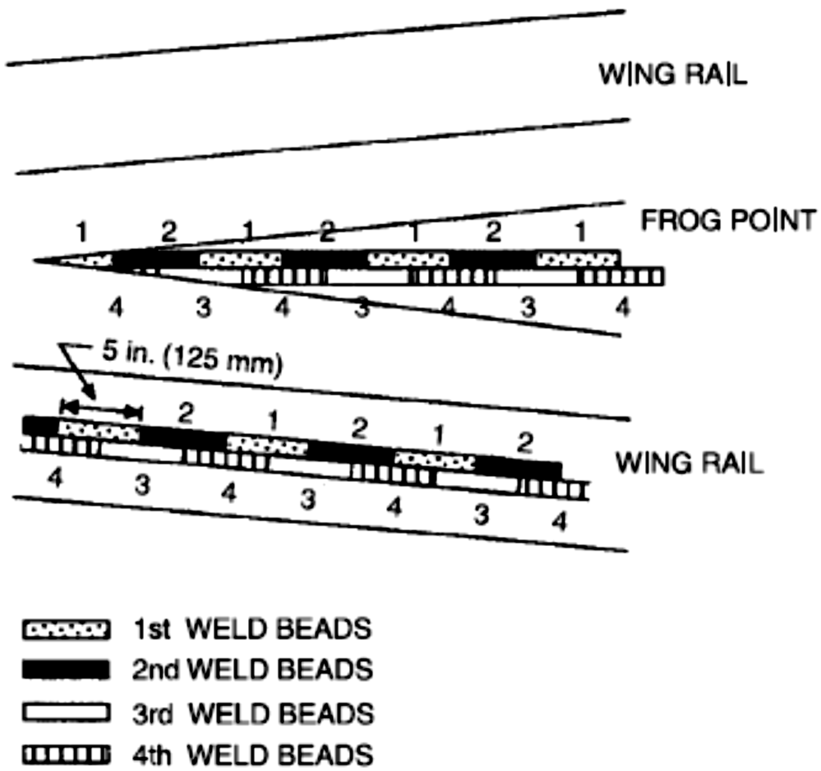


Figure Appendix I – 20 – Typical Skip Welding Repair

h) The direction of travel should be reversed for each successive bead.
i) Overlap of the adjacent weld width should be between 30% - 50%.
j) Stagger stops as starts so that they do not end / start at the same place as shown within the skip repair welding figure above.
k) Remove slag in between every pass
l) After the root pass as well as all subsequent layers of weld metal, the weld shall be inspected for any new cracking in the welds and/or casting.
m) If new cracks are visible, remove the crack before continuing with the repair.
n) Refer to the appropriate WPS for detailed welding procedure either "FC-M-SMAW" or "FC-M-FCAW"

4.9 Removing Slag and Relieving Stress

a) After applying each weld bead, remove slag and peen to reduce stress
   i. Remove slag from the beginning of the weld bead to the end of weld bead
      - The beginning of the bead is cooling so the slag will be more easily removed
   ii. Peen from the end of the weld bead towards the beginning 2 to 3 times per inch of weld
      - Peen with the round part of a 2 lb ball peen hammer before weld cools
      - This step places the weld bead in compression and relieves stress created by welding
   iii. Another means of stress relief is direction of weld travel. By alternating direction of travel, stresses are reduced to help maintain frog strength

4.10 Finish Grind

a) Finish grind the weld repair following the specification for the rail equipment.
b) Ensure that grinding does not generate too much heat and produce a blueish oxide on the weld repair

Appendix J. Units of Measurement

Although the metric system was first legalized in Canada by Prime Minister John A Macdonald in 1871, the British imperial system of units (based on yards, pounds, gallons, etc.) continued to predominate. In the 1960s, with technology rapidly advancing and expanding worldwide trade, the need for an international measurement system became increasingly apparent. In addition, the size of measurements such as the gallon differed between the United States and Canada, despite both countries using the imperial system. Beginning with the 1969 White Paper, Canada gradually transitioned from the imperial to the metric system of measurement.

Imperial measures continue to be used by the railway industry today. Standards respecting train speed and distances along railway rights-of-way and are in imperial units.

Metric			Imperial	
1 millimeter [mm]		→	0.0393701 inch [in.]	0.00328084 foot [ft.]
1 centimeter [cm]	10 mm	→	0.393701 inch [in.]	0.0328084 foot [ft.]
1 meter [m]	100 cm	→	3.2808399 foot [ft.]	0.000621371 mile [mi]
1 kilometer [km]	1000 m	→	3280.84 foot [ft.]	0.621371 mile [mi]

Figure Appendix J – 1 – Conversion of Length from Metric to Imperial

Imperial			Metric	
1 inch [in.]	0.083333 ft.	→	25.4 millimeter [mm]	2.54 centimeter [cm]
1 foot [ft.]	12 in.	→	304.8 millimeter [mm]	30.48 centimeter [cm]
1 foot [ft.]	0.000189394 mi.	→	0.3048 meter [m]	0.0003048 kilometer [km]
1 mile [mi.]	5280 ft.	→	1609.34 meter [m]	1.60934 kilometer [km]

Figure Appendix J – 2 – Conversion of Length from Imperial to Metric

Metric			Imperial	
1 kilometer per hour [km/h]	0.277778 m/s	→	0.621371 mile per hour [mph]	0.911344 foot per second [ft./s]
1 meter per second [m/s]	3.6 km/h	→	2.23694 mile per hour [mph]	3.28084 foot per second [ft./s]

Figure Appendix J – 3 – Conversion of Speed from Metric to Imperial

Imperial			Metric	
1 mile per hour [mph]	1.46667 ft./s	→	0.44704 meter per second [m/s]	1.60934 kilometer per hour [km/h]
1 foot per second [ft./s]	0.681818 mph	→	0.3048 meter per second [m/s]	1.09728 kilometer per hour [km/h]

Figure Appendix J – 4 – Conversion of Speed from Imperial to Metric

Milepost Increasing in Feet	Decimal Mile	Fractional Mile	Poles	Fractional Mile	Down Feet	Milepost Decreasing Decimal Mile
0	0.000	0	0	1	0	0.000
132	0.025		1		-132	0.975
264	0.050		2		-264	0.950
396	0.075		3		-396	0.925
528	0.100		4		-528	0.900
660	0.125	⅛	5	⅞	-660	0.875
792	0.150		6		-792	0.850
924	0.175		7		-924	0.825
1056	0.200		8		-1056	0.800
1188	0.225		9		-1188	0.775
1320	0.250	¼	10	¾	-1320	0.750
1452	0.275		11		-1452	0.725
1584	0.300		12		-1584	0.700
1716	0.325		13		-1716	0.675
1848	0.350		14		-1848	0.650
1980	0.375	⅜	15	⅝	-1980	0.625
2112	0.400		16		-2112	0.600
2244	0.425		17		-2244	0.575
2376	0.450		18		-2376	0.550
2508	0.475		19		-2508	0.525
2640	0.500	½	20	½	-2640	0.500
2772	0.525		21		-2772	0.475
2904	0.550		22		-2904	0.450
3036	0.575		23		-3036	0.425
3168	0.600		24		-3168	0.400
3300	0.625	⅝	25	⅜	-3300	0.375
3432	0.650		26		-3432	0.350
3564	0.675		27		-3564	0.325
3696	0.700		28		-3696	0.300
3828	0.725		29		-3828	0.275
3960	0.750	¾	30	¼	-3960	0.250
4092	0.775		31		-4092	0.225
4224	0.800		32		-4224	0.200
4356	0.825		33		-4356	0.175
4488	0.850		34		-4488	0.150
4620	0.875	⅞	35	⅛	-4620	0.125
4752	0.900		36		-4752	0.100
4884	0.925		37		-4884	0.075
5016	0.950		38		-5016	0.050
5148	0.975		39		-5148	0.025
5280	1.000	1	40	0	-5280	0.000

Figure Appendix J – 5 – Conversion of Feet to Decimals to Miles

Appendix K. Celsius to Fahrenheit Conversion Table

Celsius °C	Fahrenheit °F		Celsius °C	Fahrenheit °F		Celsius °C	Fahrenheit °F
-50.00	-58.00		-13.00	8.60		24.00	75.20
-49.00	-56.20		-12.00	10.40		25.00	77.00
-48.00	-54.40		-11.00	12.20		26.00	78.80
-47.00	-52.60		-10.00	14.00		27.00	80.60
-46.00	-50.80		-9.00	15.80		28.00	82.40
-45.00	-49.00		-8.00	17.60		29.00	84.20
-44.00	-47.20		-7.00	19.40		30.00	86.00
-43.00	-45.40		-6.00	21.20		31.00	87.80
-42.00	-43.60		-5.00	23.00		32.00	89.60
-41.00	-41.80		-4.00	24.80		33.00	91.40
-40.00	-40.00		-3.00	26.60		34.00	93.20
-39.00	-38.20		-2.00	28.40		35.00	95.00
-38.00	-36.40		-1.00	30.20		36.00	96.80
-37.00	-34.60		0.00	32.00		37.00	98.60
-36.00	-32.80		1.00	33.80		38.00	100.40
-35.00	-31.00		2.00	35.60		39.00	102.20
-34.00	-29.20		3.00	37.40		40.00	104.00
-33.00	-27.40		4.00	39.20		41.00	105.80
-32.00	-25.60		5.00	41.00		42.00	107.60
-31.00	-23.80		6.00	42.80		43.00	109.40
-30.00	-22.00		7.00	44.60		44.00	111.20
-29.00	-20.20		8.00	46.40		45.00	113.00
-28.00	-18.40		9.00	48.20		46.00	114.80
-27.00	-16.60		10.00	50.00		47.00	116.60
-26.00	-14.80		11.00	51.80		48.00	118.40
-25.00	-13.00		12.00	53.60		49.00	120.20
-24.00	-11.20		13.00	55.40		50.00	122.00
-23.00	-9.40		14.00	57.20		51.00	123.80
-22.00	-7.60		15.00	59.00		52.00	125.60
-21.00	-5.80		16.00	60.80		53.00	127.40
-20.00	-4.00		17.00	62.60		54.00	129.20
-19.00	-2.20		18.00	64.40		55.00	131.00
-18.00	-0.40		19.00	66.20		56.00	132.80
-17.00	1.40		20.00	68.00		57.00	134.60
-16.00	3.20		21.00	69.80		58.00	136.40
-15.00	5.00		22.00	71.60		59.00	138.20
-14.00	6.80		23.00	73.40		60.00	140.00

Figure Appendix K – 1 – Temperature Conversion Chart

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Appendix L. Clearance Obstacles and Aerial Wire Crossings

Temagami		
Mileage	Track	Obstacle
1.60	Main	Station
2.63	Main	Overpass
5.30	Main	Rock Cut
5.99	Main	Rock Cut
6.60	Main	Rock Cut
6.80	Main	Rock Cut
6.84	Main	Rock Cut
7.60	Main	Signal mast
9.50	Siding	Cantilever Signal
11.56	Main	Rock Cut
18.91	Main	Cantilever Signal
18.91	Siding	Cantilever Signal
21.23	Main	Rock Cut
21.69	Main	Rock Cut
22.40	Main	Rock Cut
22.68	Main	Rock Cut
22.72	Main	Rock Cut
23.05	Main	Rock Cut
23.15	Main	Rock Cut
23.50	Main	Rock Cut
24.48	Main	Rock Cut
27.60	Siding	Cantilever Signal
28.20	Main	Rock Cut
29.50	Main	Rock Cut
31.25	Main	Rock Cut
31.85	Main	Rock Cut
35.10	Main	Rock Cut
33.55	Main	Rock Cut
37.95	Siding	Cantilever Signal
43.50	Main	Rock Cut
47.42	Siding	Cantilever Signal
47.80	Main	Rock Cut
47.98	Main	Rock Cut
49.10	Main	Bridge
49.50	Main	Rock Cut

Temagami		
Mileage	Track	Obstacle
50.10	Main	Rock Cut
51.30	Main	Rock Cut
52.25	Main	Battery Box
52.40	Main	Rock Cut
53.90	Main	Rock Cut
54.91	Main	Rock Cut
55.45	Main	Rock Cut
55.60	Siding	Cantilever Signal
62.20	Main	Rock Cut
64.75	Main	Rock Cut
64.75	Main	Battery Box
67.50	Main	Rock Cut
67.80	Main	Battery Box
68.10	Main	Rock Cut
68.10	Main	Battery Box
70.10	Main	Rock Cut
71.25	Main	Battery Box
71.60	Main	Rock Cut
72.55	Siding	Cantilever Signal
72.70	Main	Rock Cut
73.00	Main	Rock Cut
73.10	Main	Rock Cut
73.20	Main	Rock Cut
74.40	Main	Rock Cut
74.90	Main	Rock Cut
75.70	Main	Bridge
78.00	Siding	Cantilever Signal
78.30	Main	Rock Cut
79.75	Main	Rock Cut

Temagami		
Mileage	Track	Obstacle
80.35	Main	Rock Cut
81.20	Main	Rock Cut
82.20	Main	Rock Cut
82.60	Main	Rock Cut
80.00	Main	Rock Cut
84.00	Main	Signal mast
84.50	Main	Rock Cut
85.00	Main	Rock Cut
85.60	Siding	Cantilever Signal
86.80	Main	Rock Cut
87.15	Main	Rock Cut
88.60	Main	Rock Cut
88.80	Main	Rock Cut
89.25	Main	Rock Cut
93.90	Main	Bridge
94.10	Main	Signal Mast
94.10	Main	Battery Box
94.70	Main	Cantilever Signal
94.70	Siding	Cantilever Signal
95.50	Main	Rock Cut
95.75	Main	Battery Box
96.50	Main	Rock Cut
96.80	Main	Rock Cut
98.85	Main	Rock Cut
101.30	Main	Rock Cut
101.60	Main	Rock Cut
103.25	Main	Overpass
104.70	Main	Battery Box
105.15	Main	Rock Cut
106.85	Siding	Cantilever Signal
110.25	Main	Battery Box
112.10	Main	Battery Box
112.30	Main	Rock Cut
112.40	Main	Signal Box
124.00	Main	Battery Box
125.25	Main	Cantilever Signal
125.25	Siding	Cantilever Signal
132.20	Main	Battery Box
133.50	Main	Battery Box
138.00	Main	Water Stand

Note: As at June 9, 2020; Always consult with the Director, Rail Infrastructure to confirm

Figure Appendix L – 1 – Obstructions – TSD

Kirkland Lake		
Mileage	Track	Obstacle
0.10	Main	Railing S leg of Wye
0.20	Main	Battery Box
0.40	Main	Rock Cut
0.50	Main	Battery Box
2.00	Main	Rock Cut
4.90	Main	Rock Cut
6.00	Main	Battery Box
6.15	Main	Rock Cut
7.30	Main	Rock Cut
16.50	Main	Rock Cut
19.30	Main	Rock Cut
23.10	Main	Rock Cut
23.20	Main	Rock Cut
25.20	Main	Rock Cut
26.50	Main	Rock Cut
33.10	Main	Battery Box
33.80	Main	Battery Box
36.10	Main	Battery Box
44.50	Main	Rock Cut
44.90	Main	Rock Cut

Ramore		
Mileage	Track	Obstacle
1.30	Siding	Cantilever Signal
7.45	Main	Bridge
8.90	Main	Battery Box
11.50	Main	Rock Cut
12.00	Main	Rock Cut
12.00	Main	Signal
13.20	Main	Rock Cut
13.50	Main	Rock Cut
14.50	Main	Rock Cut
14.52	Main	Battery Box
14.52	Main	Signal
15.10	Main	Water Stand
15.60	Main	Rock Cut
16.50	Main	Rock Cut
18.00	Main	Rock Cut
19.15	Main	Rock Cut
19.40	Main	Rock Cut
19.60	Main	Rock Cut
20.80	Siding	Cantilever Signal
21.90	Main	Rock Cut
22.40	Main	Battery Box
22.41	Main	Rock Cut
22.70	Main	Rock Cut
23.56	Main	Overpass
23.56	Main	Rock Cut
24.00	Main	Rock Cut
24.30	Main	Battery Box
24.30	Main	Signal
24.50	Main	Rock Cut
24.80	Main	Rock Cut
25.10	Main	Rock Cut
25.50	Main	Rock Cut
26.00	Main	Bridge
26.01	Main	Overpass
26.01	Siding	Overpass
26.20	Main	Rock Cut
26.50	Main	Rock Cut
27.00	Siding	Cantilever Signal
27.50	Main	Rock Cut
27.70	Main	Rock Cut
28.20	Main	Rock Cut
28.74	Main	Rock Cut
28.90	Main	Battery Box
29.25	Main	Rock Cut
30.10	Main	Rock Cut
30.50	Main	Battery Box
32.50	Main	Rock Cut
32.50	Main	Signal

Ramore		
Mileage	Track	Obstacle
33.20	Main	Rock Cut
33.50	Main	Battery Box
34.21	Siding	Cantilever Signal
35.50	Main	Rock Cut
39.50	Main	Rock Cut
43.33	Siding	Cantilever Signal

Kapuskasing		
Mileage	Track	Obstacle
50.40	Main	Bridge
52.40	Main	Bridge
65.30	Main	Bridge
90.10	Main	Bridge
95.00	Main	Bridge

Island Falls		
Mileage	Track	Obstacle
137.80	Main	Bridge
174.00	Main	Bridge

Note: As at June 9, 2020; Always consult with the Director, Rail Infrastructure to confirm

Figure Appendix L – 2 – Obstructions – KLSD, RSD, KSD and IsFSD

Mileage	SubCode	Type	Owned By
0.12	ASD	POWER LINE-AERIAL	ONTARIO HYDRO
3.80	ASD	POWER LINE-AERIAL	JONES & LAUGHLIN MINING CO LTD
3.83	ASD	POWER LINE-AERIAL	ONTARIO HYDRO
4.82	ASD	TELEPHONE LINE-AERIAL	NORTHERNTEL
4.92	ASD	POWER LINE-AERIAL	ONTARIO HYDRO
0.16	CSD	POWER LINE-AERIAL	ONTARIO HYDRO
1.79	DSD	POWER LINE-AERIAL	ONTARIO HYDRO
1.83	DSD	POWER LINE-AERIAL	ONTARIO HYDRO
2.82	DSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
2.92	DSD	POWER LINE-AERIAL	ONTARIO HYDRO
3.59	DSD	POWER LINE-AERIAL	ONTARIO HYDRO
4.46	DSD	POWER LINE-AERIAL	ONTARIO HYDRO
4.52	DSD	POWER LINE-AERIAL	TOWN OF IROQUOIS FALLS
5.02	DSD	POWER LINE-AERIAL	ONTARIO HYDRO
5.08	DSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
5.09	DSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
5.31	DSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
5.56	DSD	POWER LINE-AERIAL	ONTARIO HYDRO
5.62	DSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
8.70	DSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
9.84	DSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
9.85	DSD	POWER LINE-AERIAL	ONTARIO HYDRO
9.91	DSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
11.54	DSD	POWER LINE-AERIAL	ONTARIO HYDRO
11.54	DSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
12.14	DSD	POWER LINE-AERIAL	ONTARIO HYDRO
12.64	DSD	POWER LINE-AERIAL	ONTARIO HYDRO
12.64	DSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
21.74	DSD	POWER LINE-AERIAL	ONTARIO HYDRO
23.81	DSD	POWER LINE-AERIAL	ONTARIO HYDRO
23.89	DSD	POWER LINE-AERIAL	ONTARIO HYDRO
26.60	DSD	POWER LINE-AERIAL	Abitibi Electric Development Company
27.00	DSD	FIBRE OPTIC-AERIAL	NORTHERN ONT WIRES (COCHRANE PUC)
27.00	DSD	POWER LINE-AERIAL	NORTHLAND POWER
27.00	DSD	POWER LINE-AERIAL	NORTHERN ONT WIRES (COCHRANE PUC)
2.74	ELSD	POWER LINE-AERIAL	ONTARIO HYDRO
2.74	ELSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
4.00	ELSD	POWER LINE-AERIAL	ONTARIO HYDRO
5.00	ELSD	POWER LINE-AERIAL	ONTARIO HYDRO
7.00	ELSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
10.70	ELSD	POWER LINE-AERIAL	ONTARIO HYDRO
12.22	ELSD	POWER LINE-AERIAL	ONTARIO HYDRO
17.79	ELSD	POWER LINE-AERIAL	ONTARIO HYDRO
22.62	ELSD	POWER LINE-AERIAL	ONTARIO HYDRO
28.21	ELSD	POWER LINE-AERIAL	ONTARIO HYDRO
28.25	ELSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
28.50	ELSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
28.70	ELSD	POWER LINE-AERIAL	WILFRED PAIEMENT LUMBER CO.

Note: As at June 9, 2020; Always consult with the Director, Rail Infrastructure to confirm

Figure Appendix L – 3 – Aerial (Agrium, Devonshire and Elk Lake)

Mileage	SubCode	Type	Owned By
0.08	IRFSD	POWER LINE-AERIAL	NORTHERN ONT WIRES (COCHRANE PUC)
0.08	IRFSD	POWER LINE-AERIAL	NORTHERN ONT WIRES (COCHRANE PUC)
0.30	IRFSD	POWER LINE-AERIAL	COCHRANE PUC
0.36	IRFSD	POWER LINE-AERIAL	COCHRANE PUC
0.38	IRFSD	POWER LINE-AERIAL	COCHRANE PUC
1.07	IRFSD	POWER LINE-AERIAL	COCHRANE PUC
1.50	IRFSD	POWER LINE-AERIAL	ONTARIO HYDRO
1.83	IRFSD	POWER LINE-AERIAL	ONTARIO HYDRO
3.63	IRFSD	POWER LINE-AERIAL	ONTARIO HYDRO
3.71	IRFSD	CABLE TV-AERIAL	NORTHERN CABLE
3.71	IRFSD	CABLE TV-AERIAL	PERSONA COMMUNICATIONS INC
4.75	IRFSD	POWER LINE-AERIAL	ONTARIO HYDRO
4.90	IRFSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
4.90	IRFSD	POWER LINE-AERIAL	ONTARIO HYDRO
4.94	IRFSD	POWER LINE-AERIAL	ONTARIO HYDRO
4.95	IRFSD	POWER LINE-AERIAL	ONTARIO HYDRO
4.96	IRFSD	POWER LINE-AERIAL	ONTARIO HYDRO
5.29	IRFSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
5.31	IRFSD	CABLE TV-AERIAL	NORTHERN CABLE
5.37	IRFSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
5.48	IRFSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
5.60	IRFSD	CABLE TV-AERIAL	NORTHERN CABLE
5.65	IRFSD	POWER LINE-AERIAL	NORTHERN ONT WIRES (COCHRANE PUC)
5.82	IRFSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
6.02	IRFSD	TELEPHONE LINE-AERIAL	TOWN OF IROQUOIS FALLS
6.02	IRFSD	POWER LINE-AERIAL	NORTHERN ONT WIRES (COCHRANE PUC)
6.05	IRFSD	POWER LINE-AERIAL	NORTHERN ONT WIRES (COCHRANE PUC)
0.50	ISFSD	CABLE TV-BURIED	EastLink
1.07	ISFSD	POWER LINE-AERIAL	NORTHERN ONT WIRES (COCHRANE PUC)
17.83	ISFSD	POWER LINE-AERIAL	ONTARIO HYDRO
173.65	ISFSD	POWER LINE-AERIAL	DEBEERS
174.93	ISFSD	POWER LINE-AERIAL	ONTARIO HYDRO
18.40	ISFSD	POWER LINE-AERIAL	ONTARIO HYDRO
18.58	ISFSD	POWER LINE-AERIAL	ONTARIO HYDRO
182.40	ISFSD	POWER LINE-AERIAL	FIVE NATIONS ENERGY INC
182.40	ISFSD	POWER LINE-AERIAL	DEBEERS
187.71	ISFSD	FIBRE OPTIC-AERIAL	Ontera
187.72	ISFSD	POWER LINE-AERIAL	MOOSONEE DEV AREA BOARD
44.66	ISFSD	POWER LINE-AERIAL	ONTARIO HYDRO
6.60	ISFSD	POWER LINE-AERIAL	Northland Power
6.62	ISFSD	POWER LINE-AERIAL	HYDRO ONE
66.44	ISFSD	POWER LINE-AERIAL	ONTARIO HYDRO
68.94	ISFSD	POWER LINE-AERIAL	ONTARIO HYDRO
69.03	ISFSD	POWER LINE-AERIAL	ONTARIO HYDRO
70.29	ISFSD	POWER LINE-AERIAL	ONTARIO HYDRO
73.39	ISFSD	POWER LINE-AERIAL	ONTARIO HYDRO
73.92	ISFSD	POWER LINE-AERIAL	ONTARIO HYDRO
78.17	ISFSD	POWER LINE-AERIAL	Ontario Power Generation
78.30	ISFSD	FIBRE OPTIC-AERIAL	Ontera
79.10	ISFSD	FIBRE OPTIC-AERIAL	Ontera
8.23	ISFSD	POWER LINE-AERIAL	ONTARIO HYDRO
86.29	ISFSD	POWER LINE-AERIAL	ONTARIO HYDRO
9.84	ISFSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
93.12	ISFSD	POWER LINE-AERIAL	ONTARIO HYDRO
93.30	ISFSD	POWER LINE-AERIAL	ONTARIO HYDRO
93.42	ISFSD	POWER LINE-AERIAL	ONTARIO HYDRO
93.50	ISFSD	POWER LINE-AERIAL	ONTARIO HYDRO
94.60	ISFSD	POWER LINE-AERIAL	DEBEERS

Note: As at June 9, 2020; Always consult with the Director, Rail Infrastructure to confirm

Figure Appendix L – 4 – Aerial (Iroquois Falls and Island Falls)

Mileage	SubCode	Type	Owned By
1.00	KAPSD	POWER LINE-AERIAL	Powertell
1.00	KAPSD	FIBRE OPTIC-AERIAL	COCHRANE PUC
1.00	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
2.42	KAPSD	POWER LINE-AERIAL	HEPC
5.76	KAPSD	POWER LINE-AERIAL	H2O POWER LP
6.41	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
6.41	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
11.80	KAPSD	POWER LINE-AERIAL	ABITIBI-PRICE INC
14.57	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
17.47	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
18.40	KAPSD	POWER LINE-AERIAL	IVAN LAMONTAGNE
34.98	KAPSD	POWER LINE-AERIAL	Neilson-Yellow Falls Hydroelectric Proje
37.10	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
37.10	KAPSD	POWER LINE-AERIAL	HYDRO ONE
37.84	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
38.77	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
38.78	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
39.30	KAPSD	POWER LINE-AERIAL	HEPC
40.00	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
45.75	KAPSD	POWER LINE-AERIAL	Hydro One
48.10	KAPSD	POWER LINE-AERIAL	Hydro One
49.20	KAPSD	POWER LINE-AERIAL	CARMICHAEL POWER CORPORATION
49.20	KAPSD	POWER LINE-AERIAL	CARMICHAEL POWER CORPORATION
49.91	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
49.95	KAPSD	CABLE TV-AERIAL	PERSONA COMMUNICATIONS INC
49.95	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
50.20	KAPSD	POWER LINE-AERIAL	
51.50	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
51.65	KAPSD	FIBRE OPTIC-AERIAL	NORTHERNTEL
51.79	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
52.15	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
56.21	KAPSD	POWER LINE-AERIAL	HEPC
58.50	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
59.94	KAPSD	POWER LINE-AERIAL	HEPC
60.21	KAPSD	POWER LINE-AERIAL	Hydro One
62.10	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
63.50	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
64.25	KAPSD	POWER LINE-AERIAL	Hydro One
65.25	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
66.23	KAPSD	CABLE TV-AERIAL	PERSONA COMMUNICATIONS INC
66.64	KAPSD	POWER LINE-AERIAL	HEPC
66.70	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
67.31	KAPSD	POWER LINE-AERIAL	TWP OF O'BRIEN
67.98	KAPSD	CABLE TV-AERIAL	PERSONA COMMUNICATIONS INC
68.03	KAPSD	POWER LINE-AERIAL	HEPC
68.44	KAPSD	POWER LINE-AERIAL	HEPC
68.94	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
69.40	KAPSD	TELEPHONE LINE-AERIAL	SPRUCE FALLS POWER & PAPER CO LTD
69.40	KAPSD	POWER LINE-AERIAL	SPRUCE FALLS POWER & PAPER CO LTD
69.73	KAPSD	TELEPHONE LINE-AERIAL	SPRUCE FALLS POWER & PAPER CO LTD
69.80	KAPSD	CABLE TV-AERIAL	PERSONA COMMUNICATIONS INC

Note: As at June 9, 2020; Always consult with the Director, Rail Infrastructure to confirm

Figure Appendix L – 5 – Aerial (Kapuskasing up to Mile 69.80)

Mileage	SubCode	Type	Owned By
70.00	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
70.06	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
70.34	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
70.34	KAPSD	POWER LINE-AERIAL	HYDRO ONE
71.56	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
71.57	KAPSD	POWER LINE-AERIAL	HEPC
71.72	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
72.04	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
73.10	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
73.37	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
73.45	KAPSD	POWER LINE-AERIAL	HEPC
74.30	KAPSD	CABLE TV-AERIAL	PERSONA COMMUNICATIONS INC
75.89	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
76.29	KAPSD	CABLE TV-AERIAL	NORTHERN CABLE
76.72	KAPSD	POWER LINE-AERIAL	HEPC
76.75	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
77.28	KAPSD	POWER LINE-AERIAL	HYDRO ONE
78.56	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
79.40	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
79.94	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
80.03	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
80.25	KAPSD	POWER LINE-AERIAL	HEPC
80.25	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
80.38	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
80.80	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
81.80	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
84.37	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
86.38	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
87.03	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
91.36	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
91.38	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
91.86	KAPSD	CABLE TV-AERIAL	PERSONA COMMUNICATIONS INC
92.16	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
95.37	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
95.50	KAPSD	POWER LINE-AERIAL	TWP OF MCCREA
95.81	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
99.06	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL

Note: As at June 9, 2020; Always consult with the Director, Rail Infrastructure to confirm

Figure Appendix L – 6 – Aerial (Kapuskasing from Mile 70.00 to 99.06)

Mileage	SubCode	Type	Owned By
101.99	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
104.34	KAPSD	POWER LINE-AERIAL	TCPL
104.62	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
107.50	KAPSD	POWER LINE-AERIAL	B MASKELL LTD
109.70	KAPSD	CABLE TV-AERIAL	CN RAIL
110.01	KAPSD	POWER LINE-AERIAL	HEPC
110.05	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
110.15	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
110.17	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
110.50	KAPSD	POWER LINE-AERIAL	HEPC
111.03	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
111.14	KAPSD	POWER LINE-AERIAL	HEPC
116.33	KAPSD	POWER LINE-AERIAL	HEPC
119.20	KAPSD	POWER LINE-AERIAL	HEPC
121.78	KAPSD	CABLE TV-AERIAL	PERSONA COMMUNICATIONS INC
122.42	KAPSD	POWER LINE-AERIAL	HEPC
123.66	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
123.94	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
124.80	KAPSD	POWER LINE-AERIAL	HEARST HYDRO
125.20	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
125.60	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
125.77	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
125.90	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
126.50	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
127.07	KAPSD	POWER LINE-AERIAL	Hearst Power Distribution
127.10	KAPSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
127.40	KAPSD	POWER LINE-AERIAL	HEPC
127.48	KAPSD	POWER LINE-AERIAL	HEPC
127.68	KAPSD	POWER LINE-AERIAL	PUC
127.80	KAPSD	POWER LINE-AERIAL	ONTARIO HYDRO
128.30	KAPSD	POWER LINE-AERIAL	Hearst Power
128.31	KAPSD	FIBRE OPTIC-AERIAL	Hearst Connect
128.63	KAPSD	CABLE TV-AERIAL	NORTHERN CABLE
128.63	KAPSD	CABLE TV-AERIAL	NORTHERN CABLE
183.42	KAPSD	CABLE TV-AERIAL	NORTHLAND POWER

Note: As at June 9, 2020; Always consult with the Director, Rail Infrastructure to confirm

Figure Appendix L – 7 – Aerial (Kapuskasing from Mile 101.99 to 183.42)

Mileage	SubCode	Type	Owned By
14.72	KIDD	POWER LINE-AERIAL	Ontario Hydro
0.25	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
0.30	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
0.30	KLSD	FIBRE OPTIC-AERIAL	EASTLINK
0.30	KLSD	FIBRE OPTIC-AERIAL	NORTHERNTEL
0.30	KLSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
0.30	KLSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
0.69	KLSD	POWER LINE-AERIAL	HYDRO ONE
1.35	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
2.84	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
3.10	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
4.95	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
5.19	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
5.17	KLSD	POWER LINE-AERIAL	EASTMAQUE GOLD MINES LTD
5.20	KLSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
5.42	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
5.60	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
5.60	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
5.66	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
5.70	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
5.70	KLSD	FIBRE OPTIC-AERIAL	ONTERA
5.96	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
5.99	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
6.07	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
6.08	KLSD	FIBRE OPTIC-AERIAL	ONTERA
6.28	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
6.29	KLSD	FIBRE OPTIC-AERIAL	EASTLINK
9.46	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
11.21	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
11.49	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
11.79	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
13.46	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
14.05	KLSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
14.87	KLSD	POWER LINE-AERIAL	AMERICAN BARRICK RESOURCES COR
16.40	KLSD	POWER LINE-AERIAL	INCO METALS COMPANY
16.50	KLSD	POWER LINE-AERIAL	MCBEAN MINE
16.61	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
19.89	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
25.67	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
32.07	KLSD	FIBRE OPTIC-AERIAL	ONTERA
32.11	KLSD	POWER LINE-AERIAL	ONTARIO HYDRO
33.52	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
35.80	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
41.84	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
41.84	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
46.52	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
46.54	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
48.51	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
48.89	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
49.20	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
50.76	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
50.78	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)

Note: As at June 9, 2020; Always consult with the Director, Rail Infrastructure to confirm

Figure Appendix L – 8 – Aerial (Kidd and Kirkland Lake up to Mile 50.78)

Mileage	SubCode	Type	Owned By
51.79	KLSD	CABLE TV-AERIAL	CABLEVISION
52.05	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
52.35	KLSD	POWER LINE-AERIAL	Hydro-Quebec
52.80	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
55.20	KLSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
56.17	KLSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
51.64	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
51.79	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
56.44	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
56.09	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
39.03	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
50.23	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
51.04	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
51.37	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
51.52	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
51.79	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
52.05	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
52.20	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
52.70	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
52.83	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
53.07	KLSD	TELEPHONE LINE-AERIAL	Telebec
53.07	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
54.51	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
55.61	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
55.69	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
55.88	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
55.93	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
55.95	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
56.00	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
56.09	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
56.09	KLSD	CABLE TV-AERIAL	CABLEVISION
56.10	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
56.14	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
56.17	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
56.22	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
56.23	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
56.37	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
56.37	KLSD	FIBRE OPTIC-AERIAL	TELEBEC (BELL)
56.39	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
56.44	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
57.56	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
58.29	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
58.29	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
58.62	KLSD	FIBRE OPTIC-AERIAL	TELECON
58.62	KLSD	POWER LINE-AERIAL	HYDRO QUEBEC
58.77	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
59.00	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
59.06	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
59.15	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
59.39	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
59.39	KLSD	FIBRE OPTIC-AERIAL	Telus
59.41	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO
59.54	KLSD	TELEPHONE LINE-AERIAL	TELEBEC (BELL)
59.99	KLSD	POWER LINE-AERIAL	QUEBEC HYDRO

Note: As at June 9, 2020; Always consult with the Director, Rail Infrastructure to confirm

Figure Appendix L – 9 – Aerial (Kirkland Lake from Mile 51.79 to 59.99)

Mileage	SubCode	Type	Owned By
0.17	NA	POWER LINE-AERIAL	ONTARIO HYDRO
0.25	MSSD	CABLE TV-AERIAL	NORTHERN CABLE
0.67	PAGSD	POWER LINE-AERIAL	HEPC
2.65	PAGSD	CABLE TV-AERIAL	PERSONA COMMUNICATIONS INC
5.94	PAGSD	POWER LINE-AERIAL	HEPC
13.10	PAGSD	POWER LINE-AERIAL	ALGONQUIN POWER CORP INC
16.10	PAGSD	POWER LINE-AERIAL	ONTARIO HYDRO
22.31	PAGSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
22.40	PAGSD	POWER LINE-AERIAL	HEPC
0.09	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
0.14	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
0.40	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
0.60	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
0.85	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
0.97	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
1.85	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
1.85	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
4.87	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
5.88	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
6.88	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
7.93	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
14.51	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
20.88	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
20.89	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
20.89	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
23.56	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
25.97	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
25.99	RSD	CABLE TV-AERIAL	Eastlink
26.00	RSD	FIBRE OPTIC-AERIAL	NORTHERNTEL
26.00	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
26.00	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
26.07	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
26.78	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
26.83	RSD	POWER LINE-AERIAL	HYDRO ONE
36.96	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
36.96	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
37.15	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
37.76	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
37.76	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
38.16	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
38.16	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
39.14	RSD	POWER LINE-AERIAL	TCPL
39.14	RSD	POWER LINE-AERIAL	TCPL
48.37	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
49.50	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
52.20	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
52.55	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
54.17	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
55.70	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
55.70	RSD	POWER LINE-AERIAL	ONTARIO HYDRO

Note: As at June 9, 2020; Always consult with the Director, Rail Infrastructure to confirm

Figure Appendix L – 10 – Aerial (Pagwa and Ramore up to Mile 55.70)

Mileage	SubCode	Type	Owned By
56.06	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
56.17	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
56.32	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
56.50	RSD	POWER LINE-AERIAL	Hydro One
56.51	RSD	POWER LINE-AERIAL	HYDRO ONE
56.52	RSD	POWER LINE-AERIAL	HYDRO ONE
56.60	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
61.54	RSD	POWER LINE-AERIAL	Hydro One
61.54	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
61.89	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
63.17	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
64.29	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
64.79	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
65.00	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
65.12	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
65.86	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
66.37	RSD	FIBRE OPTIC-AERIAL	NORTHERNTEL
66.55	RSD	CABLE TV-AERIAL	NORTHERN CABLE
66.55	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
68.56	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
68.92	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
69.77	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
72.60	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
74.34	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
75.84	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
76.35	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
76.68	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
76.70	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
77.25	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
78.51	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
79.00	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
79.08	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
79.33	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
80.25	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
80.92	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
81.28	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
82.30	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
83.90	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
85.13	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
86.19	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
88.10	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
91.50	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
94.08	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
94.36	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
94.53	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
94.60	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
95.42	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
95.86	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
97.03	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
99.58	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL

Note: As at June 9, 2020; Always consult with the Director, Rail Infrastructure to confirm

Figure Appendix L – 11 – Aerial (Ramore from Mile 56.06 to 99.58)

Mileage	SubCode	Type	Owned By
100.44	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
100.96	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
101.95	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
103.49	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
104.17	RSD	POWER LINE-AERIAL	A&L LINE CONSTRUCTION
104.33	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
104.33	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
105.74	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
105.78	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
106.83	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
106.93	RSD	FIBRE OPTIC-AERIAL	ONTERA
106.95	RSD	FIBRE OPTIC-AERIAL	ONTERA
107.00	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
107.01	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
107.01	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
107.12	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
107.55	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
108.28	RSD	POWER LINE-AERIAL	HYDRO ONE
108.28	RSD	CABLE TV-AERIAL	TIMMINS CABLE TV SERVICES
109.30	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
109.30	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
109.72	RSD	CABLE TV-AERIAL	NORTHERN CABLE
109.72	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
109.72	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
112.15	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
112.20	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
112.39	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
112.50	RSD	CABLE TV-AERIAL	NORTHERN CABLE
112.51	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
112.54	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
113.45	RSD	CABLE TV-AERIAL	NORTHERN CABLE
113.45	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
114.46	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
114.47	RSD	FIBRE OPTIC-AERIAL	ONTERA
115.46	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
115.48	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
115.53	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
115.54	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
115.55	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
115.90	RSD	POWER LINE-AERIAL	ONTARIO HYDRO

Note: As at June 9, 2020; Always consult with the Director, Rail Infrastructure to confirm

Figure Appendix L – 12 – Aerial (Ramore from 100.44 to 115.90)

Mileage	SubCode	Type	Owned By
116.40	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
116.54	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
116.72	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
117.10	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
117.28	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
117.28	RSD	CABLE TV-AERIAL	TIMMINS CABLE TV SERVICES
117.61	RSD	POWER LINE-AERIAL	MCINTYRE PORCUPINE MINES LTD
117.64	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
117.72	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
117.78	RSD	POWER LINE-AERIAL	ECSTALL MINING LIMITED
118.00	RSD	CABLE TV-AERIAL	NORTHERN CABLE
118.00	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
118.00	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
118.50	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
118.51	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
118.70	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
118.70	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
118.70	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
118.87	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
119.02	RSD	CABLE TV-AERIAL	TIMMINS CABLE TV SERVICES
119.03	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
119.38	RSD	TELEPHONE LINE-AERIAL	NorthernTel
119.48	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
119.52	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
119.54	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
119.60	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
119.68	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
119.72	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
119.86	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
120.23	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
120.32	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
120.33	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
120.38	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
120.77	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
120.84	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
120.99	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
121.14	RSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
121.14	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
121.29	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
121.37	RSD	POWER LINE-AERIAL	ONTARIO HYDRO
121.51	RSD	POWER LINE-AERIAL	ONTARIO HYDRO

Note: As at June 9, 2020; Always consult with the Director, Rail Infrastructure to confirm

Figure Appendix L – 13 – Aerial (Ramore from Mile 116.40 to 121.51)

Mileage	SubCode	Type	Owned By
2.07	SSD	POWER LINE-AERIAL	HYDRO ONE
2.87	SSD	POWER LINE-AERIAL	ONTARIO HYDRO
2.84	SSD	POWER LINE-AERIAL	ONTARIO HYDRO
2.87	SSD	POWER LINE-AERIAL	ONTARIO HYDRO
3.48	SSD	POWER LINE-AERIAL	ONTARIO HYDRO
0.00	TSD	POWER LINE-AERIAL	ONR
0.00	TSD	POWER LINE-AERIAL	NORTH BAY HYDRO
0.00	TSD	POWER LINE-AERIAL	NORTH BAY HYDRO
0.00	TSD	POWER LINE-AERIAL	NORTH BAY HYDRO
0.76	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
0.80	TSD	POWER LINE-AERIAL	NORTH BAY HYDRO
1.03	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
1.36	TSD	FIBRE OPTIC-AERIAL	PERSONA COMMUNICATIONS INC
1.36	TSD	POWER LINE-AERIAL	NORTH BAY HYDRO
1.36	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
1.36	TSD	POWER LINE-AERIAL	NORTH BAY HYDRO
1.70	TSD	POWER LINE-AERIAL	NORTH BAY HYDRO
2.30	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
2.94	TSD	POWER LINE-AERIAL	NORTH BAY HYDRO
3.05	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
3.10	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
3.11	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
3.36	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
3.93	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
4.49	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
4.50	TSD	POWER LINE-AERIAL	NORTH BAY HYDRO
4.65	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
4.82	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
4.83	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
4.87	TSD	POWER LINE-AERIAL	NORTH BAY HYDRO
4.87	TSD	TELEPHONE LINE-AERIAL	BELL CANADA
7.57	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
7.76	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
8.86	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
8.86	TSD	TELEPHONE LINE-AERIAL	BELL CANADA
10.08	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
10.08	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
13.93	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
14.26	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
14.72	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
16.75	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
44.30	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
69.63	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
71.72	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
71.93	TSD	CABLE TV-AERIAL	CLEAR CREST CABLE COMPANY
71.93	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
72.24	TSD	POWER LINE-AERIAL	TCPL
73.15	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
75.93	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
76.10	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
78.10	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
79.33	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
80.60	TSD	FIBRE OPTIC-AERIAL	ONTERA

Note: As at June 9, 2020; Always consult with the Director, Rail Infrastructure to confirm

Figure Appendix L – 14 – Aerial (Sherman and Temagami up to 80.60)

Mileage	SubCode	Type	Owned By
92.29	TSD	POWER LINE-AERIAL	TCPL
93.42	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
93.47	TSD	POWER LINE-AERIAL	TCPL
96.08	TSD	POWER LINE-AERIAL	TCPL
97.17	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
97.80	TSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
98.55	TSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
98.55	TSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
98.56	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
98.96	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
99.34	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
102.06	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
102.06	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
102.08	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
102.68	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
102.76	TSD	CABLE TV-AERIAL	CLEAR CREST CABLE COMPANY
103.21	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
103.21	TSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
103.47	TSD	FIBRE OPTIC-AERIAL	ONTERA
103.47	TSD	CABLE TV-AERIAL	CLEAR CREST CABLE COMPANY
103.47	TSD	CABLE TV-AERIAL	NORTHERN CABLE
103.77	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
104.05	TSD	CABLE TV-AERIAL	CLEAR CREST CABLE COMPANY
104.05	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
104.73	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
104.73	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
105.10	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
105.22	TSD	CABLE TV-AERIAL	CLEAR CREST CABLE COMPANY
105.22	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
105.34	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
105.73	TSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
105.77	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
106.17	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
106.19	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
106.56	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
106.76	TSD	CABLE TV-AERIAL	HILLCREST COMMUNITY TV
106.95	TSD	FIBRE OPTIC-AERIAL	ONTERA
106.95	TSD	CABLE TV-AERIAL	PERSONA COMMUNICATIONS INC
106.95	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
106.95	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
107.30	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
107.47	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
107.50	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
107.55	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
107.56	TSD	CABLE TV-AERIAL	PERSONA COMMUNICATIONS INC
107.58	TSD	CABLE TV-AERIAL	HILLCREST COMMUNITY TV
107.58	TSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
107.65	TSD	CABLE TV-AERIAL	PERSONA COMMUNICATIONS INC
107.70	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
108.31	TSD	POWER LINE-AERIAL	HYDRO ONE
108.79	TSD	CABLE TV-AERIAL	NORTHERN CABLE
108.79	TSD	POWER LINE-AERIAL	ONTARIO HYDRO

Note: As at June 9, 2020; Always consult with the Director, Rail Infrastructure to confirm

Figure Appendix L – 15 – Aerial (Temagami from Mile 92.29 to 108.79)

Mileage	SubCode	Type	Owned By
109.68	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
109.80	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
111.51	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
111.56	TSD	CABLE TV-AERIAL	PERSONA COMMUNICATIONS INC
111.97	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
112.17	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
112.20	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
112.43	TSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
112.45	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
112.50	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
112.53	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
112.65	TSD	CABLE TV-AERIAL	CLEARVIEW CABLE TV
112.65	TSD	FIBRE OPTIC-AERIAL	NORTHERN CABLE
112.65	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
112.65	TSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
112.65	TSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
113.09	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
113.20	TSD	POWER LINE-AERIAL	HYDRO ONE
113.41	TSD	POWER LINE-AERIAL	BELL CANADA
113.55	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
113.69	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
113.80	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
114.96	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
115.18	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
115.50	TSD	POWER LINE-AERIAL	Ontario Hydro
116.00	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
116.09	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
118.45	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
120.52	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
124.66	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
125.81	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
127.10	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
127.56	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
128.10	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
128.60	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
128.77	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
129.85	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
131.67	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
132.92	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
133.25	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
135.04	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
135.92	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
137.65	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
137.65	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
138.00	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
138.23	TSD	CABLE TV-AERIAL	CLEAR CREST CABLE COMPANY
138.23	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
138.23	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
138.23	TSD	POWER LINE-AERIAL	ONTARIO HYDRO
138.23	TSD	TELEPHONE LINE-AERIAL	NORTHERNTEL
138.23	TSD	TELEPHONE LINE-AERIAL	NORTHERNTEL

Note: As at June 9, 2020; Always consult with the Director, Rail Infrastructure to confirm

Figure Appendix L – 16 – Aerial (Temagami from Mile 109.68 to 138.23)

Appendix M. Grinding – Recommended Practice for Use of Abrasive Wheels

1. Scope

These recommended practices cover the safe use, care and protection of abrasive wheels as it relates to railway construction and maintenance. Before using the equipment, even in a maintenance context, it is necessary to read the corresponding instruction manual, together with any supplementary documentation, and the safety rules in force in the workplace.

Comply carefully with the general safety instructions drawn up for the site by the person in charge of the site.

Equipment should only be used, serviced or repaired by competent personnel who have undergone thorough specialized training beforehand. Technical documentation and the instructions are useful in completing the knowledge acquired during the training courses, but they can in no way replace theoretical and practical qualifying training, provided in accordance with good professional practice.

Reference to additional requirements and standards within this Manual (e.g., turnouts), including Appendix I – Rail Welding should be made to ensure conditions in the field are within standards or protected against.

1.1 Grinding Purpose

a) Flow is the flattening or squeezing out of the metal on top of the rail head, turnouts (switch points, stock rails, etc.) rail ends such as joints, and mating surfaces of rail components such as the manganese wing and wing rail on a frog.

b) Flow is caused by excessive pressure exerted on the wheel rail contact area.

c) If flow is not removed regularly, it leads to chipping or breaking apart of costly turnout components like switch points, stock rails and frogs or derailments.

Figure Appendix M – 1 – Chipping Due to Lack of Joint Maintenance

d) Track components with limited grinding preventative maintenance must be welded or replaced prematurely, both of which are very costly, time consuming, and may affect operations.

e) Grinding is more effective than it is to weld (e.g., 2 hours to grind a turnout, and 4 hours to weld repair 1 switch point) and can greatly extend the life of the track components.

1.2 General Safety

Unless otherwise stated by the manufacturer, general recommended practices include,

a) Perform a job briefing as outlined in your Operating Manual.

b) All PPE must be in serviceable condition and worn correctly as per Corporate Policy. Always use safety glasses with side shields as a minimum, hearing protection, head protection and non-slip work gloves while operating an abrasive machine. Additionally, an apron, gaiters or boots in fireproof material, and a protective mask for avoiding any inhalation of grinding dust are also recommended.

c) Take care to ensure you have a firm, stable footing and use proper stance; all unstable working positions must be prohibited.

d) Every precaution should be taken to prevent fire caused by sparks from abrasive wheels and to check area thoroughly for any smoldering fire before leaving. When grinding, never stand in direct line with the sparks. If necessary, set up a screen for stopping sparks and prevent them from encountering any dangerous areas (e.g., dangers of brush fires in summer).

e) It is recommended that each wheel be speed tested when assembled onto the equipment at least the maximum test speed per manufacturer's guidelines.

   i. Never operate a wheel over its maximum operating speed. Excessive RPM could result in disintegration of the wheel. The maximum operating speed in RPM will be shown by the manufacturer on the label of each wheel.

f) When a new wheel is being started, allow it to operate at maximum operating speed for at least one minute before being applied to a working surface.

g) Do not let the grinding wheel hit anything when in operation as this may cause it to burst. Make sure that the grinding wheel is never in contact with a sleeper, ballast or any other foreign body.

h) Only the machine operator or helper should stand near an operating abrasive machine, and these people should avoid standing or walking in line with the abrasive wheel, except when necessary to perform their work.

i) Handle wheels carefully to prevent dropping or bumping. If an abrasive wheel is dropped or suspected of being damaged, it shall not be mounted.

j) An inspection should be made for damage to the guard, flanges, or nuts, and to ensure that the spindle has not been sprung out of balance or bent in the event of breakage of an abrasive wheel. Machines should be inspected each day by the operator to see that the arbors, adaptors or other parts are free from wear.

k) Shut down the grinding machine while moving it from one location to another. Avoid any possible damage to the abrasive wheel.

l) Frequent inspections should be made for defects in abrasive wheels in use and for irregularities in the grinding machine, such as unusual vibrations or shaking, worn shaft or any unusual increase in engine speed. Wheels showing any visible evidence of cracks or damage should be destroyed.

m) Any damaged or unsafe abrasive wheels must be destroyed to prevent accidental usage.

n) Wherever possible, reinforced wheels should be used.

o) Proper guards must be used to limit extent of damage and injury in the event of wheel failure.

1.3 Wheel Markings

a) Each abrasive wheel, unless excluded by ANSI B7.1, should be marked with the following minimum information:

   i. Maximum Operating Speed (rpm)

   ii. Manufacturer Identification

   iii. Manufacture Date

   iv. Manufacturer Product Designation

1.4 Storage

Unless otherwise stated by the manufacturer, general recommended practices include,.

a) Abrasive wheels must be handled and stored with care. Extreme temperatures will affect the structural integrity of the wheel. Extremes of humidity and moisture can disrupt the balance of a wheel, causing it to fly apart while in use.

b) Abrasive wheels are extremely fragile in some circumstances and need special treatment. Wheels should not be dropped or struck, and tools or other material must not be placed on top of abrasive wheels.

c) Abrasive wheels should be stored in their shipping boxes laying flat on a flat surface until used, or as indicated by the manufacturer, and must be stored in a dry place. Weight of shipping boxes and contents, when feasible, should be limited to approximately 50 pounds.

d) Abrasive wheels stored or being carried in trucks must not be exposed to water, solvents, oil, dampness or extreme temperatures. Suitable racks, bins or boxes should be provided to prevent damage.

e) It is recommended that all abrasive wheels should not be used after 2 years from manufacture date. Any recommended shelf life provided by an individual manufacturer will supersede this recommendation. Date, including month and year, of manufacture to be indicated on all wheels.

f) The opportunity for damaging a wheel in storage increases with time and it is therefore recommended that stock be rotated to use the oldest wheels first.

1.5 Abrasive Wheel Mounting

Unless otherwise stated by the manufacturer, general recommended practices include,

a) Abrasive wheels must fit freely on the spindles and should not be forced on, nor should they be loose.

b) A blotter (compressible washer) shall always be used between each flange and the abrasive wheel surface to ensure uniform distribution of flange pressure. Blotters shall cover the entire flange contact area. New blotters shall be used each time a wheel is mounted unless blotters are affixed to the wheel by the grinding wheel manufacturer. Loose blotters shall not be reused when mounting a new wheel or remounting a partly used wheel. Scuffed or damaged blotters shall not be used.

c) Spindle nuts should only be tightened enough to hold the abrasive wheel firmly to prevent slippage, otherwise the clamping pressure may damage the abrasive wheel. There must be no alterations to an abrasive wheel to force it to fit. Use the proper wheel only.

d) Bearing surfaces on mounting flanges and washers must be clean and flat. Both flanges, of any type, between which a wheel is mounted, shall be of the same diameter and have equal bearing surfaces.

e) The reducing bushings furnished with some abrasive wheels should not extend beyond the wheel sides.

f) Where wheels are mounted by means of a central spindle nut and flanges, the spindle should be of sufficient length and should be threaded to a sufficient length so that when the wheel and flanges are mounted there will be room for a full nut on the spindle. The threading should extend well inside the flange, or washers should be placed between the outer flange and the nut.

g) Threaded nuts, or the central spindle nut, must be threaded in a manner that will tighten the nut as the spindle or wheel rotates.

h) Closely inspect all abrasive wheels before mounting. If an abrasive wheel is suspect of damage, it shall not be used.

1.6 Operation

Always following manufacturer's instructions and training.

Some of the causes of wheel breakage, bursting during use on grinding machines are improper mounting of the wheel, worn or distorted flange plates, improper speeds, abusive operation, careless handling and oil or moisture-soaked wheels. These can all be mitigated against by proper inspection, handling and use.

Unless otherwise stated by the manufacturer, general recommended practices include,

f) Never touch the hot parts of the engine, and especially the exhaust pipe. If it is necessary to work on the engine, wait until it has cooled down.

g) If the machine does not operate correctly after the engine has been started, stop the engine and inform your supervisor or Work Equipment personnel and follow applicable 'lock-out / tag-out'.

h) Using trolleys (if applicable)

    i. A machine designed to work on a trolley must not be used without the trolley. The trolley is thus an integral part of the machine. The machine and the trolley must not be used separately.

    ii. Trolleys whose use is dedicated to a machine must never be used to transport equipment or personnel or attached to a vehicle.

    iii. Before fitting the machine on its trolley, it must be placed correctly on the track to ensure that it can run freely. If it is on a sloping section of track, make sure the trolley is kept immobile while the machine is being put on the track or taken off it.

    iv. Attention, the trolley takes up the full width of the track and can cause injuries to the legs if it hits someone.

Figure Appendix M – 2 – Allocation of Loads for Geismar Type MC.3 – 2-Person Positioning

i) Operation of grinding machines shall not be at a speed higher than that recommended by the wheel manufacturer. The wheel must have this stamped on the side and should not be used if this number is absent.

j) All abrasive wheels should be run at full operating speed for at least 1 minute before grinding. The first contact made with the wheel on the material to be ground should be light to allow the wheel to become heated to permit any defects in the wheel to indicate their presence. During this time the grinding machine operator must place themselves to one side, out of range of any possible danger if the wheel should break.

k) Use of excess pressure on the wheel can be detrimental to metal quality. If the grinding speed slows markedly or the work surface gets hot and discolored, pressure must be reduced.

l) Drive engines, electric motors, or control air supply must not be started or turned on while an abrasive wheel is in contact with any surface.

m) Never start or operate a grinding machine without the wheel hood or guard in place.

n) Grind only the material for which the machine and abrasive wheel are designed. Work should NEVER be jammed into the wheel.

o) Wheels out of balance through wear must be removed from the machine and discarded.

p) When grinding is completed, the operator must shut down the grinding machine before leaving the equipment. Abrasive wheels should be protected between grinding operations.

q) When an abrasive wheel breaks, an inspection must be made to assure that the guard and flanges have not been damaged. If there has been an injury, until a full investigation has been completed, the machine should be taken out of service until it has been determined to be in serviceable condition and safe for use.

r) Proper guards must be used to limit extent of damage and injury in the event of wheel failure.

s) If using a frog and switch grinder, due to the possibility of positioning the engine at an angle whilst working, the following rules MUST be systematically obeyed:

i. Always bring the grinding wheel back to vertical, stop all grinding operations and stop the engine before opening the fuel cap.

ii. Never fill the fuel tank over ¾ full (to avoid any seepage when the engine is working at an angle.)

iii. Never work on a fuel tank, or handle fuel for filling or for any other reason in any zone where the following may be present: An ignition source (for example: lit cigarettes, blowlamps, sparks, etc.) or materials that are incandescent or at high temperatures (for example: welding flash, various types of slag, etc.). Always carry out this type of operation in the open air in a well-ventilated area.

iv. Lock the fuel tank cap after use and check that no fuel can escape.

1.7 Grinding Practice

Unless otherwise stated by the manufacturer, general recommended practices include,

a) Prescribed types of grinding machines should be used for designated kinds of work. Machines must be sufficiently rigid and substantial to minimize vibration and its adverse effect on the abrasive wheel.

b) Only persons who have been properly qualified should perform grinding work.

c) Side grinding should only be performed with abrasive wheels designed for this purpose.

d) All grinding heads must be equipped with a protection hood or wheel guard.

e) The removable outside portion of guard for the straight hand pieces used with all flexible shaft grinders must be in place when the hand piece is in use.

f) The band-type guard used with cup-type abrasive wheels must be positioned so that at no time will the wheel protrude beyond the edge of the guard a greater distance than indicated depending on the overall thickness of abrasive wheel in inches.

Overall Thickness of Abrasive Wheel	Maximum Exposure of Wheel Beyond Edge of Guard
1” *(25 mm)*	1/2" *(13 mm)*
2” *(50 mm)*	3/4" *(19 mm)*
3” *(75 mm)*	1” *(25 mm)*
4” *(100 mm)*	1-1/2” *(38 mm)*

Figure Appendix M – 3 – Band Type Guard Positioning

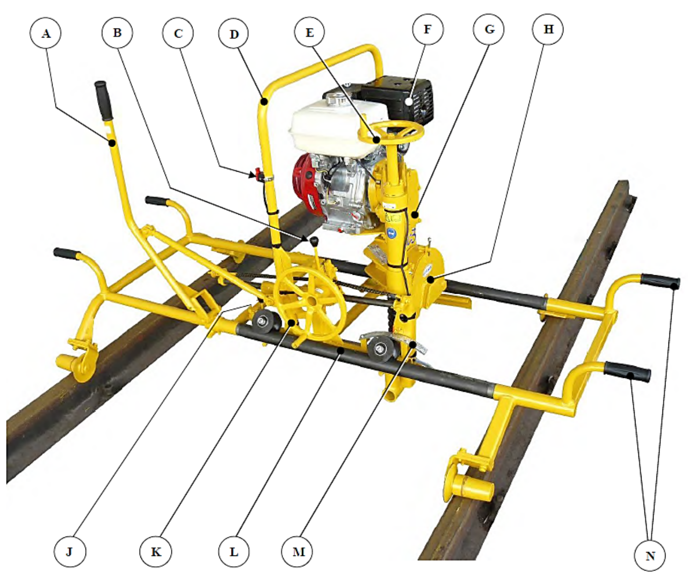
1.8 Grinding Equipment

Figure Appendix M – 4 – Example of a Profile Grinder – Geismar Type MP.12

a) For surfacing grinding on rail ends, engine burns and thermite welds, grinders equipped with mechanical vertical feed control are recommended.

b) For cross grinding to remove overflow from rail ends or providing clearance between rail ends to avoid chipping, a cross-cut grinder with a 1/8" *(3mm)* reinforced wheel or flexible shaft grinder with a cross-cutting attachment and 1/8" *(3mm)* wheel are recommended.

c) For grinding frogs, railroad crossings, switch points, and stock rails, hand-held grinders or flexible shaft attachments may be used, however <u>grinding machines are strongly recommended</u>. Reinforced wheels should be used wherever possible.



Ref.	Description
A	Operating lever
B	Wheel tilt locking catch
C	Remote motor stop button
D	Work bar
E	Wheel raising & lowering hand-wheel
F	Engine
G	Grinding head
H	Grinding wheel protective housing
J	Cross-traverse locking catch
K	Wheel tilt hand-wheel
L	Guiding column
M	Graduated scale
N	Lifting handles (x4)

Figure Appendix M – 5 – Example of a Frog and Switch Grinder – Geismar Type MC.3

d) General storage instructions include storage premises for equipment must offer the best possible protection against:

   i. Dust, exhaust gasses, dampness
   ii. Direct sunlight
   iii. Rapid changes in temperature

e) For prolonged machine storage like a frog and switch grinder, empty the fuel tank, remove grinding wheel(s) fitted, and store grinding wheels in a dry place, protected from frost, sunshine and heat. Position them so that they do not undergo any external pressure liable to warp them. Equipment should not be stored away for more than 2 years.

f) Make sure that the equipment is kept in as clean a condition as possible. The machine's service life and its satisfactory operation depend on the care given in cleaning the equipment. Clean the machine carefully with a clean rag or an air gun taking care to remove any dirt that may have been deposited on it, especially close to moving parts. As a precaution, wear gloves systematically to avoid injuring or burning hands. If equipment like a frog and switch grinder, regularly clean the chain on the tilting system.

1.9 Grinding Rail End Surface Welds

a) The higher rail end should be ground to a straight surface as determined by holding an 18" straight edge even with the end of the rail.

b) Grinding should not extend beyond the limits of the weld except to make a smooth transition between welded and adjacent rail surfaces.

c) The undamaged adjacent surface of the rail should not be lowered.

1.10 Grinding Welded Engine Burns and Thermite Welds

a) The welded engine burns and thermite welds must be ground to conform to the contour of the existing rail head.

b) Grinding should not extend beyond the limits of the weld except to make a smooth transition between welded and adjacent rail surfaces.

1.11 Cross Grinding Rail Ends

a) On joints where the expansion is 1/16" *(2 mm)* or greater, the 1/8" *(3 mm)* reinforced wheel must be used to grind out all excess or flowed metal in the expansion area.

b) On joints where the expansion is 1/16" *(2 mm)* or less, referred to as tight joints, the 1/8" *(3 mm)* reinforced wheel must be used and the grinding made to a depth of 3/16" *(5 mm)*.

c) The abrasive wheel must not contact the joint bars or bond wire (if applicable).

1.12 Grinding Frogs, Railroad Crossings (Diamonds) and Switch Points

Grinding should be used for the following purposes using the proper equipment (e.g., frog and switch point grinder):

Preventative grinding: The removal of overflowed metal from flangeways on new track material to extend the service life. The grinding may be done several times until work hardening has occurred.

Preparation grinding: The removal of spalled, cracked, flowed, and work hardened metal prior to welding (cutting torch shall not be used for this purpose).

Finish grinding: The finish ground frog, railway crossing (diamond), and switch point should closely conform to the original specifications to produce a smooth surface, proper flangeway, and radius. Use gauge to check flangeway clearance and radius.

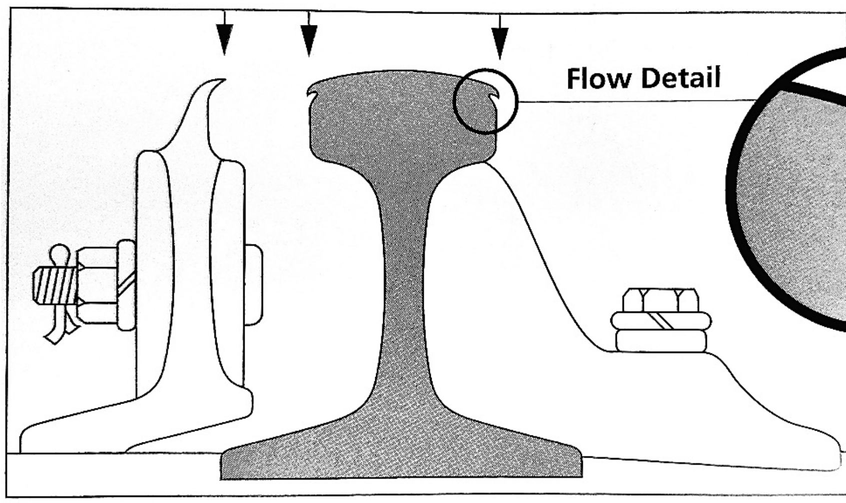


Figure Appendix M – 6 – Flow Evident on Stock Rail and Switch Point

Switch Points and Stock Rails:

a) Equipment that allows the grinding wheel to pivot at various angles should only be used to grind frogs and switch points. It is not advisable to use a hand-held grinder, and it should be avoided as it will not grind uniformly.

b) Set the grinder in place using proper lifting techniques and handles per the manufacturer's instructions.

c) It is important to grind and slot the entire area you've marked from the weld or joint ahead of the points to the weld or joint behind the heel block.

d) Mark the area to the ground, starting with the line 3" *(76 mm)* ahead of the switch point or ahead of the joint bar in front of the switch point.

e) Inspect the switch point area, starting ahead of the switch point and working back towards the heel of the switch. Note areas of accumulated flow along both stock rails and switch points.

f) Draw a line where the stock rails and switch points no longer mate and draw a line on the stock rail to mark the end of the undercut (e.g., Samson is an undercut rail that has a 30° angle).

Figure Appendix M – 7 – Line Marking End of Undercut

g) To avoid over-grinding, always use a steady back and forth motion to remove flow. Keep checking the rail visually to ensure you have not over-grinded the area and to ensure all flow has been removed.

h) Grind only the flow and avoid contact with the rail or other components.

i) Grind the standard stock rail perpendicularly and the undercut stock rail at a 30° angle to maintain proper closure of the switch points and avoid a possible derailment.

Figure Appendix M – 8 – Grinding of Standard Stock Rail

Figure Appendix M – 9 – Grinding of Undercut Stock Rail

j) Grind the full length of the points in order to remove flow, tapering out a little beyond the heel block.
k) Smooth off the sharp edge on both the stock rails and switch points to mitigate against further flow.
l) Check the fit of the mating surfaces upon completion.
m) Remove flow from the gauge side of the switch point if the mating surfaces fit.
n) Reverse the grinder and do the same with the other stock rail and switch point.

<u>Slotting</u>

a) Using a handheld grinder with appropriate slotting wheel, start at the rail joints ahead of the switch points, checking for flow and slot using a straight up and down motion.

Figure Appendix M – 10 – Straight Slot

b) Once slotted, put a 1/8" *(3 mm)* bevel at the top of the rail end to mitigate against further flow.

Figure Appendix M – 11 – Slotted Joint with 1/8" (3 mm) Bevel

c) Go back to the heel block and slot all joints moving towards the frog as required.

Figure Appendix M – 12 – Straight Slot at Heel Block

Frogs

Rail Bound Manganese Frogs have left and right manganese wing rails and frog point within the rails. This steel gets harder as it is impacted, however the running surfaces tend to flow.

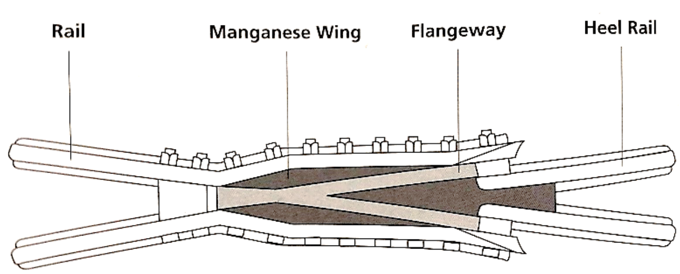


Figure Appendix M – 13 – Rail Bound Manganese (RBM) Frog

***Figure Appendix M – 14 – RBM Frog – Wing Rails** (left)**, Frog Point** (centre) **and Rails** (right)*

The same procedures for grinding and slotting these frogs may be applied for Bolted Rigid Frogs, Spring Frogs, Self-Guarded Frogs (mating surfaces at the toe and heel).

All flow should be removed from the components through grinding and slotting. Taking a little off at a time to avoid over-grinding.

a) Using a straight hand-held grinder with proper grinding wheel remove flow from the sidewalls by grinding both sides of the frog point and the gauge side of the manganese wings.

Figure Appendix M – 15 – RBM Frog – Grinding Frog Point and Wing Rails

b) Verify flangeway clearance is maintained (1-7/8” or 44 mm) with the appropriate check gauge.

Figure Appendix M – 16 – RBM Frog – Flangeway Clearance Verification with Check Gauge

c) Check the heel of the frog for flow.

d) Remove flow from the field side of the wing rails around the frog throat.

Figure Appendix M – 17 – RBM Frog – Flow Removed from Field Side at Frog Throat

e) At the guardrails, flow must be removed from the gauge side of the guard rail running rail to ensure the gap is 1-7/8" *(48 mm)*, maintaining guard check gauge and guard face gauge specifications.

f) Grind the entire length of the guardrail running rail and taper a little past the ends using a frog and switch point grinder.

Figure Appendix M – 18 – RBM Frog – Flow Removed from Guard Rail Running Rail

g) Verify the 1-7/8” *(48 mm)* flangeway clearance between the guardrail and guardrail running rail at few locations to ensure this.

Figure Appendix M – 19 – RBM Frog – Flangeway Clearance - Guardrail

h) Upon completion, using an angle head grinder with the appropriate wheel, restore 9/16” *(14 mm)* radius along the running surfaces to mitigate against flow.

Figure Appendix M – 20 – RBM Frog – 9/16” (14 mm) Radius Restoration of Running Surfaces

i) Verify the 9/16” *(14 mm)* flangeway clearance with the appropriate gauge.

j) All mating surfaces and rail ends have to be slotted using a 1/8” *(3 mm)* slotting wheel, such as between the wing rails.

Figure Appendix M – 21 – RBM Frog – Slotting Mating Surfaces

k) The 1/8” *(3 mm)* bevel should be done to the rail ends after the straight slot.

Self-Guarded Manganese Frogs require the same grinding and slotting maintenance.

l) Grind the mating surfaces at the toe and the heel.

Figure Appendix M – 22 – SGM Frog – Slotting Mating Surfaces

m) Check and measure the guard to determine if maintenance is required.

n) Measurements of the SGM guardrail to determine wear is taken by measuring at the toe and heel of guard where there is no wear to determine its original width, then measuring the guard where there is wear (usually at the frog point) to determine the difference between. If the guard is worn more than 3/8” *(10 mm)*, it must be repaired immediately.

Figure Appendix M – 23 – SGM Frog – Guardrail Measurements

Railway Crossings (diamonds), require the same grinding and slotting maintenance.

o) Radius should be restored to 3/8” *(10 mm)*.

Figure Appendix M – 24 – Railway Crossing (Diamond) Grinding Radius

1.13 Grinding Stock Rails

Grind all overflow off the gauge side of the stock rail opposite the switch point contact area.

The ground area must extend 4" beyond each end of contact area.

1.14 Rail Cutting

a) Abrasive wheels should be stored under cover, not in the same car or storage area where oil is stored, and should not be used when wet, fouled with foreign particles, overheated or glazed. They should be stored in a flat position when carried in trucks.

b) Injuries are likely to occur if the saw work head is not oscillated and the abrasive blade gets overheated or warps while sawing a rail.

c) Any tie plate or rail anchor falling directly under the location of the cut should be removed. There should be sufficient clearance below the location of the cut to prevent abrasive wheel contact with ballast, ground or concrete.

d) Operators should ease the abrasive wheel on the rail head and then maintain a constant pressure throughout the entire cut.

e) Saws shall be firmly attached to the rail to provide safe control and proper alignment while cutting rail. The equipment shall not be used for any other purpose than cutting rail.

f) To avoid overspeed, sufficient fuel must in machine to prevent interruption of cutting.

Appendix N. Wayside Inspection Systems

The following outlines the recommended track requirements to minimize false stops, ensure intended functionality, increase equipment life, and reduce trouble calls related to poor track conditions.

Ensure track conditions meet or exceed the requirements as outlined throughout the Manual of Track Requirements and *Transport Canada's* current *Rules Respecting Track Safety*. Site plans should always be referred to.

ALWAYS coordinate with Signals and Communications personnel in advance when conducting maintenance or repairs where track conditions do not meet the requirements or recommendations.

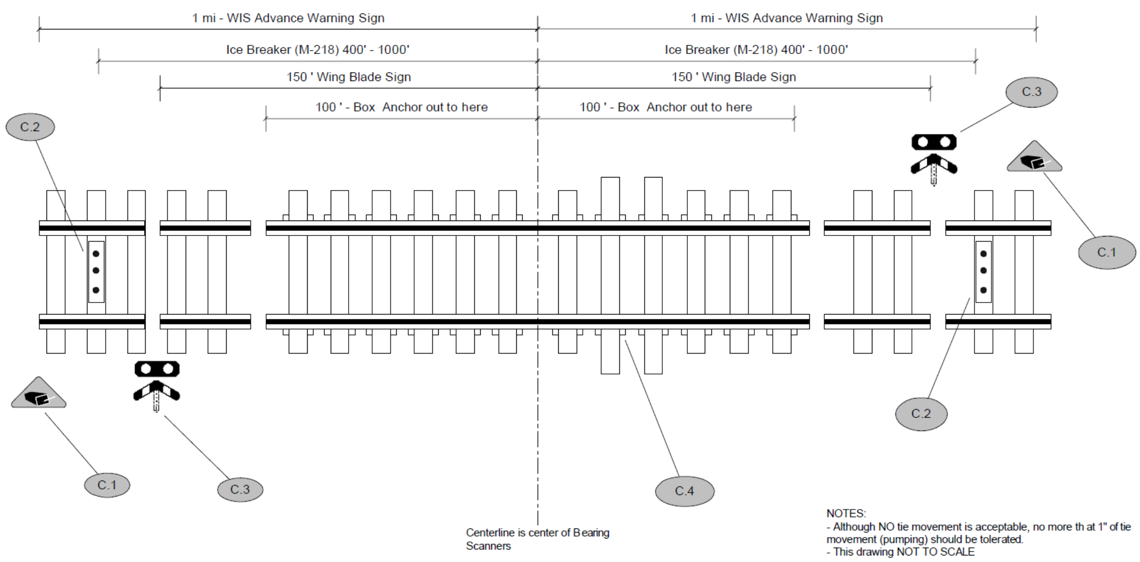


Figure Appendix N – 1 – Example of Possible Track Features for Wayside Inspection System

1.1 Wayside Inspection Systems – Track Condition Recommendations

Site plans may reference other requirements. Always defer to Signals and Communications personnel.

a) Rail

i. 115 lbs rail weight or greater should be used throughout the inspection site.

ii. For Wheel Impact Load Detector (WILD) sites, unless otherwise specified, the rails within the total zone shall not contain any welds (including factory welds), joints, drill holes or electrical installation prior to the salient system installation. Nor shall the rail contain any field welds within 50' of the beginning or end of the instrumented zone boundaries.

b) Gauge

i. Gauge should be as tight as allowable conforming to track standards.

ii. Maximum dynamic gauge (under load) should be no more than 56-3/4".

iii. Maximum static gauge (not under load) should be no more than 56-5/8".

- Reduce this if there are signs of rail movement (e.g., plate cutting).

iv. Correction of gauge requires a transition of 100’ of rail for each 1/4" to limit variation in gauge conditions.

c) Ties

i. Tie cribs should be wide enough (e.g., 19-1/2”) to accommodate scanners and tie bracket / ballast blocker.

Ref. correction: Should be N - 2 not O - 2

ii. Tie cribs within Wheel Impact Load Detector sites should be as per design (e.g., see Figure Appendix O – 2 – below showing 9 cribs with no more than 24-1/8” spacing ahead of detector transitioning to 15 cribs with no more than 26-1/8” spacing).

iii. Ties are properly aligned and centered (no more than 1/2" off-centre).

iv. For Wheel Impact Load Detector (WILD) sites, unless otherwise specific, at least 150 concrete ties are to be used located symmetrically within and around the instrumented zone, providing 100’ of stabilized structure on either side. Tie spacing would be determined per Site Plan.

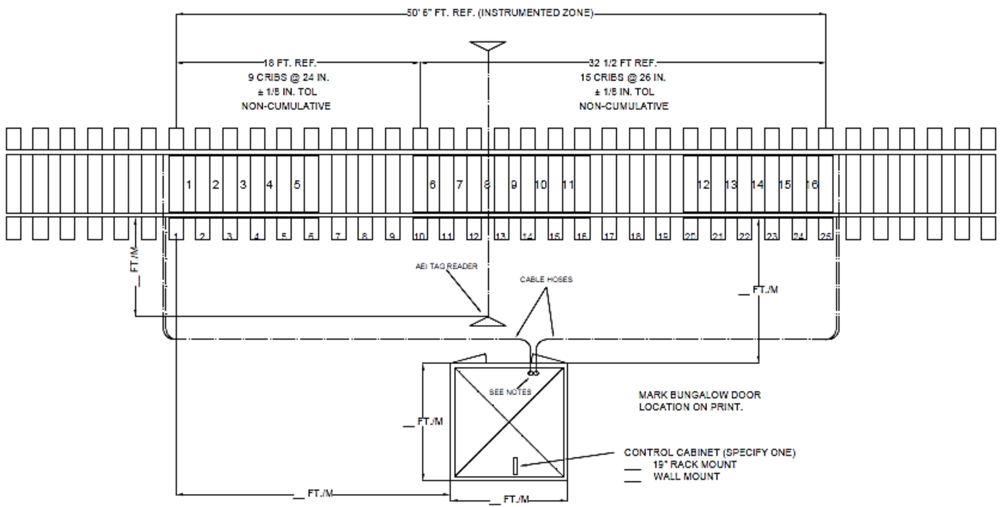


Figure Appendix N – 2 – Wheel Impact Load Detector Inspection System Example

d) Track Pumping

i. Limit to no more than 1” for 100’ either side and throughout the wayside inspection site.

ii. Ensure adequate rail, tie, plate, surface and rail condition.

e) Roadbed

i. Maintained to ensure sufficient drainage, and water flows away from equipment and track.

ii. Standing water is not acceptable and improvements should be arranged to the site.

f) Anchors

i. Box anchor every tie, where possible, for 100’ on both sides of the site to ensure rail has sufficient restraint to resist longitudinal movement due to thermal or dynamic forces.

ii. For Wheel Impact Load Detector (WILD) sites, no rail anchors should be applied within the weigh section.

g) Signage

i. Signs and posts should be replaced / maintained if damaged, bent, missing and otherwise maintained so they effectively notify maintenance operations.

ii. Refer to Appendix H – Standard Signs for installation standards of wayside inspection system, flanger, and wing blade signs and posts.

1.2 Wayside Inspection Systems – Snow Clearing Operations

a) Per Sub-Part E, Section 2.3, there are many 'at risk' components such as transducers, cables and scanners around wayside inspection systems,

b) Markers are being installed (4 per site) to indicate the location of transducers as well as the "dead zone" where wing, plow, and broom operation is prohibited.

c) Most signal installations have markers installed to warn of equipment that can be damaged by wings,

d) These markers are located directly in front of, or beside, the item that is at risk of being struck,

e) The marker is not to be struck or plowed over by the wing of snow clearing equipment,

Figure Appendix N – 3 – Utility Marker

f) Plow must be lifted at outer markers to clear the transducers. Broom can be used, but not lower than head of rail.

g) Between the centre markers or "dead zone", snow must be cleared by hand.

h) Signal Maintainers will clear snow from around the scanners and dragging equipment detector.

i) Any Infrastructure employee can shovel snow within the dead zone if it is required to allow passage (e.g., track units).

j) In cases where snow buildup has occurred and a machine is required for removal, a Signal Maintainer must be present to locate and protect the equipment at risk.

k) Wings must be raised and / or pulled in to clear the marker and the equipment it is protecting,

l) Utility markers that are struck will eventually break off at the base, placing this equipment at significant risk of damage,

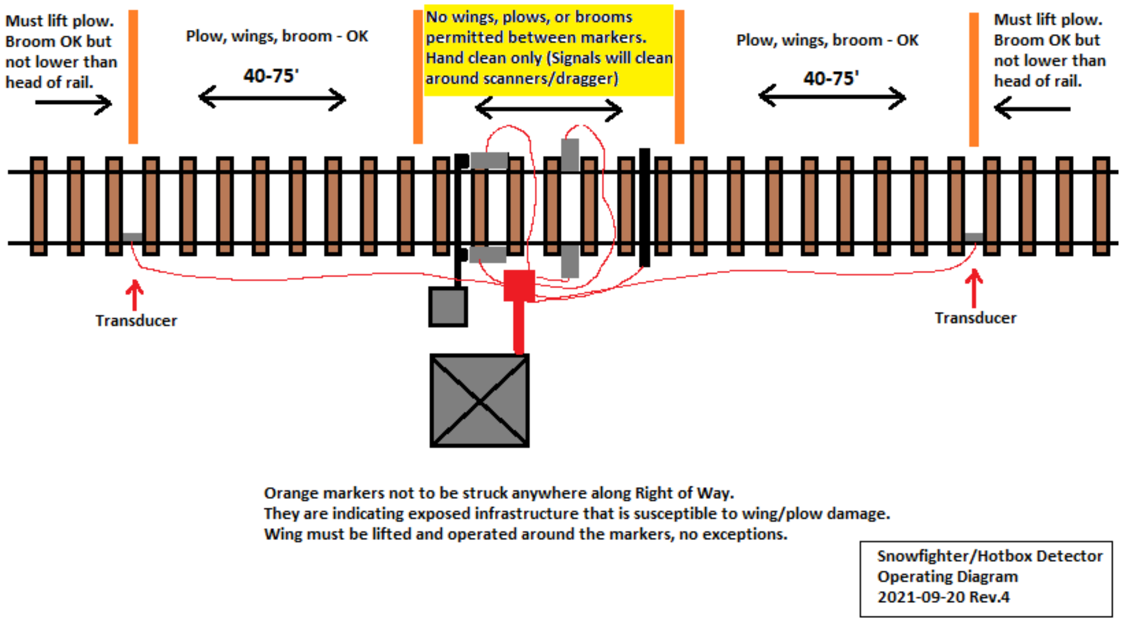


Figure Appendix N – 4 – Snow Clearing Operations / Hot Box Detector Diagram

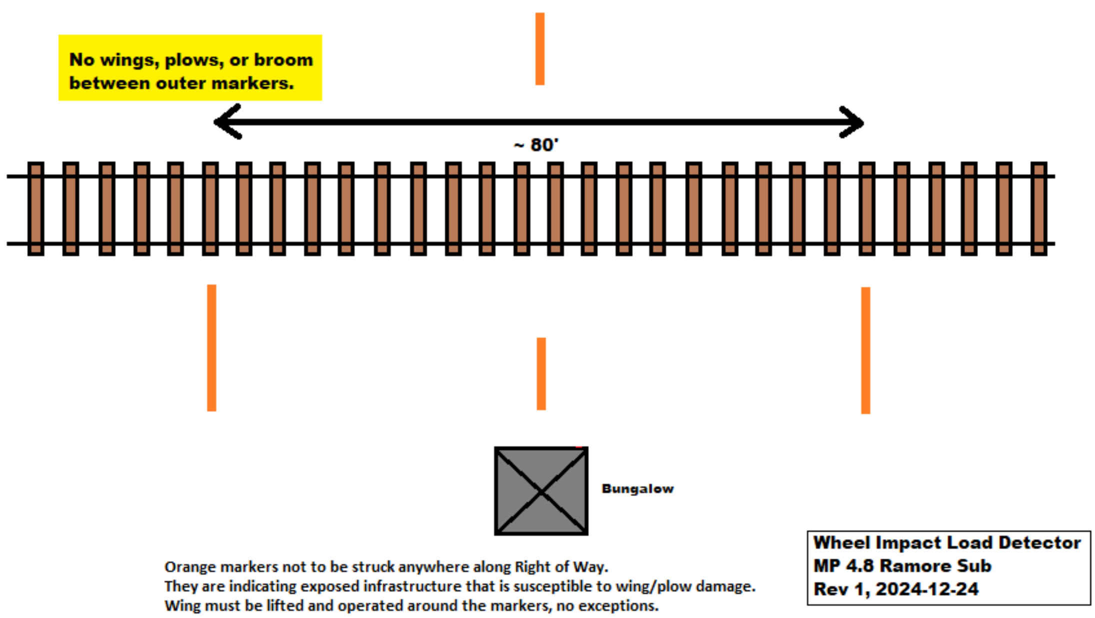


Figure Appendix N – 5 – Snow Clearing Operations / Wheel Impact Load Detector (WILD) Diagram

m) Brooms must not be operated over top of the dragging equipment detector, as it will be forced out of position and stuck in the tripped position.

n) Radio controlled switches have marked ‘protection zones’ (P ZONE) where only the plow and wings (set no lower than the head of the rail) are to be used between up to the switch air blower nozzles.

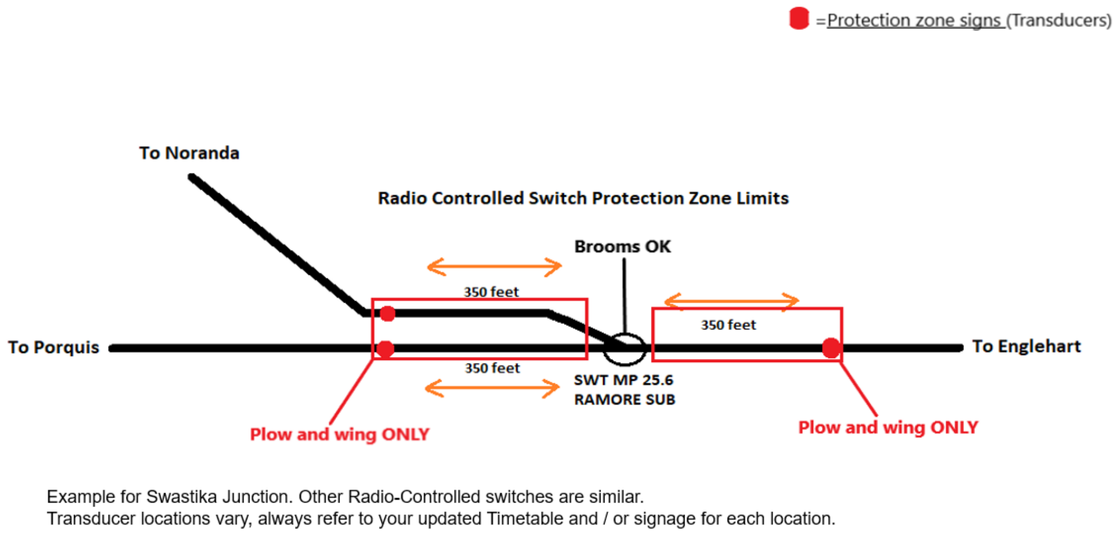


Figure Appendix N – 6 – Snow Clearing Operations / Radio Controlled Switches

o) Transducers are marked with ‘P ZONE’ signage in the field and are approximately the same height as a joint bar.

Figure Appendix N – 7 – Snow Clearing Operations / Transducer and ‘P ZONE’ Signage

p) Brooms can be used from the air blower nozzles up to and including the frog; using the plow and brooms as normal when outside of the zone.

Figure Appendix N – 8 – Snow Clearing Operations / Cold Air Blower Nozzles

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Appendix O. Track Inspection Quick Reference Guide

Inspection Description	Required	Frequency / Trigger	Type	Reference(s)
Ballasting and Undercutting (CWR) **- Rail Temp. of 70°F or lower - Skeletonized** **- Inward Movement**	As Required	1 Week After Curve is Surfaced	Visual	Sub-Part D, Section 7.7.2. Ballasting and Undercutting in CWR Territory
Beaver Dams	As Required	As Required	Visual	Sub-Part F, Section 8 Beaver Dams
Broken Spikes **- Curves**	As Required	When broken spikes are found in curves	Walking	Sub-Part D, Section 4.3 Spikes - Considerations in Jointed Track Sub-Part D, Section 7.7.5. Spikes for Maintenance or Upgrading of CWR
Defective Tie Inspection (1/5 of the track)	No	Annually	Walking	Sub-Part D, Section 2.0 Ties
Derails **- Detailed**	Yes	Annually - Detailed	Walking	Sub-Part E, Section 1.3 Derails - Maintenance
Grade Crossing Warning Systems	Yes	Weekly	Walking	Sub-Part F, Section 13 Inspection and Testing of RCWS
Grade Crossings - Private or Public **- Detailed**	Yes	Annually	Walking	Sub-Part E, Section 5.2 e) Road Crossings - Regulatory Requirements Sub-Part F, Section 3 d) Methods of Inspection
Heavy Geometry Inspection Vehicle **- Various Classes, Categories and Tonnage**	Yes	Various	HGIV	Sub-Part F, Section 12.3 Yard Track Inspections - Electronic Geometry Sub-Part F, Section 14 Track Evaluation Car
Rail **- Broken in Mainline or Siding - 300' Each Direction of Break**	As Required	When broken rail found in mainline or siding	Walking	Sub-Part D, Section 6.8 - Rail Inspection of Broken Rail
Rail **- CWR Installed < PRLT and Not Restressed**	As Required	Prior to Temp. Increase / Heat of the Day	Visual	Sub-Part D, Section 7.4.1. Rail Temperature When Laying CWR
Rail **- Defective, Replacement**	As Required	Various	Visual	Sub-Part D, Section 6 Rail
Rail **- Joints - Main Track**	Yes	Annually (NO electronic inspection)	Walking	Sub-Part F, Section 10 Scheduled Rail Joint Inspection
Rail **- Joints - Main Track Curves 4° or >**	Yes	Annually (if electronic inspection conducted)	Walking	Sub-Part F, Section 10 Scheduled Rail Joint Inspection
Rail **- Surface Defects** *(e.g., Class 3 Rail Batter 1/8" or >)*	Yes	Monthly, Until Repaired / Replaced	Walking	Sub-Part D, Section 6.9 Rail Surface Management Plan
Rail **- Untested In-Track** *(NO UTT Date)*	As Required	Weekly Until Repaired / Replaced with UTT Rail	Walking	Sub-Part D, Section 6.13 c) Rail - Classification
Rail Anchors **- CWR Installed >40°F Below PRLT and Not Adjusted**	As Required	Prior to Temp. Increase / Heat of the Day	Visual	Sub-Part D, Section 7.4.3. Anchoring When Laying CWR
Rail Flaw Detection **- Various Classes, Categories, and Tonnage**	Yes	Frequency Def. Differ	Rail Flaw	Sub-Part F, Section 12.4 Yard Track Inspections - Rail Flaw Sub-Part F, Section 15 Rail Flaw Detection
Surfacing and Lining (CWR) **- Rail Temp. More Than 15°F Above the PRLT**	As Required	Behind Surfacing Work	Visual	Sub-Part D, Section 7.7.1. Surfacing and Lining in CWR
Surfacing and Lining by Tamping Machine (CWR) **- Rail Temp. of 50°F or lower - Inward Movement**	As Required	1 Week After Curve is Surfaced	Visual	Sub-Part D, Section 7.7.1. Surfacing and Lining in CWR
Temporary Gauge Rods **- Mainline**	Yes	Monthly if in Mainline	Walking	Sub-Part B, Section 7 Gauge Rods
Temporary Speed Restrictions for Various Track Work for Various Temperatures	As Required	Various	Visual	Sub-Part D, Section 7.9.4. Temp. Speed Restrictions Account Track Work Appendix E Temporary Speed Restrictions Account Track Work
Track Buckle **- Imminent**	As Required	Daily / Heat of the Day	Visual	Sub-Part D, Section 7.8.3. Protection of a Track Buckle or Imminent
Track Buckle **- Permanent Repairs**	As Required	Prior to Return to Track Speed / Heat of the Day	Visual	Sub-Part D, Section 7.8.5. Permanent Repair of a Track Buckle
Tracks **- Class 1 through 5 (excluding Yard and Inactive), With and Without Passengers**	Yes	Based on Class, Use, MGT	Visual	Sub-Part F, Section 2 b) Frequency of Track Inspections

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Figure Appendix O – 1 – Track Inspection Quick Reference Guide

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Inspection Description	Required	Frequency / Trigger	Type	Reference(s)
Tracks - Mainline - Via Train	Yes	Quarterly	Train	Sub-Part F, Section 3 b) Methods of Inspection
Tracks - Yard - Various Categories	Yes	Various	Visual	Sub-Part F, Section 12.1 Yard Track Inspections - Track
Tracks - Yard - Unclassified	Yes	Monthly	Visual	Sub-Part F, Section 12.1 Yard Track Inspections - Track
Tracks and Track Structure - Additional Inspections	As Required	As Required	As Directed	Sub-Part F, Section 1 Inspection Scope
Tracks and Track Structure - Hot Weather - CWR and Applicable Jointed Track	As Required	Daily / Heat of the Day	Visual	Sub-Part F, Section 6.2 Hot Weather - Inspections
Tracks and Track Structure - Fire, Flood, Severe Storm or Any Other Occurrence	As Required	Prior to Use	Visual	Sub-Part F, Section 1 Inspection Scope
Tracks and Track Structure - First Cold Snap	As Required	As Required	Visual	Sub-Part F, Section 7.2 Cold Weather - Inspections
Tracks and Track Structure - Inactive	As Required	Prior to Use	Visual	Sub-Part F, Section 1 Inspection Scope
Tracks and Track Structure - Priority Locations	As Required	As Outlined	Walking	Sub-Part F, Section 3 c) Methods of Inspection
Tracks and Track Structure - Water Related Conditions, Bridges (alignment / level), Inlets	As Required	As Required / Spring Run-Off / High Water	Visual	Sub-Part F, Section 9 High Water and Spring Run-Off Inspection
Tracks and Track Structure - When -25°C Ambient or Colder Ambient Air Temp. - Applicable Tracks	As Required	Daily	Visual	Sub-Part F, Section 7.2 Cold Weather - Inspections
Tracks and Track Structure - When -25°C Ambient or Colder Ambient Air Temp. Within 24 Hours - All Main Tracks	As Required	Daily	Visual	Sub-Part F, Section 7.2 Cold Weather - Inspections
Tracks and Track Structure - When -35°C Ambient or Colder Ambient Air Temp. - All Main Tracks	As Required	Daily	Visual	Sub-Part F, Section 7.2 Cold Weather - Inspections
Turnouts - Yard - Various Categories	Yes	Various	Walking	Sub-Part F, Section 12.2 Yard Track Inspections - Turnouts
Turnouts - Yard - Category 1 - Detailed	Yes	Annually if applicable	Walking	Sub-Part F, Section 12.2 Yard Track Inspections - Turnouts
Turnouts, Track Crossings, Special Track Work - Mainline - Routine	Yes	As Used	Visual	Sub-Part F, Section 11.2 Turnout and Track Crossing Inspections - Types
Turnouts, Track Crossings, Special Track Work - Mainline, Signaled Sidings, Signaled Tracks - Monthly	Yes	Monthly	Walking	Sub-Part F, Section 11.2 Turnout and Track Crossing Inspections - Types
Turnouts, Track Crossings, Special Track Work - Mainline, Signaled Sidings, Signaled Tracks - Detailed	Yes	Annually and Upon New / Upgraded	Walking	Sub-Part F, Section 11.2 Turnout and Track Crossing Inspections - Types

Figure Appendix O – 1 – Track Inspection Quick Reference Guide

*Always refer to the contents within Manual to ensure compliance with inspections.

The above is only a guide and may not be an exhaustive list of all inspections required to be completed.

'As Required' indicates that inspections must be completed when the condition(s) exist and continued as required.

Appendix P. In Development

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